The Effects of False Feedback, Sex, and Personality on Learning, Retention, and the Zeigarnik Effect in Programmed Instruction

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The Effects of False Feedback, Sex, and Personality on Learning, Retention, and the Zeigarnik Effect in Programmed Instruction

by
Edward J. Carels

A Dissertation Submitted to the Faculty of the Graduate School of Loyola University of Chicago in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

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Further, the experimental materials are adapted from earlier programs developed by O'Day and Kulhavy for use in their prior research studies and those of other collaborators. These studies are reported in Programmed Instruction: Techniques and Trends, New York: Appleton-Century-Crofts, 1970. I am grateful to the publisher for releasing this copyrighted material.

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LIFE

The author, Edward J. Carels, is the son of Edward V. Carels and Catherine (Conway) Carels. He was born July 10, 1943, in Camden, New Jersey.

His elementary education was obtained at St. Aloysius School in Oaklyn, New Jersey, and secondary education at Camden Catholic High School, Camden, New Jersey, where he was graduated in 1961.

In September 1961, he entered Rutgers University and in June 1965, received the degree of Bachelor of Arts with a major in psychology. While attending Rutgers University, he was a member of the Psychology club, JV basketball team, and Lambda Sigma Chi Fraternity.

In September 1965, he entered Villanova University and in August 1968, received a Master of Science degree in psychology.
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INTRODUCTION

The purpose of the present investigation was to determine whether presenting true or false feedback to the learner has a differential effect upon learning and retention of programmed text material. Data were collected on program completion time (latency), learning errors, recall accuracy, retention errors, and personality needs. Previous researchers showed that feedback had differential effects on program completion time, retention, and recall. A number of studies have also suggested that both the personality and sex of the learners can differentially affect various types of learning and retention performance. The effects of both these factors were herein investigated. The present study also tested whether feedback following errors was as effective or more effective than providing feedback following correct responses.

Previous research (Geis, Jacobs, Spenser, and Nielson, 1970) had also revealed that learners exposed to various programmed textbooks do not always look at the feedback provided. The present design, therefore, made use of special answer sheets which required each subject to respond to a question and then provided immediate feedback automatically. Researchers have studied the effects of feedback on verbal learning, programmed instruction, perceptual tasks, behavior modification, standardized test scores, psychomotor tasks, and self-concept. From a theoretical framework, some researchers have focused upon the reinforcement versus information interpretation of feedback
effects while others have measured the role of errors, temporal spacing of feedback, and type of feedback (i.e. partial, false, active, affective, etc.).

The study also investigated the presence or absence of the Zeigarnik effect and what, if any, personality variables correlate with it. Zeigarnik effect researchers have focused upon the interruption of tasks, degree of subject ego involvement in the task, structure of and time spent on the task, achievement motivation, and the association between failed test items and the Zeigarnik effect. One premise of the study was that if feedback effects can be attributed to informational effects rather than reinforcement or incentive effects, then distorting the feedback should reduce learning acquisition and retention. It was further assumed that a failed learning test item could be interpreted as an incompletely task. In this regard, an assumption was made that if information is the key to feedback effects, then subjects who fail learning test items should remember a higher percentage of incorrectly answered rather than correctly answered items. Such an eventuality would then constitute a demonstration of the Zeigarnik effect.

Interest on the part of educational psychologists in the Zeigarnik phenomenon was kindled by the research of Atkinson (1953) who showed that learners with high achievement needs showed greater evidence of the Zeigarnik effect than those low in achievement need. It must be noted, however, that the Zeigarnik effect which originally measured interrupted tasks was a short term phenomenon (less than 24 hours). As a consequence, the present paradigm used an immediate
free choice recall test.

The association of memory of failed test items with high achievement needs was enough to interest any educator. The present research, therefore, sought to evaluate the efficacy of treating failed test items as the equivalent of incompleted tasks as well as the relationship of achievement need to the Zeigarnik effect. In addition, the paradigm sought to determine whether the Zeigarnik effect was a learning or retention phenomenon.

Lastly, the study sought to determine the correlation between personality characteristics and age, education, program latency, learning errors, retention errors, and the Zeigarnik effect. The purpose of this phase of the study was to isolate those personality factors and differences between the sexes which most affected the above variables. Researchers have evaluated the personality and gender correlates on attitudes toward programmed instruction, cultural role expectations, level of anxiety, need structure, and achievement motivation.

Several educational implications are raised by the study. Assuming many teachers still use programmed text materials, feedback's role in enhancing programmed instruction must be better understood. The educator must be cognizant of the appropriate ways and times to use feedback to maximize learning and retention. The use of false feedback has implications for the theoretical basis of feedback effects. It will permit a test of the information versus reinforcement interpretations. It will also permit an experimental manipulation of the number of incorrect responses made on frames which will, in
turn, affect the Zeigarnik effect.

The study will compare males and females on the number of errors they make on the programmed text and the amount of time taken to complete the programmed text. The paradigm will also permit an evaluation of what personality characteristics in males and females most affect their performance on the programmed text and contribute to the Zeigarnik effect. One obvious educational implication is that if males and females differ in their learning and retention of the text, despite having identical presentations, teachers must evaluate performance with these differences in mind. If there are systematic differences between male and female learners on various types of instruction, new norms will have to be developed for accurate and unbiased measurements of individual differences. The existing techniques of grading and grouping students may be altered slightly to counterbalance any bias in the evaluation methods currently in use.

Research on the Zeigarnik effect provides insight into the phenomenon of short term memory. In recent years, researchers have substituted questions which were answered incorrectly for incompleted tasks to demonstrate the Zeigarnik effect. Zeigarnik's original work was done strictly with incompleted tasks. The implication for education is that some students may remember those items which they failed better than those which they passed. Such a phenomenon, if better understood, would permit educators to concentrate on errors in learning and possibly institute remedial instruction. There seems to be no empirical justification, however, for substituting incorrect responses for incompleted tasks. Perhaps additional light must be shed
on this substitution before erroneous inferences find their way into the classroom.

Lastly, it is still not clear what role personality plays in learning and retention. It may be that high achievement need facilitates academic performance whereas a high autonomy need has a deleterious effect. If specific personality correlates of academic performance could be isolated, the teacher could use this knowledge to maximize learning in the classroom. On the other hand, it could be used in identifying potential problem areas for classroom learning and permit the teacher to implement remedial action.

The following research hypotheses were investigated:

HR1 -- Learners given feedback will take longer to complete the programmed text material than those not receiving feedback.

HR2 -- Learners given no informational feedback will learn and retain less than those given either true or false feedback.

HR3 -- Learners given false feedback will learn and retain less than those given true feedback.

HR4 -- Learners given false feedback will be more likely to exhibit the Zeigarnik effect than those given either true feedback or no feedback.

HR5 -- Personality factors will have a differential effect upon learning and retention of the programmed text as well as any observed Zeigarnik effect.

The Concomitant Null Hypothesis is as follows:

H01 -- Neither true nor false feedback will differentially affect learning and/or retention of programmed text material. In addi-
tion, the treatment groups will not evidence any differences with regard to personality factors or the Zeigarnik effect.
Feedback Effects

Feedback in a learning setting is best described as a means to provide the learner with an awareness of the appropriateness of his responses. While the issue of providing the learner with immediate feedback about his response is not new, much controversy still surrounds it. A review of the recent literature reveals that feedback is being used in a wide variety of situations with a continuing variation in positive results. Research, thus far, has centered on its causes as well as its effect on psychomotor tasks, perceptive tasks, standardized test scores, behavior modification, verbal learning, programmed instruction, role of errors, and false feedback.

In an exhaustive review and analysis of the literature, Annett (1969) isolated three factors possibly explaining the effects on learning and retention of providing the learner with feedback in programmed instruction. The three factors are: (1) reinforcement, (2) incentive, and (3) information. Annett concluded that feedback may be regarded as information about the outcome of a test carried out on the environment. He suggested that saying feedback is due to an incentive function added nothing to its meaning since motivation was feedback in action. He added that combining reinforcements in the form of bonuses or shocks to informational feedback had little effect upon learning efficiency.
In an investigation which compared the effects of information feedback, knowledge of results, and reinforcement, Rivera - Medina (1972) found that paired associate learning performance improved at the fastest rate if information feedback was provided.

In another extensive review, Geis and Chapman (1971) compared and contrasted studies showing feedback to be effective with numerous studies that demonstrated no effect. The review was intended to demonstrate that feedback was a reinforcer. The conclusions from the review suggest that feedback did not enhance learning, as measured by immediate posttest and/or retention tests. Further, studies which varied the amount of reinforcement failed to verify feedback as a reinforcer although high error scores were evidenced whenever feedback was reduced. On the other hand, the data suggest that feedback may well be a reinforcer when uncertainty or the probability of emitting an incorrect response is high, or where confidence is low.

Psychomotor tasks. Regarding the acquisition and retention of psychomotor skills, Salvendy and Harris (1973) found that gradual reduction in feedback was superior to an abrupt halt to feedback for the retention of a skill. They also found that negative reinforcement was superior to the positive one in both the acquisition and retention of psychomotor skills. Spoelders (1973) investigated the effect of three levels of feedback (group performance fictitiously evaluated as good, very bad, or no feedback) on the effectiveness of groups of university students on a physical task of building a Roman arch. No significant difference between feedback conditions was demonstrated.
Perceptual tasks. Mahan and Gupta (1972) found feedback and monetary incentives effective in improving auditory signal detection. Holland (1958) performed a series of studies on human vigilance where subjects were required to report deflections of a point on a dial. Holland's data suggested that shortly after each detection there is a period in which no observing responses are emitted. Signal detections can control the rate or probability of emission of observing responses. Such signal detections, therefore, serve as reinforcements for observing responses. The implication of these findings for programmed instruction is that providing the correct answer to a given frame may cause a decrease in careful reading of subsequent frames.

Standardized test scores. Some researchers have shown feedback to be effective in altering scores on various standardized tests. Schmeck and Schmeck (1972) found that children's Stanford-Binet IQ scores were significantly improved following feedback and reinforcement in the form of M & M candy. In apparent support of the reinforcement interpretation of feedback, Rosenfeld (1972) found that the addition of reinforcements (monetary and chart) to a classroom curriculum resulted in improved performance for many students and the improvement was positively related to IQ. Sweet and Ringness (1971) tested children of low socio-economic status on the WISC. They found that Negroes did not differ across treatments. Lower class whites, however, tested under feedback or monetary conditions performed significantly better than lower class whites under standardized conditions. Turner, Hall and Grimmett (1973) tested the effects of familiarization feedback on the performance of lower class and middle class
children on the Raven's Colored Progressive Matrices. The results revealed that both middle class and lower class experimental groups had scores that were higher than those of the control group by about the same amount. In addition, middle class children achieved significantly higher digit span scores as well as significantly longer response latencies and higher scores on the Raven's.

**Behavior modification.** Researchers have also tested the effects of providing feedback in behavior modification studies. Roll (1973), for example, found equivocal results with the introduction of feedback where reversal and reinstatement of the feedback conditions resulted in a rapid decrease, increase, and decrease in unwanted behavior. Hunting and Bruce (1971) found that neither modeling nor feedback produced significant changes in the oral language of Head Start children. O'Brien and Azrin (1970) found informational feedback actually increased the unwanted behavior (slouching). The authors concluded that feedback's effect depends on a subject's motivation to perform a given response. Klinge (1973) demonstrated that adult learners receiving accurate feedback were able to control autonomic behavior (i.e., GSR, respiration, cardiac rate).

**Verbal learning and programmed instruction.** The bulk of the research on feedback effects has been on verbal learning and programmed instruction. It is generally agreed that programmed instruction is one way of improving teaching efficiency. Research findings reported in Lumdsdaine and Glaser (1960) have shown the advantages and limitations of programmed instruction. A number of research studies have tried to ascertain the best methods of learning from text
material. The research has, for example, shown the importance of: specificity of instructional objectives (Rothkopf & Kaplan, 1972), overt responding (Kemp & Holland, 1966), questions in maintaining attention (Bull, 1973), length of passage, position of questions and knowledge of results (Fraser, 1967). The following are the basic principles of programmed instruction: objective specification, empirical testing, self pacing, overt responding, small step size, prompting and immediate feedback for knowledge of results (O'Day, Kulhavy, Anderson and Malczynski, 1971). The present research pertains to the latter and is designed to evaluate its effect on learning and retention.

Additional research has been directed at the effects of programmed instruction using different media. Federico (1971) compared an audiovisual module with a commercial programmed linear text. Findings showed that the audiovisual programmed approach was more efficient and equally as effective as the programmed text. Subjects acquired as much after seeing the 20 minute audiovisual module as from interacting for 80 to 120 minutes with the text. Both Homme and Glaser (1959) emphasize that the programmed textbook can do just what the machine can and "without hardware." They admit, however, it cannot prevent cheating as well as the machine.

Anderson, Kulhavy and Andre (1971; 1972) found that feedback provided to students learning programmed text materials significantly improved performance on criteria tests. Both studies also indicated that learning performance was significantly better when feedback was given after, rather than before, the response. Other research
demonstrated positive effects of feedback on decision making performance (Williges & North, 1972). The findings in the latter study were interpreted as being incompatible with the hypothesis that reinforcement has no effect on perceptual learning and the reinforcement explanation that performance should vary with the amount of feedback provided.

An important study for consideration in any research on programmed instruction using feedback was conducted by Geis, Jacobs, Spencer, and Nielsen (1970). The authors used a variety of programmed text materials and showed that students observed available answers in the program far less than 100% of the time. The authors noted that some subjects never check the feedback provided while the majority check only on occasion. Consequently, any study purporting to measure feedback effects must ensure that the learner view the feedback which is provided.

Cook (1962) has isolated several factors to be used in evaluating the acceptability and adequate performance on a programmed text. Cook found that there is a fairly orderly negative relationship between program completion time and IQ. High IQ persons appear to complete most programs more rapidly. He also suggests that on a good program there should be no apparent relationship between IQ and errors. In a good program, most of the errors should reflect individual differences in learning styles.

Anderson (1972) showed that subjects who answered inserted questions did about 40% better on the same questions than a reading only control group. The data suggest that answering questions after, but
not before, reading a passage also significantly affected performance on new questions. Wentling (1973) compared the effects of a mastery strategy with those of a nonmastery strategy of instruction, employing varying levels of feedback from unit achievement tests. The mastery strategy was found to be superior in terms of immediate and delayed achievement, but students required 50% more time to complete instructions. Partial item feedback was provided by a chemically treated answer sheet that enabled students to learn if they had responded correctly or incorrectly to each item. The mastery strategy with partial item feedback appears most desirable when time trade-off is justifiable. Weisenberg (1973) conducted a study where high school students participated in a verbal conditioning experiment where each group received either informative feedback which provided knowledge about the correctness and incorrectness or affective feedback which provided approval or disapproval. Results show that both informative and affective feedback led to conditioning. However, affective feedback was not as effective as informative in yielding a high performance level. No differences were obtained between positive and negative feedback.

McMahon (1973) found no significant differences between groups given detailed, limited, or no feedback on test performance. The data suggest, however, that test anxiety was higher for the detailed knowledge group. Devlin (1972) also found no differences and the treatments included knowledge of correct results (KCR) plus money. Using among others, a treatment where subjects got detailed feedback via tape cassettes, Tauber (1972) found no advantages in providing
feedback to the learner. Similar nonsignificant evidence for the feedback effect on verbal and motor learning have been shown by others (Magill, 1973; Schmidt & White, 1972; Kent, 1972; and Lublin, 1965). Interestingly, Lublin's study used a programmed text developed by Holland and Skinner and found that higher ability students did better than low ability students. The latter finding was contrary to Skinner's belief in a "wash out" effect of ability under programmed instruction. Flook and Robinson (1972) concluded that the relationship between feedback and learning performance is dependent upon the nature of the situation and the subjects themselves.

Tait, Hartley, and Anderson (1973) designed two computer assisted instructional programs labeled "active" and "passive" for helping children to multiply numbers. Active feedback required an overt response for computing the answer. The passive feedback was provided merely through a printed message. The results showed the greatest effects were for subjects whose initial level of achievement was low. The overall differences between the two feedback groups did not reach significance.

In a study conducted with Reserve Officers' Training Corps (ROTC) cadets, Sullivan, Schutz, and Baker (1971) discovered that cadets receiving immediate feedback indicating the correct response scored significantly higher on the 100 item final test than the cadets receiving delayed feedback. The paradigm permitted some cadets to gain release from a maximum of three drill periods for acceptable test performance. Interestingly, they found that cadets under the drill period contingency scored significantly higher than
a comparable group had scored under a monetary contingency with a $4 maximum. An effective incentive, therefore, also appears necessary for acceptable learning performance.

Role of errors. Several researchers have explored the role of errors in learning with feedback. They wished to determine whether feedback was more effective following errors or correct responses.

Elley (1965) explored the role of errors in learning with feedback. He varied both the number of initial error alternatives and the judged meaningfulness of the multiple-choice items. All of the subjects in these experiments responded overtly by entering their answers into a punchboard. Interestingly, for the items rated as high meaningful, the number of initial wrong alternatives available did not have a significant influence upon final test performance. Error repetition was uncommon. Kulhavy and Parsons (1972) also varied the number of incorrect question alternatives under conditions of either overt or covert responding to multiple-choice frame questions. Results indicate that the perseveration of incorrect choices from learning to posttest is not a direct function of the transfer of learning errors as such, but rather of the design of the instruction itself. The authors concluded that making an error per se doesn't guarantee the transfer of that error to the posttest. Rather, error perseveration from learning to the posttest occurs because the learner cannot obtain correct information during learning. With similar concerns for errors, Melching (1966) found that subjects using programmed instruction requested feedback on 28% of the frames on which errors occurred. The error rate on frames where no feedback
was requested was only 4%. The results suggest that subjects may attend more closely to feedback when it follows an error than when it follows a correct response. Guthrie (1971) concluded that feedback following wrong responses increases the probability that these responses will be correct on a test, whereas feedback following correct responses doesn't effect the likelihood that the response will be correct on a successive trial.

Kaess and Zeaman (1960) used a modified Pressey-type punch-board to study the influence of positive and negative knowledge of results on multiple-choice learning of definitions. They manipulated initial error probability by varying the number of incorrect alternatives presented on the 30 multiple-choice test items. The results showed that errors made on the initial test tended to perseverate to later trials on the same items.

False feedback. Several researchers have sought to evaluate feedback effects by falsifying the information given to the subject. Bringmann, Balance and Sandberg (1971), for example, studied the effects of feedback upon rated personality profile reports. Results showed that subjects endorsed significantly more highly the feedback statements from their own profiles than randomly selected feedback statements. Apparently, self-concept is not easily distorted by false feedback. Henrikson (1971) also investigated the effects of providing the learner with false feedback (i.e., telling the learner he is doing better than he is). Groups told they were doing better or worse than they actually were, evidenced decreased mean reaction times. The author interpreted the feedback effects as lowering the
learner's decision criterion. The effects persisted for twenty-four hours. Koenig (1973) administered a measure of test anxiety to undergraduates and provided false feedback concerning their emotional reactivity during the solution of arithmetic problems. The findings indicate that high feedback led to performance deterioration, and average feedback resulted in intermediate performance.

Eckerman and Vreeland (1973) manipulated experimenter feedback ("correct" or "incorrect") according to a prefixed order rather than according to characteristics of a motor response. Subjects made an "x" on a series of blank sheets of paper in a study designated as an "acquisition of manual skill." The results demonstrate control by the schedule of feedback on the response variability of human subjects.

Zeigarnik Effect

The Zeigarnik effect is described as a distortion of memory due to the interruption of a task. Research on the Zeigarnik effect has encompassed the following areas: interruption of tasks, ego involvement in the task, structure of and time spent on the task, and achievement motivation. Of greater importance to educational psychology, much attention has centered on the interpretation of incorrect responses to test items as being interruptions of tasks. Researchers have investigated the relationship between achievement motivation and the Zeigarnik effect using incorrect responses. Researchers have also tried to determine whether the Zeigarnik effect was due to learning or selective remembering.

Relatively little is known about the interruption of tasks. Zeigarnik (1927) pioneered in the discovery of phenomena associated
with the memory of incomleted tasks. She gave her subjects simple operations to perform and then systematically interrupted various tasks before they were completed. Her results suggest that in a recall test, subjects remembered those tasks which were interrupted better than the completed ones. The Zeigarnik effect, as it is now called, suggests that the need to complete a task creates a tension system within an individual which finds resolution only when that need is met. As such, a task which is interrupted will produce tensions which force the learner's thoughts toward the incomleted task.

A number of researchers attempted to clarify and expand upon the theories developed by Zeigarnik in explaining the memory phenomenon which she discovered. Marrow (1938) found that subjects who were told they were working successfully tended to forget their tasks even though they were interrupted. In this instance, the interruption was equivalent to completion since it gave the subject a feeling of success. Subsequent research by Rosenzweig (1943) has shed additional light on the Zeigarnik phenomenon. In a series of innovative experiments, Rosenzweig found that when subjects believed they were taking an IQ test, and hence presumed to be ego involved, they tended to recall the finished tasks more frequently than unfinished ones. A comparable group of subjects who were led to believe that they were working on puzzles, on the other hand, recalled the unfinished tasks better than the finished ones. The implication here is that the amount of ego involvement or need-persistence associated with a task may be the determining factor in whether or not the Zeigarnik effect can be
demonstrated.

A comparable review of the Zeigarnik effect literature by Prentice (1944) revealed the tremendous complexity in interpreting the recall of interrupted tasks. Based on a careful analysis of all of the existing data on interrupted tasks, Prentice (p. 338) isolated the following factors as affecting recall after a task is interrupted: (a) structure of the task, (b) age of subject, (c) fatigue, (d) time spent on tasks, (e) difficulty, (f) "personality" of subject, (g) "importance" of task, (h) success vs. failure, (i) attitude of subject, (j) nature of post-experimental activity, and (k) homogeneity of interruption. Obviously, the difficulties involved in finding quantitative measures expressing degrees of fatigue, task-difficulty, and success or failure are staggering ones.

Atkinson (1953) performed an experiment which appeared to resolve the apparent contradictions between those of Zeigarnik and Rosenzweig. He showed that individuals who were classified as high in need for achievement remembered more incompletely than completed tasks. Conversely, he found that subjects who are low in need achievement and considered anxious about failure will remember more completed than incompletely tasks.

Gradually educational psychologists realized the implications of the Atkinson research for learning and retention. It was assumed that items which were failed on examinations constituted "incompletely" tasks while those which were passed represented "completed tasks." It was further assumed that subjects high in need of achievement could, if identified, be trained to learn and recall on a short term basis
information to which they had been exposed. Weiner, Johnson, and Mehrabian (1968) found that subjects high in achievement motivation recalled a greater percentage of failed than passed questions (the Zeigarnik effect). Also evident was the fact that those subjects scoring low in achievement motivation showed less evidence of the Zeigarnik effect. Weiner et al. suggested that the differential recall was due to greater remembrance of the failed items by the high achievement-oriented subjects.

Caron and Wallach (1957) tested whether superior recall of successes or failures in an intelligence test situation is a function of selective forgetting (repression) of failures or selective learning in favor of successes. The findings suggested that both success and failure recall tendencies were due to selective learning rather than a selective remembering process. Lublin (1965) using a programmed text and various levels of feedback to the learner found no differences between groups on the criterion retention test. She explained the lack of significance between groups by suggesting that the Zeigarnik effect may have been operating for the no reinforcement control groups. That is, confirmation following a correct response may have detracted from the retention of that response. Raffini and Rosemier (1972) studied the effect of achievement motivation on the Zeigarnik effect and post-exam error correcting performance. Half the subjects received feedback about their initial test performance. During the retest, the Zeigarnik effect was found not to be related to achievement motivation. Feedback, however, was more effective than no feedback at each resultant achievement level for both sexes.
Personality and Sex Differences

One purpose of this study was to evaluate the impact of personality variables and sex differences upon errors (both learning and retention), program completion time, and the Zeigarnik effect. The study sought to determine which personality traits were associated with performance during learning and retention. Thus far, researchers have concentrated upon such issues as: attitude toward programmed instruction, need structure, level of anxiety, achievement motivation, cultural role expectations, and general differences between males and females on a variety of measures.

Blitz and Smith (1973), for example, compared personality needs as measured by the Edwards Personal Preference Schedule (EPPS) with achievement on computer assisted instruction (CAI) of a programmed text. They found consistent negative correlations with programmed text material for Deference, Order, Affiliation, and Nurturance. On the other hand, there were positive correlations for Exhibition, Intracception, Abasement and Aggression respectively. They found that students with high Deference scores do well on programmed text learning. Students with high Order scores did poorly on the programmed text compared to CAI whereas students high in Endurance did well on the text. The Autonomy need, incidentally, seemed to have no differential effect. Conroy (1971) found that age was a significant factor in programmed instruction in that older students showed the greatest achievement gains. No significant differences between sexes were noted. Haskell (1971) found that the programmed learning approach favored learners who were slow and methodical or who could
be characterized as agreeable and easy to get along with (high friendliness). The more aggressive types (low friendliness) performed better under more conventional types of instruction. Spiegel and Keith-Spiegel (1971) found that student grades were best predicted differentially for males and females when information on personality and attitudes were taken into account. Pasewark, Fitzgerald, and Watson (1971) found great similarity between EPPS needs of male and female delinquents. Delinquents do not show the normal sex differences whereby males have a greater need for Achievement, Autonomy, and Heterosexuality while females have greater Intracception, Abasement, and Endurance needs.

Pietrafesa (1970) showed that personality need patterns are relatively similar among students pursuing different academic majors while major sex differences are still apparent. Again using the EPPS, Fitzgerald and Pasewark (1971) found that males score consistently higher than females on Achievement, Dominance, and Aggression, and lower on Affiliation, Succorance, and Nurturance. Also using the EPPS, Aldag (1970) found that the manifest needs it measures appear to be sex related rather than vocationally related.

Regarding personality differences between the sexes, Mehotra (1972) showed that girls were warmer and more sociable, excited, aesthetically sensitive, and insecure than boys. On the other hand, boys appeared more enthusiastic, happy-go-lucky, dominant, aggressive, adventurous, thick-skinned, and self-sufficient. Horner (1969) demonstrated that females, compared to males, fear rejection after a success or distort the success. When placed in competitive situations
with men, women's achievement scores decreased. Wyer and Malinowski (1972) showed that males and females have tendencies toward dominance and submission respectively in their interpersonal relations. They emphasized the influence of sex role expectancies on behavior. A number of other researchers (Weiss, 1961; Mehrabian, 1968; Simon & Feather, 1973) have suggested that females may, to be consistent with cultural expectations, distort their performance in achievement tasks so as to appear inferior to males that performed less well than they. French and Lesser (1964) demonstrated that females heightened their achievement motivation scores only when the goal was achievement relevant to females.

A number of researchers have demonstrated a relationship between achievement anxiety and poor performance in females (Suchett-Kaye, 1972; Walsh, 1971; Devi, 1969). Campeau (1965) has suggested that not only may anxiety have a deleterious effect upon females' test performance but it may be heightened by an interaction with feedback. The implication of these results is that detailed feedback provided to the learner may heighten test anxiety which, in turn, appears to be more pronounced in females than males. Lin and McKeachie, (1971) failed to demonstrate sex differences in test anxiety. Marso (1970) found that students with high measured test anxiety achieved more from frequent unit tests followed by feedback. Lublin (1965) showed, among other things, that low Autonomy subjects did better on a programmed learning criterion test. She used the EPPS to measure personality needs. Moore, Smith, and Teevan (1965) demonstrated that high need achievement subjects outperformed and had more favorable attitudes toward programmed
learning than low achievement subjects. Also evident was that high hostile subjects achieved more and had more favorable attitudes toward programmed instruction.

Scherman and Scherman (1973) showed that males had particularly positive attitudes toward programmed instruction. Females, on the other hand, indicated on their questionnaires that programmed learning was neither interesting nor stimulating. Using a CAI program on mathematics, Nagel (1970) found males to be superior to females in their posttest achievement measures. Results showed some positive correlation between CAI achievement and extraversion but none for socio-economic status, academic motivation, or creativity. Marx, Witter, and Mueller (1972) provided college males and females with knowledge of results following each response on a visual display multiple-choice task. The results showed that females were slower learners. Females also learned significantly less than the males working under either the social or isolate condition. Among other things, the authors suggested the scientific subject matter, female role expectations, and heightened female anxiety in explaining the observed sex differences. Tyler (1956) showed that males tend to be higher in mathematical reasoning, spatial judgment, and scientific reasoning. He found that females excelled in verbal fluency, rote memory, perceptual speed, and dexterity. Duggan (1950) and Hobson (1947) supported the results of Tyler. They both showed support for the notion that females were superior in verbal fluency, rote memory, and remembering words. Reid, Palmer, Whitlock, and Jones (1973) used CAI and a mathematical program to compare male and female performance. Although the differences were not significant,
females required more time than males to complete the program. Since the authors used a mathematical program, they hypothesized that males would outperform females. The results were in the hypothesized direction but the differences did not reach statistical significance. In addition, no significant overall correlations between achievement motivation and the performance measures (posttest and time) resulted. A further examination of the data revealed no relationship between test anxiety and sex nor between either of these variables and achievement, attitude toward CAI, or dominance. The authors conclude that learning performance is best improved through homogeneous groupings on the basis of sex, test-anxiety, and achievement levels.

Herbert and Sassenrath (1973) categorized subjects as high or low on achievement and test anxiety. Subjects were given a pretest followed by a programmed learning task. A parallel form of the pretest was given as a posttest five days later. Both errors and latency were used as dependent variables. The results showed that there were significant differences between pretest and posttest. However, none of the effects of achievement motivation, test anxiety, or their interactions were associated with scores on any of the measures obtained.

Simon and Feather (1973) have also shown that male subjects tend to enter a test situation with notably higher levels of confidence than do females. Todd and Kesslar (1973) measured four independent types of recall (total words, idea units, eight-word sequences, and identical words). The data revealed that females performed significantly better than the males in all but the recall of eight-word sequences. Yavuz (1971) examined sex differences in the retention and
organization of free recall. The sample was drawn from eight and twelve year olds attending Turkish primary schools. The results suggest that girls are superior to boys in free recall and with increasing age the recall capacity appears to increase. The results obtained by Todd and Kesslar and Yavuz clearly support the notion that females excel in tasks involving verbal fluency and rote memory respectively.

The effects of feedback on learning and retention of programmed instruction, while somewhat unclear, depend upon the manner in which it is presented. The fact that it is made available is no guarantee that learners will make use of it. The use of false feedback should shed additional light on the theoretical and pragmatic issues involved in feedback usage. Whether learners tend to remember their successes or failures following a test is unclear and may depend upon the situation. The present study will evaluate the use of incorrect test items recalled as a measure of the Zeigarnik effect.

The extent to which sex and personality differences in the learner effect learning and retention is fairly well understood. Previous research has indicated that both sex and personality differences play a role in intellectual functioning. The study will further refine these comparisons and seek to determine the personality and sex correlates of the following variables: (a) program completion time (latency), (b) learning errors, (c) retention errors, (d) Zeigarnik effect, (e) age, (f) educational level. Inferences can then be drawn as to the effects of sex and personality differences upon the learning and retention of programmed text material.
METHOD

Subjects

The subjects consisted of 42 (19 male, 23 female) graduate and undergraduate volunteers ranging in age from 18 to 51. The average age of males and females was 26.16 and 21.0 respectively. Subjects were attending one of three schools: a large private, urban midwestern university (N = 15), a small private midwestern college (N = 17) and an eastern state university (N = 10). Volunteers were recruited by offering them a chance to win one of four prizes ($75, $25, $10, or $10) in a lottery fashion. Subjects were informed that the award of the first two prizes would be contingent upon the two best performances while the two $10 prizes were to be awarded randomly to two of the participants in the experiment.

Subjects were randomly assigned to one of three treatment groups (N = 14). Each subject received the same course of treatment except during the learning phase. During learning, subjects within the three separate treatment groups received either true, false, or no feedback (control) respectively.

Materials

Programmed Text. The learning apparatus consisted of a modification of a 30 frame programmed textbook developed by O'Day et al. (1971) describing structure and function of the eye. The original
program was altered slightly through consultation with an ophthalmologist. The sequence of the accompanying multiple-choice questions was also altered to be consistent with the specially prepared answer sheets used with subjects in the true feedback (TF) and false feedback (FF) treatment groups. The frames were typed in 8½" x 11" plain bond and placed in a blue ringed paper binder. The frames average approximately 105 words each including a three choice multiple-choice question for each frame.

The programmed text was accompanied by a manila folder containing Xerox copies of six figures which were referred to throughout the text. The answer sheets which also accompanied the text were of two types: The first answer sheet was an 8½" x 11" Xerox sheet numbered from 1 to 30 with answer choices (a, b, or c) beside each number. The second answer sheet used by the TF and FF treatment groups was a specially treated 5½" x 4" answer sheet which presented answer choices in blocks. The answer sheet was specially developed by the Minnesota Mining and Manufacturing Company (3M). These answer sheets required the use of a special 3M Action Mark crayon which, when rubbed on a given answer choice block, would reveal a printed numeral 1-3 within that block.

Posttest Recall. The recall test following the 30 frame learning text consisted of an 8½" x 11" sheet. The recall sheet requested each subject to fill in his name and the date and react to the following directions:

From the thirty frames you just read, please recall any six answers you can. If you cannot recall the exact answer to certain frames, then list any facts, principles, or key phrases associated with a given frame. Be as specific as possible.
Retention Test. The retention test, with one minor exception, was the exact duplicate of the one used by O'Day et al. (1971). Basically, it consisted of nothing more than a listing of each of the 30 multiple-choice questions presented in the learning text minus the text itself. An answer sheet was attached to each retention test to permit reusability of the latter.

Personality Inventory. Each subject was administered the Edwards Personal Preference Schedule (EPPS). The EPPS consists of 225 questions of the forced choice variety. It provided percentile comparisons for each subject on 15 basic needs including Achievement, Autonomy, and Endurance. The average completion time for the EPPS was approximately 40 minutes.

Procedure

The experimental session (approximately 1 hour and 50 minutes) consisted of four phases: learning, post learning recall, retention, and the administration of the EPPS. Subjects worked on each phase of the experiment in separate individual carrels of the three different college libraries used by students in the sample. Each of the four phases were completed in one session. While working on each of the four phases subjects were permitted as much time as they needed in order to complete each phase.

In the first phase, each subject was handed a programmed text booklet, an answer sheet, a specially prepared 3M Action Mark crayon (except for controls). Accompanying the text was a manila folder containing copies of six figures for use in working through the text. Subjects were instructed to complete the program while seated in the
library carrels. No time limit was imposed. The programmed text consisted of 30 frames. Multiple choice questions followed each of the 30 frames. The treatment differences varied according to the manner in which subjects responded to these questions and the feedback, if any, provided following a given response.

The control group (no feedback, N = 14) responded to each of the 30 multiple-choice questions following the text of each frame without any feedback. Control subjects circled their answer choice (a, b, or c) on an 8½” x 11” answer sheet.

Subjects assigned to the true feedback group (TF, N = 14) received feedback following their response to each multiple-choice question during the learning phase of the experiment. That is, each subject in the true feedback group was given a specially prepared 3M Action Mark crayon and an answer sheet. The 5½” x 4” chemically treated answer sheet was of the three choice multiple-choice variety. The subject shaded in the block (a, b, or c) which he felt to be the correct answer. The crayon would react with the chemically treated answer blocks and a numeral (1, 2, or 3) would then appear within the shaded answer block. The instructions for the true feedback group (see Appendix B) indicated to the learner that the correct answer for questions 1-24 was a 3 in the shaded answer block. The correct number for answer blocks 25-30 was indicated by a 2. Subjects were further instructed to shade in answer blocks until they had chosen the correct response. This procedure ensured that the learner knew the correct answer before responding to the next question. It also ensured that subjects who made errors would immediately know they were incorrect
and be forced to select another answer choice.

The remaining subjects were assigned to the false feedback treatment group (FF, \( N = 14 \)). The instructions for this treatment group were similar to those given to the TF group. The essential difference, however, was that false feedback was provided on a random sample of six of the 30 learning frames. Subjects were instructed to read each frame and answer the connected multiple-choice questions by shading in the appropriate answer blocks with the crayon on the specially prepared 3M Action Mark answer sheet. Feedback for members of this treatment group consisted of printing below and to the right of each learning frame in the program text booklet one of the following: 1-correct, 2-correct, or 3-correct. For those six frames which were chosen for false feedback, the statement below the frame (i.e., 1-correct, etc.) indicated as correct for that frame was actually incorrect. Under this format, therefore, a subject may have made an incorrect response and be informed that it was correct or vice versa. In order to avoid number choice effects, feedback was varied such that 1, 2, or 3 was used to indicate which of the chosen responses was correct. Subjects within the FF group therefore, received true feedback on 24 frames and false feedback on six of the learning frames.

In order to avoid frame effects, the six frames chosen for false feedback varied for each subject within the FF group. For each of the 14 subjects, six frames were randomly chosen from the thirty for false feedback. At this point, the experimenter simply assigned the false feedback (i.e., 1 is correct where 2 actually was correct) to
the right and below six of the frames in the learning booklet. Following completion of the 30 learning frames, all 42 subjects were given a post recall test.

The sheets were numbered 1-6. Space was provided between each number for subjects to write in their free choice recall. Again, no time limits were imposed. These responses were later rated by three independent judges who had no knowledge of the subject's identity or treatment group to which the subject belonged. Judges were asked to make two evaluations of the recall responses. First, they determined whether or not each of the responses was correct or incorrect. Second, each of the six recall responses was assigned a number from 1 to 30 indicating the frame to which the response referred. The frame association of these recall responses was later used as a measure of the Zeigarnik effect. Subjects who tended to recall principles or facts associated with frames on which they had made errors during either the learning or retention tests were presumed to be exhibiting the Zeigarnik effect.

Immediately following the completion of the six recall questions, each subject was administered the criterion retention test. This test contained the same 30, three choice, multiple-choice questions used in the learning sequence. Subjects were instructed to simply fill in their names and make all of their responses on the one page answer sheet which accompanied the retention test. Subjects were given unlimited time to finish responding to these questions. With the interposition of the recall test between the learning and retention phases, both recollection and interference may have taken
Immediately following the criterion retention test all subjects were given the EPPS. All subjects were permitted as much time as needed to complete this test.

Upon completion of the EPPS, E discussed briefly with each subject the hypothesis being tested in the experiment and answered questions posed by any of the volunteers. Special attention was paid to debriefing subjects in the FF treatment group. It was explained that the learning text booklets had provided false feedback on a random sample of six of the learning frames.

Design

The paradigm will use the following as dependent variables: program completion time (latency), learning errors, retention errors, recall accuracy, and the Zeigarnik effect for learning frames, retention frames, and both of them combined. The Zeigarnik effect was measured by the number of incorrect frames which were recalled during the recall phase of the experiment. This phase followed the learning sequence. Nine 2 x 3 factorial unequal N analyses of variance were used to evaluate these dependent variables. The independent variables were sex with two levels (male and female) and feedback with three levels (control, true feedback, and false feedback).

The EPPS variables were used as independent variables in calculating the Pearson Product Moment correlations and multiple regressions. The EPPS purportedly measures the following variables; Achievement, Deference, Order, Exhibition, Autonomy, Affiliation, Intraception, Succorance, Dominance, Abasement, Nurturance, Change,
Endurance, Heterosexuality, and Aggression. Correlations for each of these factors with the above dependent variables were calculated to assess the effects of personality upon performance in programmed instruction and the Zeigarnik effect.
RESULTS

A total of nine 2 X 3 factorial designs with unequal N were used to analyze the data gathered on the first three phases of the experiment (learning, free-choice recall, and retention). The MANOVA statistical computer package was utilized to compute both univariate and multivariate tests. Two factors were used. The first was sex (male and female). The second was feedback including three levels: control, true feedback (TF), and false feedback (FF). The nine dependent variables were: latency, learning errors, recall accuracy, retention errors, initially failed items later correct, initially correct items later failed, Zeigarnik estimators for learning, Zeigarnik estimators for retention, and Zeigarnik estimators for both learning and retention. Summary ANOVA tables for all nine univariate and multivariate tests are located in Appendix A. The personality data were obtained during the fourth phase of the experiment and evaluated using Pearson Product Moment correlations and multiple regressions. The above statistics compared the personality variables of the EPPS with age, education, latency, learning errors, retention errors, Zeigarnik estimators for learning, Zeigarnik estimators for retention, and Zeigarnik estimators for both learning and retention, respectively.

Table 1 depicts the mean latencies (minutes) for males and females in each treatment group. The analysis of variance for latency revealed a significant feedback effect, \( F (2, 36) = 3.380 \),
### Table 1

Mean Latencies (minutes) for Males and Females in each Treatment Group in Completing the Thirty Frame Learning Program

<table>
<thead>
<tr>
<th>Gender</th>
<th>Treatment Group</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control</td>
<td>True Feedback</td>
<td>False Feedback</td>
</tr>
<tr>
<td>Males</td>
<td>37.00</td>
<td>39.66</td>
<td>44.25</td>
</tr>
<tr>
<td>Females</td>
<td>45.55</td>
<td>41.60</td>
<td>60.16</td>
</tr>
</tbody>
</table>

*a n = 14 for each group*
p = .045. A Tukey test (Kirk, 1968, p. 88), at the .05 alpha level revealed significant differences between males in both the control (no feedback) and TF groups, along with females in the FF group. In short, it took learners significantly longer to complete the programmed text under false feedback than the no feedback controls. The main effects for sex and the interaction were not significant.

The factorial analysis of variance on learning errors revealed significant differences for the main effects of both sex, $F(1, 36) = 5.404, p = .048$, and feedback, $F(2, 36) = 3.301, p = .048$, respectively. A Tukey test again showed significant differences ($p < .05$) between males in the control and TF groups compared to females in the FF group. The interaction between sex of the subject and type of feedback given was not significant. The summary analysis of variance for retention errors follows a similar pattern. The analysis yielded a significant sex effect, $F(1, 36) = 6.916, p = .012$, and feedback effect, $F(2, 36) = 4.978, p = .012$. A Tukey test showed a significant ($p < .05$) difference between females in the false feedback and true feedback groups.

A pictorial depiction of the error data is contained in Figure 1. During learning and retention, subjects in the FF group made consistently more errors than either of the other treatment groups. During the retention test the TF group consistently made the fewest errors followed by the control and FF groups respectively. It was hypothesized that both feedback groups would retain information from the text better than the controls.
Figure 1. Total errors made on questions contained in a programmed text: On the structure and function of the human eye (adapted from O'Day et al., 1971). Errors were summated over blocks of five frames.
Figure 2 depicts the difference in mean errors for males and females. Males in each of the treatment groups made consistently fewer errors on the programmed text. During learning, however, the mean errors for both sexes in the control condition are quite similar.

The six free choice recall responses were first judged for accuracy and then frame association. The results of a Pearson Product Moment correlation yielded a rater reliability for frame association of .969 (p < .001). That is, the three raters showed extremely high agreement as to with which frames the free choice recall responses were associated for each subject. The rater reliability for recall accuracy was .706 (p < .001). The 2 X 3 factorial analysis of variance for recall accuracy (number correctly recalled) indicated a significant effect for the Sex X Feedback interaction, F (2, 36) = 10.434, p < .01. The main effects for both sex and feedback were not significant. A graphic representation of the significant interaction in Figure 3 shows that females in the control group had a superior recall accuracy while under true feedback both males and females showed similar recall accuracy. Under the false feedback treatment, males showed better recall accuracy than females.

In order to better gauge the effects of feedback on learning and retention, an analysis of variance was performed on those frames which were initially failed and later (during retention) correct. This measure provided an estimate of whether feedback following a response which is wrong on learning would be corrected during retention. The analysis of variance revealed a significant feedback effect, F (2, 36) = 3.874, p = .030.
Figure 2. A comparison of the mean errors of males and females made during learning and retention for each of the treatment groups.
Figure 3. The interaction of mean number of frames judged correct with feedback treatments for males and females. These data were obtained in the second phase of the experiment and later used, in part, to estimate the Zeigarnik effect.
A Tukey test of means using a .05 alpha level was applied to the data. The significantly different feedback combination, however, was not revealed. The data suggest that feedback following incorrect responses increases the likelihood that these responses will be correct on a subsequent test.

An analysis of variance was also performed on those frames which were initially correct (learning) and later failed (retention). This paradigm tested whether the presence of feedback would increase the probability that a response which was correct on one trial would also be correct on a subsequent test trial. The analysis of variance yielded no significant differences for sex, feedback groups, or their interaction (p values = .104, .093, and .741, respectively). Thus, it was concluded feedback following a correct response does not affect the probability that the response will be correct on a successive test trial.

Table 2 shows the mean estimators of the Zeigarnik effect for males and females. The Zeigarnik effect was estimated by counting the number of frames which were incorrect during learning and retention. A count was then made of the number of these incorrect frames which appeared in the responses given during the free choice recall phase of the experiment. The number of incorrect frames recalled was used as an estimator of the Zeigarnik effect during either learning or retention. The data in Table 2 are in the hypothesized direction for males. That is, males in the false feedback group show higher estimates of the Zeigarnik effect for learning, retention, and both of them combined. Interestingly, the reverse seems true for
Table 2
Mean Zeigarnik Effect Estimators for Males and Females in Each of the Three Treatment Groups

<table>
<thead>
<tr>
<th>Mean Estimators of Zeigarnik Effect</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control</td>
<td>True Feedback</td>
</tr>
<tr>
<td>No. of Incorrect Frames</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recalled for Learning Test</td>
<td>.400</td>
<td>.333</td>
</tr>
<tr>
<td>No. of Incorrect Frames</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recalled from Retention Test</td>
<td>.800</td>
<td>1.000</td>
</tr>
<tr>
<td>No. of Incorrect Frames</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recalled for Both Learning and Retention Tests</td>
<td>1.200</td>
<td>1.333</td>
</tr>
</tbody>
</table>
females. That is, females in the control (no feedback) group show higher estimates of Zeigarnik effect than those in the false feedback group. Three separate factorial ANOVA designs were applied to the Zeigarnik estimators. They measured the presence of the Zeigarnik effect for learning, retention, and the combined learning and retention frames respectively. No significant differences for any main effects or interactions were found (see complete ANOVA Tables in Appendix A).

Table J of Appendix A shows the multivariate tests of significance obtained using the MANOVA statistical computer package. The multivariate data reflect only seven of the nine dependent variables. The recall accuracy and Zeigarnik Both categories were not included.

For the seven dependent variables tested the sex main effect was significant, $F(7, 30) = 2.613, p = .031$. The main effect for feedback was also significant for both roots, $F(14, 60) = 3.015, p = .001$ and $F(6, 30.5) = 3.071, p = .018$, respectively. The MANOVA computations indicated an insignificant interaction for both roots 1 through 1 ($p = .346$) and roots 2 through 2 ($p = .310$).

The lack of any clear-cut Zeigarnik effect is best depicted by Figure 4. The data reveal the total number of incorrect frames recalled for each block of five frames. For the retention frames, the only apparent result is that frames 20–25 are the most frequently recalled. From Figure 1, it can be seen that this same block of frames (20–25) created the highest mean error rate for each feedback group.
Figure 4. Estimated Zeigarnik effect for each treatment group on both learning and retention frames. Zeigarnik estimates were summed over blocks of five frames. Zeigarnik estimates were derived by counting the number of frames wrong during learning and retention and subsequently recalled during the free choice recall test.
Table 3 depicts the Pearson correlation coefficients for males on the 15 EPPS Variables with age, education, latency, learning, retention, Zeigarnik estimators for learning, Zeigarnik estimators for retention and both combined. For males, Abasement correlates \(-.454, p = .05\) with education. With regard to latency, males show significant correlations for Autonomy, \(-.596, p = .007\), and Change, \(-.596, p = .007\).

There were no significant correlations between EPPS scores and either learning errors or retention errors for males. Regarding Zeigarnik estimators for learning, the correlations indicated a significant positive relationship with Heterosexuality, \(.596, p = .007\). With regard to Zeigarnik estimators for retention, a significant relationship with Affiliation, \(-.452, p = .05\), was noted. Lastly, when the Zeigarnik estimators for both learning and retention were combined, significant relationships for Achievement, \(-.452, p = .05\), and Affiliation, \(.491, p = .03\), emerged.

Table 4 gives the same breakdowns for females as Table 3 does for males. Pearson Product Moment correlations for females reveal no significant relationships between EPPS variables and either age, education, or latency. Interestingly, all the correlations on the latter variable were not significant. The high negative correlation (\(-.378, p = .07\)) between age and Achievement, however, should be noted. With regard to learning errors, on the other hand, three personality measures appear to have significant relationships. They are Exhibition, \(-.437, p = .03\), Abasement, \(.475, p = .02\), and Endurance, \(.521, p = .01\), respectively. No significant relationships emerge for retention errors. Regarding Zeigarnik estimators for learning and
|                          | Achievement | Deference | Order | Exhibition | Autonomy | Affiliation | Intraception | Succorance | Dominance | Abasement | Nurturance | Change | Endurance | Hetero- | Aggression |
|--------------------------|-------------|-----------|-------|------------|----------|-------------|--------------|------------|-----------|-----------|-----------|---------|-----------| sexuality|            |
| Education p.             | .266 .270  | .346 .14  | -.150 .53 | -.182 .45  | -.189 .44 | -.336 .10  | -.368 .10  | -.452 .05  |           |           |           |         |           |         |            |
| p.                       | .346 .14  | -.150 .53 | -.182 .45 | -.189 .44 | -.336 .10 | -.368 .10  | -.452 .05  |           |           |           |           |         |           |         |            |
| Latency p.               | .367 .12  | -.023 .92 | -.285 .24 | -.401 .09  | -.117 .63 | -.158 .51  | -.176 .47  |           |           |           |           |         |           |         |            |
| Learning Errors p.       | -.003 .99 | .279 .24  | .081 .74  | -.032 .83  | -.131 .59 | -.287 .23  | -.285 .23  |           |           |           |           |         |           |         |            |
| Retention Errors p.      | -.026 .91  | -.045 .85 | .110 .65  | -.194 .42  | .154 .53  | -.265 .27  | -.148 .54  |           |           |           |           |         |           |         |            |
| Zeigarnik Learning p.    | .1494 .54  | -.596 .007** | -.159 .51 | .045 .85  | -.015 .95 | .088 .72  | .064 .79  |           |           |           |           |         |           |         |            |
| Zeigarnik Retention p.   | -.036 .82  | .1494 .54  | -.596 .007** | -.159 .51 | .045 .85  | -.015 .95 | .088 .72  | .064 .79  |           |           |           |         |           |         |            |
| Both p.                  | -.285 .23  | -.160 .51  | -.207 .39  | -.067 .78  | .184 .45  | -.061 .80  | -.078 .75  | -.088 .72  |           |           |           |         |           |         |            |

* p < .05
** p < .05
## Table 4

### Pearson Correlation Coefficients for Females

<table>
<thead>
<tr>
<th></th>
<th>Age</th>
<th>Education</th>
<th>Latency</th>
<th>Learning Errors</th>
<th>Retention Errors</th>
<th>Zeigarnik Learning</th>
<th>Zeigarnik Retention</th>
<th>Both</th>
</tr>
</thead>
<tbody>
<tr>
<td>Achievement</td>
<td>-.378</td>
<td>.07</td>
<td>-.143</td>
<td>.52</td>
<td>-.066</td>
<td>.76</td>
<td>-.320</td>
<td>.13</td>
</tr>
<tr>
<td>Defe.rence</td>
<td>.286</td>
<td>.18</td>
<td>-.066</td>
<td>.76</td>
<td>.096</td>
<td>.66</td>
<td>.149</td>
<td>.50</td>
</tr>
<tr>
<td>Order</td>
<td>-.026</td>
<td>.90</td>
<td>-.153</td>
<td>.49</td>
<td>-.082</td>
<td>.71</td>
<td>.323</td>
<td>.13</td>
</tr>
<tr>
<td>Exhibition</td>
<td>.043</td>
<td>.85</td>
<td>-.114</td>
<td>.60</td>
<td>-.088</td>
<td>.69</td>
<td>-.437</td>
<td>.03</td>
</tr>
<tr>
<td>Autonomy</td>
<td>.220</td>
<td>.31</td>
<td>.389</td>
<td>.06</td>
<td>.059</td>
<td>.79</td>
<td>-.230</td>
<td>.29</td>
</tr>
<tr>
<td>Affiliation</td>
<td>.219</td>
<td>.31</td>
<td>-.044</td>
<td>.84</td>
<td>-.008</td>
<td>.97</td>
<td>-.108</td>
<td>.62</td>
</tr>
<tr>
<td>Intraception</td>
<td>.109</td>
<td>.62</td>
<td>.198</td>
<td>.36</td>
<td>.012</td>
<td>.96</td>
<td>.144</td>
<td>.51</td>
</tr>
<tr>
<td>Succorance</td>
<td>-.236</td>
<td>.28</td>
<td>-.316</td>
<td>.14</td>
<td>-.362</td>
<td>.09</td>
<td>-.141</td>
<td>.52</td>
</tr>
<tr>
<td>Dominance</td>
<td>.056</td>
<td>.80</td>
<td>.176</td>
<td>.42</td>
<td>.068</td>
<td>.76</td>
<td>-.318</td>
<td>.14</td>
</tr>
<tr>
<td>Abasement</td>
<td>-.284</td>
<td>.19</td>
<td>-.123</td>
<td>.5</td>
<td>.087</td>
<td>.69</td>
<td>.475</td>
<td>.02</td>
</tr>
<tr>
<td>Nurturance</td>
<td>.196</td>
<td>.37</td>
<td>.065</td>
<td>.77</td>
<td>.076</td>
<td>.73</td>
<td>.031</td>
<td>.88</td>
</tr>
<tr>
<td>Change</td>
<td>-.134</td>
<td>.54</td>
<td>.092</td>
<td>.68</td>
<td>.098</td>
<td>.66</td>
<td>-.269</td>
<td>.21</td>
</tr>
<tr>
<td>Endurance</td>
<td>.129</td>
<td>.56</td>
<td>.055</td>
<td>.80</td>
<td>.253</td>
<td>.25</td>
<td>.521</td>
<td>.01**</td>
</tr>
<tr>
<td>Heterosexual</td>
<td>-.143</td>
<td>.52</td>
<td>-.036</td>
<td>.87</td>
<td>-.093</td>
<td>.67</td>
<td>-.349</td>
<td>.10</td>
</tr>
<tr>
<td>Aggression</td>
<td>.047</td>
<td>.83</td>
<td>.072</td>
<td>.74</td>
<td>-.021</td>
<td>.92</td>
<td>-.351</td>
<td>.10</td>
</tr>
</tbody>
</table>

*p < .05

**p < .01
retention, no significant relationships with the EPPS variables appear to exist. In both cases, however, a strong negative relationship with Autonomy arises, $r = -0.423, p = 0.04$. A computer analysis of the intercorrelations between each of the 15 EPPS variables obtained in this sample was made. The matrix revealed a close approximation in both direction and magnitude to those coefficients reported by Edwards in the EPPS manual (1959). It appears that subjects in this study have similar scores as those sampled in the EPPS norm group.

In order to further clarify the apparent sex differences observed in this study, several $t$ tests were run. The $t$ tests showed that males are significantly older than females, $t (40) = 2.989, p < 0.01$. Males on the average had a greater number of years of college experience, $t (40) = 2.344, p < 0.05$. Using raw scores obtained on the EPPS for Achievement, males appear to be significantly higher in their achievement needs than girls, $t (40) = 2.198, p < 0.05$. Again using raw scores obtained on the EPPS, no significant differences between males and females on Autonomy appear to exist in the students sampled, $t (40) = 0.242, p > 0.05$.

Stepwise multiple regressions were calculated using the EPPS personality variables as independent or covariate variables. Tables 5-10 depict the stepwise multiple regressions using latency, learning errors, retention errors, Zeigarnik estimators for learning, Zeigarnik estimators for retention, and Zeigarnik estimators for both learning and retention respectively as dependent variables. The calculations were performed using the Statistical Package for the Social Sciences (SPSS) computer program. The stepwise multiple regression format
provided a comparison for males and females on each of the dependent variables. The SPSS package entered, in sequence, those EPPS personality need variables which appeared to contribute the most to the variance. The variables listed in each Table are listed in the order in which the computer entered them into the regression equation. Tables 5-10 provide a comparison for the Pearson correlations as well as a means to determine the proportion of variance in each dependent variable accounted for by the regression equation.

Regarding latency, Table 5 shows that males with high Autonomy and Change needs take less time to complete the programmed text. Males with high Affiliation needs take longer to complete the program. Note that together these three variables explain approximately 56% of the variance in Latency scores. For females, high Deference and Achievement contribute to longer programmed text completion times. High Succorance, in females, on the other hand, is related to shorter program completion times.

Table 6 indicates that males high in Aggression make more learning errors while high Dominance need in males brings fewer such learning errors. For female learning errors, there are substantial negative correlations (−.249, −.637, and −.094) for Affiliation, Autonomy, and Succorance respectively.

The many variations between the sexes on the same dependent variable must be noted. Table 7 shows that Autonomy needs, in females, are inversely correlated (−.345) with retention errors. For males, on the other hand, there is a high positive correlation (.366) between Autonomy need and retention errors.
Table 5
Stepwise Multiple Regression Comparisons of EPPS Variables with Latency for Males and Females

<table>
<thead>
<tr>
<th>EPPS Variables</th>
<th>Beta</th>
<th>F</th>
<th>R-Square^a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Autonomy</td>
<td>-.382</td>
<td>2.846</td>
<td>.355</td>
</tr>
<tr>
<td>Change</td>
<td>-.375</td>
<td>3.375</td>
<td>.512</td>
</tr>
<tr>
<td>Affiliation</td>
<td>.552</td>
<td>2.874</td>
<td>.559</td>
</tr>
<tr>
<td>Females</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Succorance</td>
<td>-.772</td>
<td>2.366</td>
<td>.156</td>
</tr>
<tr>
<td>Deference</td>
<td>.646</td>
<td>2.357</td>
<td>.293</td>
</tr>
<tr>
<td>Achievement</td>
<td>.205</td>
<td>.355</td>
<td>.332</td>
</tr>
</tbody>
</table>

Note: The SPSS program was used to enter into the equation at least those variables which were significant on the Pearson correlations. From the SPSS summary tables at least the first three EPPS variables are reported unless the F-level or Tolerance was insufficient for further computer computation.

^aR-Square is the proportion of the variance in the dependent variable accounted for by the regression equation. The dependent variable is latency.
Table 6
Stepwise Multiple Regression Comparisons of EPPS Variables
with Learning Errors for Males and Females

<table>
<thead>
<tr>
<th>EPPS Variables</th>
<th>Beta</th>
<th>F</th>
<th>R-Squarea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dominance</td>
<td>-.351</td>
<td>1.649</td>
<td>.162</td>
</tr>
<tr>
<td>Aggression</td>
<td>.414</td>
<td>3.885</td>
<td>.344</td>
</tr>
<tr>
<td>Succorance</td>
<td>.132</td>
<td>.236</td>
<td>.355</td>
</tr>
<tr>
<td>Females</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Affiliation</td>
<td>-.249</td>
<td>.950</td>
<td>.311</td>
</tr>
<tr>
<td>Autonomy</td>
<td>-.637</td>
<td>8.205**</td>
<td>.393</td>
</tr>
<tr>
<td>Succorance</td>
<td>-.094</td>
<td>.052</td>
<td>.501</td>
</tr>
<tr>
<td>Intraception</td>
<td>.513</td>
<td>2.672</td>
<td>.641</td>
</tr>
</tbody>
</table>

Note. The SPSS program was used to enter into the equation at least those variables which were significant on the Pearson correlations. From the SPSS summary tables at least the first three EPPS variables are reported unless the F-level or Tolerance was insufficient for further computer computation.

aR-Square is the proportion of the variance in the dependent variable accounted for by the regression equation. The dependent variable is learning errors.

**p < .01.
Table 7
Stepwise Multiple Regression Comparisons of EPPS Variables with Retention Errors for Males and Females

<table>
<thead>
<tr>
<th>EPPS Variables</th>
<th>Beta</th>
<th>F</th>
<th>R-Square&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deference</td>
<td>-.436</td>
<td>3.033</td>
<td>.160</td>
</tr>
<tr>
<td>Succorance</td>
<td>.283</td>
<td>.749</td>
<td>.269</td>
</tr>
<tr>
<td>Autonomy</td>
<td>.366</td>
<td>1.416</td>
<td>.295</td>
</tr>
<tr>
<td>Females</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Autonomy</td>
<td>-.345</td>
<td>2.271</td>
<td>.132</td>
</tr>
<tr>
<td>Change</td>
<td>.185</td>
<td>.653</td>
<td>.166</td>
</tr>
</tbody>
</table>

Note. The SPSS program was used to enter into the equation at least those variables which were significant on the Pearson correlations. From the SPSS summary tables at least the first three EPPS variables are reported unless the F-level or Tolerance was insufficient for further computer computation.

<sup>a</sup>R-Square is the proportion of the variance in the dependent variable accounted for by the regression equation. The dependent variable is retention errors.
Table 8

Stepwise Multiple Regression Comparisons of EPPS Variables with Zeigarnik Estimators for Learning for Males and Females

<table>
<thead>
<tr>
<th>EPPS Variables</th>
<th>Beta</th>
<th>F</th>
<th>R-Square&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Males</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heterosexuality</td>
<td>.100</td>
<td>.075</td>
<td>.354</td>
</tr>
<tr>
<td>Achievement</td>
<td>-.357</td>
<td>.960</td>
<td>.420</td>
</tr>
<tr>
<td>Exhibition</td>
<td>.417</td>
<td>1.420</td>
<td>.496</td>
</tr>
<tr>
<td>Dominance</td>
<td>-.896</td>
<td>3.037</td>
<td>.553</td>
</tr>
<tr>
<td><strong>Females</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Autonomy</td>
<td>-.540</td>
<td>7.187*</td>
<td>.212</td>
</tr>
<tr>
<td>Affiliation</td>
<td>-.342</td>
<td>2.159</td>
<td>.388</td>
</tr>
<tr>
<td>Endurance</td>
<td>.167</td>
<td>.531</td>
<td>.409</td>
</tr>
</tbody>
</table>

Note. The SPSS program was used to enter into the equation at least those variables which were significant on the Pearson correlations. From the SPSS summary tables at least the first three EPPS variables are reported unless the F-level or Tolerance was insufficient for further computer computation.

<sup>a</sup>R-Square is the proportion of the variance in the dependent variable accounted for by the regression equation. The dependent variable is Zeigarnik estimators for learning.

*<sup>p</sup> < .05.
Table 9
Stepwise Multiple Regression Comparisons of EPPS Variables with Zeigarnik Estimators for Retention for Males and Females

<table>
<thead>
<tr>
<th>EPPS Variables</th>
<th>Beta</th>
<th>F</th>
<th>R-Square^a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Affiliation</td>
<td>.764</td>
<td>3.975</td>
<td>.280</td>
</tr>
<tr>
<td>Autonomy</td>
<td>.365</td>
<td>1.652</td>
<td>.315</td>
</tr>
<tr>
<td>Achievement</td>
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<td>.991</td>
<td>.354</td>
</tr>
<tr>
<td>Females</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Autonomy</td>
<td>-.425</td>
<td>3.562</td>
<td>.253</td>
</tr>
<tr>
<td>Affiliation</td>
<td>-.403</td>
<td>3.862</td>
<td>.375</td>
</tr>
<tr>
<td>Intraception</td>
<td>-.248</td>
<td>1.034</td>
<td>.438</td>
</tr>
</tbody>
</table>

Note. The SPSS program was used to enter into the equation at least those variables which were significant on the Pearson correlations. From the SPSS summary tables at least the first three EPPS variables are reported unless the F-level or Tolerance was insufficient for further computer computation.

^aR-Square is the proportion of the variance in the dependent variable accounted for by the regression equation. The dependent variable is the Zeigarnik estimators for retention.
Table 10
Stepwise Multiple Regression Comparisons of EPPS Variables with Zeigarnik Estimators for Both Learning and Retention for Males and Females

<table>
<thead>
<tr>
<th>EPPS Variables</th>
<th>Beta</th>
<th>F</th>
<th>R-Square&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Males</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Affiliation</td>
<td>.697</td>
<td>5.127*</td>
<td>.241</td>
</tr>
<tr>
<td>Heterosexuality</td>
<td>.456</td>
<td>4.769*</td>
<td>.427</td>
</tr>
<tr>
<td>Achievement</td>
<td>-.292</td>
<td>1.369</td>
<td>.453</td>
</tr>
<tr>
<td><strong>Females</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Autonomy</td>
<td>-.574</td>
<td>8.410**</td>
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<td>Affiliation</td>
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<tr>
<td>Heterosexuality</td>
<td>.138</td>
<td>.486</td>
<td>.492</td>
</tr>
</tbody>
</table>

Note. The SPSS program was used to enter into the equation at least those variables which were significant on the Pearson correlations. From the SPSS summary tables at least the first three EPPS variables are reported unless the F-level or Tolerance was insufficient for further computer computation.

<sup>a</sup>R-Square is the proportion of the variance in the dependent variable accounted for by the regression equation. The dependent variable is Zeigarnik estimators for both learning and retention.

*<sub>p</sub> < .01.

**<sub>p</sub> < .05.
For males, the consistent negative correlations between Achievement need and all of the Zeigarnik estimators should be noted in Tables 8, 9, and 10. It appears that high achieving males are less likely to remember errors in a recall test (Zeigarnik effect) which were made during either learning or retention. The consistent negative correlations between Zeigarnik estimators and both Autonomy and Affiliation must be noted in Tables 8, 9, and 10. That is, females with very high Autonomy and Affiliation needs are not likely to exhibit the Zeigarnik effect. It is clear that the higher they are in either Autonomy or Affiliation, the less likely they are to remember errors made during either learning or retention.
DISCUSSION

The results summarized in Tables B and D (Appendix A) suggest that providing learners with true feedback immediately following responses of multiple-choice questions will enhance both learning and retention. The data reported in Figure 1 suggest that the control and TF groups were very similar in their performance during learning. The factor which contributed most to the significant main effects for feedback in learning was the consistently higher number of errors made by the FF group. During retention, a pattern clearly favoring the use of true feedback emerged. Learners receiving true feedback made fewer errors within each block of programmed text frames.

Learners receiving no feedback made fewer errors during retention than those who received false feedback on six out of the 30 frames. These results suggest that providing false information has deleterious effects upon both learning acquisition and short term retention. Several subjects indicated that they had little confidence in the feedback provided on some of the responses. False feedback appeared to place these subjects into a state of cognitive dissonance (Festinger, 1957). That is, subjects believed that the answer they chose was correct according to the material presented in the frame but the feedback which they received indicated a wrong answer was given. As a result, dissonance for that response was increased. Cognitive dissonance purportedly creates a state of conflict.
when beliefs or assumptions are contradicted by new information. Dissonance theory holds that the conflict produces feelings of discomfort which the individual seeks to relieve by reconciling the differences or by convincing himself that they do not exist. This situation may have contributed to the longer latencies in completing the programmed text for FF as compared to TF subjects. That is, FF subjects probably spent more time rereading frames trying to resolve the dissonant information with which they were confronted.

Another comment made by a learner during the retention test may shed some light on the problem. The student had been exposed to false feedback. He asked the proctor if he should give, on the retention test, those answers which he felt were correct or those which appeared as feedback in the programmed text booklet. He was not confident in the previous feedback. The directions for the retention test with both feedback groups clearly stated the following: "Give the answer you think is correct regardless of previous feedback on the frames." The subject was given the directions and told to do his best. Whether or not some subjects in the FF group gave the false answers reported in the text while actually believing another answer was more appropriate cannot be determined, but seems unlikely. The possibility of winning up to $75 appeared sufficiently motivating to encourage each student to perform at his best and further prompted several students to inquire about the feedback they were receiving.

Theoretically, it is difficult to attribute the feedback effects to either their reinforcement or informational aspects. Annett (1969) reported a number of interesting studies which supported
the informational interpretation of feedback. Wallach and Henle (1941), for example, used a traditional Thorndike learning task with "right" and "wrong" feedback following each response. However, learners were informed that they were participating in an ESP experiment rather than a learning task. Under these instructions, no permanent connection between a given stimulus and specific response was implied. Results showed the frequency of "rewarded" responses did not increase. George (1972) showed that information provided to learners about the frequency of correct responses exerted a facilitating influence on learning whereas information about the frequency of response reinforcement exerted an inhibitory influence. In the present paradigm, there was an increase in the responses receiving feedback for both feedback groups. The reinforcement theorist could argue that the FF group made more errors on both learning and retention simply because subjects in it were reinforced for making incorrect responses. While this position may be theoretically valid, it does not explain the disparity in latencies between the TF and FF groups. The latter group took significantly longer to complete the programmed text for both males and females. This cannot be interpreted as a function of the reinforcement provided. Rather it seems likely that there was not a concomitant reduction of uncertainty, which information implies, for the FF group. The research on programmed instruction clearly suggests that providing feedback increases program completion time (O'Day et al., 1971; Annet, 1969, Strang & Rust, 1973). One possible interpretation for the latency differences is that the FF group did not find all of their feedback
reinforcing. As a result, cognitive dissonance created by the conflicting information which false feedback conveyed may have caused these subjects to spend longer amounts of time looking over the questions. Table 1 reveals that false feedback increases programmed text completion time. It also shows that females in each treatment group took longer than males to complete the text. This is especially true for females in the FF group. An important point here is that subjects given true feedback had about the same average latencies as the no feedback controls. It should also be kept in mind that subjects in both feedback groups were instructed to respond to questions on each frame until they had found the correct answer.

The issue of reinforcement vs. information in feedback effects may be viewed in another way. The impact of feedback on correct and incorrect responses raises questions for both reinforcement and informational interpretations of feedback. Kaess and Zeaman (1960) and Elley (1965) found that the more negative knowledge a group receives, the more errors it makes. Guthrie (1971) found that feedback corrects wrong responses but does not strengthen correct responses. Interestingly, Melching (1966) found that subjects requested feedback on 28% of the frames on which errors occurred, whereas the error rate on frames on which no feedback was requested was only 4%. This suggests that subjects may attend more closely to feedback when it follows an error than when it follows a correct response. In this study a significant difference was observed between feedback groups in the number of initially failed frames (during learning) which were correct later during retention. The means for the control,
true feedback, and false feedback groups were 1.24, 4.63, and 5.70 respectively. It seems clear that feedback is instrumental in correcting errors. The false feedback group has the highest mean. Perhaps this is best explained by the fact that they made significantly more errors during the learning sequence. Without feedback the errors made by controls persisted during retention. The analysis of variance for frames initially correct and later failed (see Table E of Appendix A) yielded no significant differences. Since reinforcement implies an increase in the probability of a given response to a specific stimulus, the differential effects of feedback for incorrect and correct frames during learning are difficult to explain in terms of a reinforcement theory. One possible explanation is that feedback following incorrect responses provides more information and a greater reduction of uncertainty. The results obtained in the present study are in agreement with those obtained by Guthrie (1971), Rivera-Medina (1972), and Kulhavy and Parsons (1972). The conclusion is that learning error perseveration occurs because the learner cannot obtain correct information during learning.

Does feedback have a positive impact upon learning and retention? The data presented in this study suggest that it does. How then can those studies be explained wherein no significant feedback effects were observed? A careful analysis of the literature for and against feedback effects revealed studies using constructed response programs, multiple-choice formats, test and nontest situations. Moore and Smith (1964) found that type of reinforcement, mode of presentation, and mode of responding did not significantly affect
results on programmed instruction. A plausible interpretation for the lack of significant results in numerous feedback studies (i.e., Lublin, 1965; Strang & Rust, 1973; Devlin, 1972; McMahon, 1973; etc.) has been suggested by Geis, Jacobs et al. (1970). Using a variety of programmed materials, these authors showed that students looked at available answers in the program far less than 100% of the time. Some subjects almost never check available answers while others check them only on occasion. In short, there is no guarantee that any information placed in the answer section of a programmed text will be read by the student.

Interestingly, in those studies which observed significant effects for feedback in programmed instruction (i.e., Anderson, Kulhavy, & Andre, 1971; 1972), controls were introduced for this problem. In these studies subjects were exposed to computer controlled instructional systems which required a response before feedback was presented. Similar controls were operating in the present study. Subjects in both feedback conditions were forced to shade in the answer blocks of the chemically treated answer sheet. Only after the block was shaded with the crayon did a number appear indicating whether or not that response was correct. None of the answer sheets used by feedback subjects revealed empty blocks on any question. It seems, therefore, that subjects answered all questions prior to obtaining feedback. They couldn't obtain it without first responding, and they had to see the feedback when a response was made.

It appears that providing feedback is effective only if the learner reads the frames, makes a response, and then reads the
feedback provided. The latter two were accounted for in the present study. Whether or not there were differences between treatment groups on reading the programmed text frames is not certain. The frames used in this study were sometimes long. One female subject did mention that she had not read all of the frames, but rather read the questions first and then looked through the frames for the answer. Her results were subsequently discarded from the study. In any event, it is unlikely that differences in reading the frames alone accounted for the sex and feedback differences observed here.

The presence of sex differences is best exemplified by Figure 2. Males in all three groups have lower mean errors on both learning and retention. These results are quite similar to those obtained by Marx, Witter, and Mueller (1972) where male superiority in multiple-choice learning was also observed. As in this study, Marx et al. found that female students were slower learners. They also observed a significant interaction between sex of the subject, social condition (whether subject worked in a group or alone), and tests. They found social females (those working in groups) performed least well. In the present study there were no significant interaction effects for latency, learning errors, or retention errors. There was, however, a significant interaction between sex of the subject and type of feedback given on recall accuracy (Figure 3). These data suggest that false feedback may have affected the performance of females adversely while not impairing that of males. That is, female controls had higher recall accuracy than males while males and females in the TF group performed similarly. Under false feedback, the female recall
accuracy declined markedly below all other groups while males experiencing false feedback actually had a higher rate of recall than those in either the control or TF groups. Perhaps the females became frustrated and/or more anxious in the face of dissonant feedback. Siddiqi, Fucks, and Voss (1970) verified that females in contrast to males of the same age, show a high tendency toward cognitive dissonance. Palmer (1972) has shown that there are marked differences between males and females regarding accepted reactions to frustrations. When age is disregarded, the principle difference appears to be that boys are generally more accepting of externalized or overt reactions to frustration. One female indicated on her recall sheet that the test was the most frustrating she had ever taken. Comments by several other females in the false feedback group suggested they thought the test was "hard." The fact that no significant main effects were found for recall accuracy is probably caused by the fact that recognition tests used for learning and retention frames did not measure the same thing as the recall test. The traditional explanation suggests that answering a recall test requires higher levels of learning than answering a recognition test. In order to answer a recall item, a learner must construct a response while the response is provided for him in a recognition item (Anderson, 1972). Perhaps students receiving feedback were simply concentrating on the answers to the multiple-choice questions rather than comprehending the frames themselves.

It is interesting to note that Simon and Feather (1973) found that females rated both luck and task difficulty (external factors) as possible explanations for their poor exam performance more so than
males. Perhaps females are more likely than males to view their fate as being determined by external factors. Locus of control research (Rotter, 1966) has made the distinction between internal and external control. It has shown that learning acquisition varies with this locus of control. A learner may perceive a causal relationship between his own behavior and the reward (internal control). External control exists when a reinforcement is perceived by the learner as following one of his own actions but is not entirely contingent upon that action. In the present study, it is likely that some subjects in the FF group may have perceived the reinforcement on as many as six of the frames (those which provided false feedback) as the result of luck or fate. In short, they may have perceived feedback as due to external factors on some of the frames on which they received feedback.

The effect of a reinforcement following some behavior on the part of a human subject depends upon whether or not the learner perceives a causal relationship between his own action and the reward. Learners differ in the degree to which they attribute reinforcement to their own actions. This is especially dependent upon a learner's history of reinforcement.

Interestingly, Rotter (1966) reports that people who are high in need for achievement are likely to believe in their own ability or skill to determine the outcome of their efforts. A belief in external controls is also likely to serve as a defensive reaction enabling learners to preserve their self-esteem in the face of failure. Rotter (1966) also cites evidence that suggests that experimenter control is quite similar to chance controls. The data
suggest that "tasks with chance instructions produce the same kinds of differences between 100% and 50% partial reinforcement in extinction rates as do typical experimenter control experiments" (p. 9). With that as background, it seems unlikely that learner perceptions of locus of control could have accounted for the differences observed between treatment groups in this study. Some of the dynamics of the locus of control concept could be better understood through additional false feedback experimentation.

Several possible causal interpretations for the observed sex differences can be made. First, male superiority on both learning and retention may be reflective of their greater familiarity and/or lesser antipathy toward the scientific nature of the programmed text. Marx et al. (1972) reported superior male performance in repeating correct responses with the use of non-scientific learning materials. Nagel (1970) found males to be superior in achievement on a computer assisted instruction (CAI) program on mathematics. Reid et al. (1973), however, failed to show significant sex differences in a (CAI) course on mathematics, although males did perform better than females. Results in the present study support those of Tyler (1956) who found male superiority in science oriented material. Females have been shown to outperform males in both verbal fluency and rote memory (Todd & Kesslar, 1971; Hobson, 1947; Duggan, 1950; Tyler, 1956). The superiority of females, compared to males, in a free recall of objects (Yavuz, 1971) was found using Turkish students and seems in part explained by differences in cultural sex roles and interests. Second, social expectation and cultural role may have con-
tributed to the observed sex differences. Simon and Feather (1973), for example, suggested that females are expected to appear more dependent and less assertive than males. Weiss (1961) found tendencies for females to distort their performance on an achievement task in order to appear inferior to males who had originally performed less well than they. Wyer and Malinowski (1972) suggested that females and males attempt to maintain the traditional social role expectancies of submissiveness and dominance respectively. Testing a hypothesis that women possess a motive to avoid success, Horner (1969) showed that females, compared to males, fear rejection after a success, worry about the definition of their success, and may actually distort the success. Such findings, however, have occurred in situations where males and females were interacting together. In the present study, each student worked alone at an individual study carrel in the library. The only possible interaction influence may have come during learning when some of the females may have viewed male subjects finishing the program more quickly. It is unlikely, however, that such an influence would have created a fear of success in the female sample.

Third, there may have been initial differences between sexes regarding their confidence levels. Simon and Feather (1973) found that males gave higher ratings of their academic ability prior to an examination than did females. Without the benefit of confidence measures for males and females in this study, however, additional speculation on the contribution of this variable to the observed differences is fruitless.
Fourth, males and females may have differing reactions and attitudes toward programmed instruction per se. Scherman and Scherman (1973) found that males had particularly positive attitudes toward programmed instruction compared to females. Attitudes were measured by a questionnaire. Females reportedly found this form of instruction neither interesting nor stimulating. Again, without any valid measures on attitudes toward programmed instruction in this study, such effects are difficult to assess.

Fifth, French and Lesser (1964) have suggested that females would respond to arousal cues with heightened achievement motivation scores and higher motivation performance only when these cues were related to a goal that was relevant to females. Perhaps, as was suggested in regard to cultural roles, learning the structure and function of the human eye was not perceived as a relevant goal by the females.

A sixth possible explanation of the sex differences relates to the role of greater anxiety and dissatisfaction with failure generally experienced by females in programmed instruction (Campeau, 1965; Devi, 1969; Koenig, 1973; Marx et al., 1972; Simon & Feather, 1973; O'Neil, 1972). These data suggest that there is an interaction between feedback and anxiety for females during both immediate and delayed retention. No such interaction appears to exist for males. This view is supported, in part, by the results observed on recall accuracy which revealed an interaction of feedback and sex. McMahon (1973) and Strang and Rust (1973) found that test anxiety was higher for those subjects given detailed knowledge of results. Unfortunately,
no sex comparisons were made. Walsh (1969) showed sex differences in the relationships between achievement anxiety scales and psychological needs as measured by the EPPS. Lin and McKeachie (1971), however, failed to replicate this finding. Suchett-Kaye (1972) reports that the relationship between anxiety and performance is curvilinear and appears to be increasingly detrimental with increasing age. He further suggests that programs requiring constant feedback or which induce high ego involvement are more likely to result in test anxiety being a significant factor in performance. It is conceivable, therefore, that any predisposition toward anxiety the females in this study may have had was heightened by the introduction of false feedback which, in turn, adversely affected performance.

Lastly, the use of a lottery styled incentive may have created a volunteer effect. The volunteers in this study showed significant differences favoring males with regard to age, number of years of education, and achievement need. The greater achievement need and college experience may have accustomed the males in the sample (N = 19) to better answer multiple-choice questions and respond more quickly. The age factor may simply have permitted the males to draw from their greater years of general academic experience. Conroy (1971) found that older students showed greatest achievement gains in programmed instruction. Although, as Suchett-Kaye (1972) suggested, anxiety coupled with feedback can be increasingly detrimental with advancing age. In view of the present findings, differences between males and females on programmed instruction appear to exist. Such differences must be considered in future research. Such variables as
age, years of education, attitudes toward programmed instruction, confidence levels, anxiety, attitudes toward subject matter, reactions to frustration, and goal orientation must be considered when making inferences about male and female performance on programmed instruction.

The lack of any observed Zeigarnik effect (either for sex, feedback, or the interaction) needs some explanation. Zeigarnik estimators were calculated for both learning and retention frames and then combined. The purpose was to test whether the Zeigarnik effect was due to learning or retention or both. Caron and Wallach (1957) suggested that recall of interrupted tasks under stress is due to selective learning rather than selective retention. They did not, however, use programmed instruction as their stimulus material. The present results fail to substantiate those of Caron and Wallach.

One possible explanation for the lack of Zeigarnik effect lies in the nature of the program itself. Learners in all treatment groups were encouraged to take as much time as they wished on each frame. This permitted them to reread portions of a frame more than once, especially in those cases where feedback had indicated they were wrong. The fact that the program was self instructional, however, combined with the freedom to reread frames, made the error rate quite low. During learning, 27 subjects made three or fewer errors. During retention, 17 subjects made four or fewer errors. Given the fact that subjects were only asked to recall six of the 30 frames they learned, the lower error rates for many subjects may have reduced the potential Zeigarnik effect variance to insignificant levels. Yet there were significant differences between sexes and
the treatment groups on errors and latencies. The ANOVA results (See Tables G, H, and I in Appendix A) reveal that the Zeigarnik effects for learning, retention, and the combination are insignificant throughout.

A number of researchers have tested the link between Zeigarnik effects and achievement need (Atkinson, 1953; Herbert & Sassenrath, 1973; Lublin, 1965; Raffini & Rosemier, 1972; Weiner, Johnson, & Mehrabian, 1968). The results are equivocal. Some have demonstrated a strong positive association between them (Atkinson, 1953; Weiner et al., 1968) while the others have observed no significant relationship. In the present study, when the Zeigarnik estimators for both learning and retention were combined a significant negative correlation ($-.452, p = .05$) with Achievement emerged for males. No significant correlation for Achievement on any variable tested appears for females. For males, such a negative correlation suggests that, as Achievement needs go up, the tendency to recall incorrect responses (Zeigarnik effect) decreases. Such results are opposite to what is expected based upon previous research (i.e., Raffini & Rosemier, 1972; Atkinson, 1953; Weiner & Mehrabian, 1968). Such findings are best explained in light of the results of Rosenzweig (1943). Rosenzweig found that when subjects thought they were taking an IQ test as opposed to helping design a puzzle, there was a greater tendency to recall successes rather than failures. He suggests that subjects determine whether the task is threatening or ego involved and react accordingly. Subjects in the present study filled out a form indicating their names and addresses. This infor-
mation was used in paying the winners in the experiment. As such, the usual anonymity for this type of research was not present. It can further be proposed that since many of the students knew each other, there was a degree of ego involvement for all learners in competing for the prizes. Under these circumstances, it is quite likely that those highest in Achievement were least likely to recall those frames which they got incorrect during the learning phase. Hence, we have the high negative correlation (-.452, p = .05) between Achievement scores and Zeigarnik effect for both learning and retention frames in males with a lower yet negative correlation (-.06, p = .78) for females.

Prentice's review (1944) does show that 11 factors have some impact upon the Zeigarnik effect including age of subject, time spent on tasks, personality of subject, attitude of subjects, etc. Obviously, all of these factors were present in this study. Given the factors cited by Prentice and the lack of feedback effects on the Zeigarnik effect observed in this study, the use of the number of incorrect questions recalled in programmed instruction as a measure of the Zeigarnik effect must be questioned. Recall for interrupted tasks and incorrect questions may involve two distinct memory processes. As Prentice has suggested, there is always the knotty problem of defining what constitutes a failure for each subject. In addition, using the number of incorrect questions as a Zeigarnik estimator can be greatly distorted by such factors as item difficulty and permitting subjects unlimited time to complete each frame. Unless there is an appropriate balance between correct and incorrect responses, the
variance of the latter will be masked by the former. Until adequate controls can be developed for all of the factors reported by Prentice, the use of the number or proportion of incorrect questions recalled as a measure of the Zeigarnik effect must be questioned.

The EPPS was used in this study to help determine whether personality characteristics have a bearing on an individual's success in programmed instruction. Personality factors do affect performance on programmed instruction. In addition, the significant differences between males and females regarding personality factors seem to further compound the issue. Regarding latency, males who have a high need to experiment and try new things (as measured by the Change factor) actually take less time in completing the programmed text. The personality traits which contribute to females who take longer to complete the programmed text is not clear.

For females, significant correlations exist between learning errors and Exhibition (−.437), Abasement (.475), and Endurance (.521). For Exhibition scores, it appears that females who tend to make few learning errors have a greater need to talk about personal achievements, or to say clever and witty things. Interestingly, females with high Endurance scores also tend to make high errors. It appears that those females who have high needs to complete any job undertaken or to avoid being interrupted while at work make more errors on the programmed text. Perhaps the reading of frames followed by questions containing feedback has a disruptive influence on females who prefer to work at a job without any distractions. Also, females who have a greater tendency toward feeling guilty when something is wrong or
willingly accept blame for wrongdoing (as measured by the Abasement factor) will make more errors while learning programmed text material. It is likely that the performance of female subjects was worsened by their Abasement needs which made them feel depressed by their inability to handle the situation. For males, the lack of significant correlations between EPPS needs and learning errors suggest that the interaction of personality and feedback appears to have little deleterious effect upon their acquisition of programmed text material.

The data from Table 3 reveal a high negative correlation between age and Abasement scores for males. Abasement, according to the EPPS manual, suggests a need to confess errors and feel depressed by an inability to handle situations. As such the correlational data presented in Tables 3 and 4 suggest that males show a significant decrease in Abasement as they grow older. Females show similar but less significant tendencies. Future research on the Zeigarnik effect must take this age-Abasement interrelationship into account. Especially if older learners are less likely to "confess errors" than younger ones. Although confessing errors and recalling errors are quite similar, they may involve quite different processes.

It is also interesting to note the relatively high negative relationship (\(-.378, p = .07\)) between Achievement and age for females. As females grow older perhaps they have a reduced need for achievement. The opposite trend appears true for males who show a .266 correlation between age and Achievement. Obviously, such opposing trends could, if not properly controlled in studies comparing Achievement and the Zeigarnik effect, mask any true relationships that may emerge.
It seems also worth noting that Achievement correlates negatively with education for females (-.271) while, at the same time, positively with education for males (.346). Numerous explanations can be advanced to explain these events but it seems clear that the EPPS Achievement measure means different things for males and females as far as education and age are concerned. The EPPS manual describes the Autonomy factor (see Appendix C) as a need to feel free to do what one wants, and to do things that are unconventional. It connotes a need to avoid situations where one is expected to conform. Tables 6 and 7 show that for females there is a high negative correlation between Autonomy scores and both learning and retention errors (-.637 and -.345 respectively). The opposite seems true for males. That is, males show a high positive correlation (.336) between retention errors and Autonomy. Interestingly, Lublin (1965) found that low Autonomy subjects outperformed those with high Autonomy needs. Results of this study suggest support for Lublin's findings for males but not females. It appears that females in this study with high Autonomy scores made fewer learning and retention errors. Lublin did not test for sex differences so no retrospective comparisons for the sex factor can be made.

Blitz and Smith (1973) sampled dentists and compared EPPS variables with programmed instruction. They found that the more deferent learners do well on programmed text materials. Results in this study generally support those of Blitz and Smith. They show negative correlations for Deference and learning errors and retention errors. In short, the higher the Deference score the lower the errors.
Further results of Blitz and Smith (1973) showed that subjects with high Endurance performed better on programmed instruction. The present study has shown a significant positive correlation (.521) between Endurance and learning errors in females. It seems that females with high Endurance make more errors during learning. Blitz and Smith also found that Aggression and exam performance correlated negatively for programmed text learning. Results in the present study support this finding. Table 3 reveals that for males, positive correlations exist between Aggression and both learning errors (.393) and retention errors (.139) suggesting that aggressive male learners make more errors. Interestingly, the opposite trend exists for females. Highly aggressive females make fewer retention errors. Since Blitz and Smith sampled dentists (most were male subjects), no sex differences were noted.

Regarding personality and performance on programmed instruction, several trends appear. Assuming a textbook with a scientifically oriented subject matter is used, one can expect the following generalizations to apply to females. Regarding program completion time, females who have a need to seek encouragement and help from others (as measured by Succorance) will take less time in finishing the text. Perhaps they find it an unpleasant task and desire to finish it quickly. Additionally, females with high needs for following instructions and praising others (Deference) and high needs for Achievement will tend to take longer to finish the text. Together Succorance, Deference, and Achievement personality needs will account for approximately 33% of the latency scores. Females high in Affilia-
tion, Autonomy, and Succorance will make fewer errors (Table 6). The relatively high negative correlation (-.249) between Affiliation (friendliness) and errors on learning is supportive of the results obtained by Haskell (1971). Even more interesting is the fact that females with high needs to observe others, to understand how others feel about problems, and to analyze the behavior of others (Intraception) will make more errors learning a programmed text. Approximately 64% of the learning errors made by females can be accounted for by Affiliation, Autonomy, Succorance, and Intraception needs.

For retention errors different personality variables are involved. Interestingly, females who enjoy being free and independent of others in making decisions (Autonomy) make fewer errors on retention. However, this variable will only help explain 13% of the retention errors.

For males, performance on a program with a scientific subject matter is related to other personality variables. Males with high needs for both Autonomy and Change (experience new things and experiment) will finish the text more quickly than others. Males with high Affiliation (friendliness) needs will take longer to finish the program. Together these three variables will help account for approximately 55% of the latency variance (see Table 5). Regarding learning errors, those who have a high need to argue their point of view and to persuade and influence others (Dominance) will make fewer errors. On the other hand, highly aggressive males will make more learning errors. Table 6 reveals that together they account for about 34% of the variance in learning errors for males. Again, these results support those of Haskell (1971). Lastly, males showing high
Deference needs appear to make fewer errors (see Table 7). Males showing high Succorance and Autonomy needs, on the other hand, make higher errors on retention. Perhaps males who prefer having others provide help when in trouble and who also prefer to come and go as desired are hampered by the programmed text format and thus retain less information presented in the text.

A word of caution should be issued in drawing conclusions from these correlational data. From the multiple regression Tables 5-10 it is clear that, while at times a high percentage of the variance can be explained by personality needs, a high percentage cannot be so explained. While, in general, the results obtained in this study agree with those found by other researchers using the EPPS, the question of validity remains. Reviews in the seventh Mental Measurements Yearbook (Buros, 1972) noted the paucity of validity evidence supporting the EPPS. In short, whether the EPPS measures all of what it purports to measure remains a question. The EPPS has been widely used in research settings. Perhaps its greatest support comes from the fact that there is even less data existent to suggest that it does not measure what it purports to measure. Lastly, the fact that departures from linearity can distort any correlational results must be kept in mind. Plots of the personality data suggest that this requirement was fulfilled, but the extent to which curvilinearity existed in those studies cited is difficult to assess.
SUMMARY

The premise of the study was that feedback provided to the learner would enhance learning and retention of programmed text materials. It was further assumed that the beneficial effects of feedback could more appropriately be explained in terms of the information it conveys rather than the reinforcement it provides. The results lend support to both of these propositions. Results showed that feedback following errors reduced the probability of recurrence of those errors. They also revealed significant sex differences showing that males make fewer errors on both learning and retention. Feedback following correct responses did not seem to increase the likelihood that a given response would be correct on a subsequent trial. The data further suggest that subjects receiving false feedback take significantly longer than those receiving either true or no feedback. Learners who received false feedback had the longest latencies in completing the text. Learners receiving true feedback took about as long as those obtaining no feedback. Females in all groups took longer to complete the program than males although the differences were not statistically significant. Together the results on latencies and feedback following errors lend support to Annett's (1969) theory favoring the informational interpretation of feedback effects.

Following the learning phase, each subject was asked to make six free choice recall responses which were associated with principles
or facts discussed in any of the frames. The measure was used to
gauge recall accuracy as well as the presence of the Zeigarnik effect.
Independent raters judged these responses for frame association and
accuracy (the reliabilities were .969, p < .001, and .706, p < .001
respectively). The data revealed no significant differences for
either sex or feedback on recall accuracy. The interaction, however,
was significant suggesting that females were more adversely affected
by false feedback than males.

The hypothesis that false feedback would cause subjects to
subsequently exhibit the Zeigarnik effect was not confirmed. Three
separate analyses of variance failed to show any differences in main
effects for sex or feedback. Furthermore, the suggestion that the
Zeigarnik effect was a learning rather than a retention phenomenon
(Caron & Wallach, 1957) was not confirmed. Contrary to the research
of others (i.e., Atkinson, 1953) the present study found high nega-
tive correlations between Achievement needs, as measured by EPPS,
and the Zeigarnik effect. The results of Rosenzweig (1943), suggest-
ing that ego involved subjects more often recall successes rather
than failures, were used in explaining the present findings.

Lastly, the hypothesis that personality factors have a differ-
ential effect on latency, learning, and retention as well as the
Zeigarnik effect was confirmed. The most striking result was the
difference between male and female personality needs which were
associated with the above dependent variables. For males, significant
negative correlations exist between latency and both Change and Auton-
omy. Males with high Dominance needs and low Aggression needs make
fewer learning errors. For males, a high negative correlation also exists between Deference scores and retention errors. For females, on the other hand, a high negative relationship between Succorance and latency appears to exist. For learning errors a significant negative relationship with Exhibition, and significant positive relationship with both Abasement and Endurance were observed for females. Finally, females with high Autonomy needs and low Change needs made fewer retention errors. Differences between males and females in regard to age, education, anxiety, cultural role expectations, reactions to frustration, and implications for future research were also discussed.
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APPENDIX A

ANOVA Results

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TABLE A

Summary of Analysis of Variance for a Sex X Feedback Groups Factorial Design on Program Completion Latency

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sums of Squares</th>
<th>Degrees of Freedom</th>
<th>Mean Squares</th>
<th>F Ratio</th>
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<tr>
<td>Sex</td>
<td>525.283</td>
<td>1</td>
<td>525.283</td>
<td>3.205</td>
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<tr>
<td>Feedback Group</td>
<td>1107.708</td>
<td>2</td>
<td>553.854</td>
<td>3.380*</td>
</tr>
<tr>
<td>Sex X Feedback Groups</td>
<td>334.32</td>
<td>2</td>
<td>167.160</td>
<td>1.020</td>
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<tr>
<td>Within Cell</td>
<td>4928.184</td>
<td>36</td>
<td>163.894</td>
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*p < .05
TABLE B
Summary of Analysis of Variance for a Sex X Feedback Groups
Factorial Design on Learning Errors

<table>
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<tr>
<th>Source of Variation</th>
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<th>Degrees of Freedom</th>
<th>Mean Squares</th>
<th>F Ratio</th>
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<tbody>
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<td>1</td>
<td>61.565</td>
<td>5.404*</td>
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<tr>
<td>Feedback Groups</td>
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<td>2</td>
<td>37.599</td>
<td>3.301*</td>
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<tr>
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<td>27.25</td>
<td>2</td>
<td>13.625</td>
<td>1.196</td>
</tr>
<tr>
<td>Within Cell</td>
<td>410.112</td>
<td>36</td>
<td>11.392</td>
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</table>

* p < .05
### TABLE C

Summary Analysis of Variance for a Sex X Feedback Groups

Factorial Design on Recall Accuracy (Number Correct)

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sums of Squares</th>
<th>Degrees of Freedom</th>
<th>Mean Squares</th>
<th>F Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>.0134</td>
<td>1</td>
<td>.0134</td>
<td>.008</td>
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<tr>
<td>Feedback Groups</td>
<td>3.8367</td>
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<td>Sex X Feedback Groups</td>
<td>20.868</td>
<td>2</td>
<td>10.434</td>
<td>6.3614**</td>
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<tr>
<td>Within Cell</td>
<td>59.05</td>
<td>36</td>
<td>1.6402</td>
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</tr>
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** p < .01
### TABLE D

Summary of Analysis of Variance for a Sex X Feedback Groups Factorial Design on Retention Errors

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sums of Squares</th>
<th>Degrees of Freedom</th>
<th>Mean Squares</th>
<th>F Ratio</th>
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</thead>
<tbody>
<tr>
<td>Sex</td>
<td>62.963</td>
<td>1</td>
<td>62.963</td>
<td>6.916 *</td>
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<tr>
<td>Feedback Groups</td>
<td>90.642</td>
<td>2</td>
<td>45.321</td>
<td>4.978 *</td>
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<tr>
<td>Sex X Feedback Groups</td>
<td>13.058</td>
<td>2</td>
<td>6.529</td>
<td>.717</td>
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<td>Within Cell</td>
<td>327.744</td>
<td>36</td>
<td>9.104</td>
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* p < .05
TABLE E
Summary Analysis of Variance for a Sex X Feedback Groups Factorial Design on Initially Failed Items Later Correct

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sums of Squares</th>
<th>Degrees of Freedom</th>
<th>Mean Squares</th>
<th>F Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>13.028</td>
<td>1</td>
<td>13.028</td>
<td>2.146</td>
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<tr>
<td>Feedback Groups</td>
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<td>2</td>
<td>23.527</td>
<td>3.874*</td>
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<tr>
<td>Sex X Feedback Groups</td>
<td>16.098</td>
<td>2</td>
<td>8.049</td>
<td>1.326</td>
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<td>Within Cell</td>
<td>218.52</td>
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<td>6.070</td>
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* p < .05
TABLE F

Summary Analysis of Variance for a Sex X Feedback Groups Factorial Design on Initially Correct Items Later Failed

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sums of Squares</th>
<th>Degrees of Freedom</th>
<th>Mean Squares</th>
<th>F Ratio</th>
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<td>Feedback Groups</td>
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<tr>
<td>Within Cell</td>
<td>252.968</td>
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TABLE G

Summary Analysis of Variance for a Sex X Feedback Groups
Factorial Design on Zeigarnik Estimators for Learning Frames

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sums of Squares</th>
<th>Degrees of Freedom</th>
<th>Mean Squares</th>
<th>F Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
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<td>1</td>
<td>2.882</td>
<td>2.782</td>
</tr>
<tr>
<td>Feedback Groups</td>
<td>1.226</td>
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<td>.613</td>
<td>.592</td>
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<td>Sex X Feedback Groups</td>
<td>.212</td>
<td>2</td>
<td>.106</td>
<td>.103</td>
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<tr>
<td>Within Cell</td>
<td>37.26</td>
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<td>1.035</td>
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### TABLE H

**Summary Analysis of Variance for a Sex X Feedback Groups Factorial Design on Zeigarnik Estimators for Retention Frames**

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sums of Squares</th>
<th>Degrees of Freedom</th>
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<th>F Ratio</th>
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<tr>
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<tr>
<td>Feedback Groups</td>
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<td>.369</td>
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<td>3.112</td>
<td>2</td>
<td>1.556</td>
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<td>Within Cell</td>
<td>59.544</td>
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<td>1.654</td>
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TABLE I

Summary Analysis of Variance for a Sex X Feedback Groups Factorial Design on Zeigarnik Estimators for both Learning and Retention Frames

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sums of Squares</th>
<th>Degrees of Freedom</th>
<th>Mean Squares</th>
<th>F Ratio</th>
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</thead>
<tbody>
<tr>
<td>Sex</td>
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<td>1</td>
<td>1.099</td>
<td>.280</td>
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<tr>
<td>Feedback Groups</td>
<td>2.196</td>
<td>2</td>
<td>1.098</td>
<td>.279</td>
</tr>
<tr>
<td>Sex X Feedback Groups</td>
<td>1.784</td>
<td>2</td>
<td>.892</td>
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</tr>
<tr>
<td>Within Cell</td>
<td>141.3</td>
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<td>3.925</td>
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Table J

Multivariate Tests of Significance

Using Wilks Lambda Criterion

<table>
<thead>
<tr>
<th>Test of</th>
<th>Roots</th>
<th>F</th>
<th>DF Hyp.</th>
<th>DF Error</th>
<th>P</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>1 through 1</td>
<td>2.613</td>
<td>7.000</td>
<td>30.000</td>
<td>.031</td>
<td>.615</td>
</tr>
<tr>
<td>Feedback</td>
<td>1 through 2</td>
<td>3.015</td>
<td>14.000</td>
<td>60.000</td>
<td>.001</td>
<td>.669</td>
</tr>
<tr>
<td></td>
<td>2 through 2</td>
<td>3.071</td>
<td>6.000</td>
<td>30.500</td>
<td>.018</td>
<td>.614</td>
</tr>
<tr>
<td>Interaction of Sex and</td>
<td>1 through 1</td>
<td>1.138</td>
<td>14.000</td>
<td>60.000</td>
<td>.346</td>
<td>.471</td>
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<tr>
<td>Feedback</td>
<td>2 through 2</td>
<td>1.249</td>
<td>6.000</td>
<td>30.500</td>
<td>.310</td>
<td>.441</td>
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Note. These data were calculated using the MANOVA Computer Package. Only seven of the nine dependent variables were used in the calculations. The subjective determination of recall accuracy and high intercorrelation of the Zeigarnik Both measure with Zeigarnik learning and Zeigarnik retention measures mitigated against including these two variables in the analysis.
APPENDIX B

The Programmed Text

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Instructions and Sample Frames</td>
<td>104</td>
</tr>
<tr>
<td>II. Programmed Text</td>
<td>110</td>
</tr>
<tr>
<td>III. Post Test Recall</td>
<td>119</td>
</tr>
<tr>
<td>IV. Retention Test</td>
<td>120</td>
</tr>
</tbody>
</table>
INSTRUCTIONS

This is a programmed textbook about the structure and function of the human eye. The text material is presented by paragraph, in small steps. At the end of each paragraph you will find a multiple-choice question about the information contained in the paragraph. The paragraph of text plus the test question is referred to as a frame. In working through the book you will take the following steps:

1. Read the paragraph of text material;

2. Read the question and alternate answers of the test item;

3. Choose the answer you believe to be correct (either A, B, or C) and circle it on the answer sheet.

4. Continue on to the next frame until all 30 are completed.

There is only one correct answer for each question. You may re-examine the test material as much as you like before answering the question but choose only one of the three possible answers for each question. There is no time limit in completing the text.

During your reading you will be referred to another booklet labeled "Figures" which are useful in understanding the text. You may refer to these figures as often as you wish, but do not advance to a new figure until told to do so by the text.

The first frame is a sample to help you become familiar with the format of the book. Work through it. If you do not understand how to work through the program, raise your hand and the proctor will help you.

When you have completed the entire booklet, return it to the proctor.

YOU MAY TURN THE PAGE AND BEGIN
This is a sample frame. The remainder of this book is identical in format to this frame. When you finish reading this paragraph, you may answer the question below. Choose the answer you find most correct.

The psychologist who developed the first IQ test was:

(a) Binet
(b) Truman
(c) Webster

On the answer sheet provided simply circle the choice you feel is correct.
This is a programmed textbook about the structure and function of the human eye. The text material is presented paragraph by paragraph in small steps. At the end of each paragraph you will find a multiple-choice question about the information contained in the paragraph. The paragraph of text plus the test question is referred to as a frame.

In working through the text you should:

1. Read the paragraph of text material.

2. Read the question and alternate answers of the test item.

3. Choose the answer you believe to be correct, and mark it on the answer sheet using the special action/mark crayon.

Each question will have three possible answers identified as (a), (b), or (c). On the answer sheet provided, notice that there are two pages, the first is numbered from 1-24 and the second sheet from 25-30. To respond to the question on a given frame simply decide whether choice (a), (b), or (c) is correct and crayon in that portion of the answer sheet. At this point, a number (either 1, 2, or 3) will appear in the answer block. If you have chosen the correct answer the number 3 will appear for 1-24. The correct answer for frames 25-30 is 2. An incorrect response is indicated if either a 1 or 2 appears for frames 1-24 or a 1 or a 3 appears for frames 25-30.

On any given frame you may choose one, two, or all three of the answers before you choose the correct one. KEEP CHOOSING UNTIL YOU DO FIND THE ONE RIGHT ANSWER FOR THAT FRAME. Stop shading answer blocks once you have obtained the correct response for each question. You may re-examine a text paragraph as much as you like before answering the question. There is no time limit for completing the text.

During your reading you will be referred to another booklet labeled "Figures". These figures are drawings or illustrations which are useful in understanding the text. You may refer to these figures as often as you wish, but do not advance to a new figure until told to do so by the text.

The first frame is a sample to help you become familiar with the format of the book. Work through it. If you do not understand how to work through the program raise your hand and ask the proctor to help you.

When you have completed the entire booklet, return it to the proctor.

YOU MAY TURN THE PAGE AND BEGIN
This is a sample frame. The remainder of this book is identical in format to this frame. When you finish reading this paragraph, you may answer the question below. Choose the answer which you find most correct.

The psychologist who developed the first IQ test was:

(a) Binet
(b) Truman
(c) Webster

Use the special crayon and shade in one of the answer blocks (a, b, or c). In the above example, the correct answer is Binet and a 3 should appear in box a. Remember a 3 indicates a correct response for frames 1-24 while a 2 indicates a correct response for frames 25-30.

On any given frame you may choose one, two, or all three of the answers before you choose the correct one. Keep choosing until you find the one correct answer for that frame. Again, stop shading answer blocks once you have obtained the correct response for each question.
INSTRUCTIONS

This is a programmed textbook about the structure and function of the human eye. The text material is presented paragraph by paragraph in small steps. At the end of each paragraph you will find a multiple-choice question about the information contained in the paragraph. The paragraph of text plus the test question is referred to as a frame.

In working through the text you should:

1. Read the paragraph of text material.

2. Read the question and alternate answers of the test item.

3. Choose the answer you believe to be correct and mark it on the answer sheet using the special action/mark crayon.

Each question will have three possible answers identified as (a), (b), or (c). On the answer sheet provided notice that there are two pages. The first is numbered from 1-24 and the second sheet from 25-30. To respond to the question on a given frame simply decide whether choice (a), (b), or (c) is correct and crayon in that portion of the answer sheet. A number (either a 1, 2, or 3) will appear in the crayoned answer block.

Beneath each frame will appear an answer key indicating whether the number 1, 2, or 3 which appears is correct or incorrect. If the block you shade in shows a 1, check under the frame to see if it is correct. The association between the numbers below each frame and the correctness or incorrectness of your answer choice will vary for each frame. If the choice you selected is incorrect, crayon another block until you get the correct answer. However, on those frames where you shaded in all three answer blocks, you should circle the choice you made first.

You may re-examine a text paragraph as much as you like before answering the question. There is no time limit for completing the text.

During your reading you will be referred to another booklet labeled "Figures." These figures are drawings or illustrations which are useful in understanding the text. You may refer to these figures as often as you wish, but do not advance to a new figure until told to do so by the text.

The sample frame will help you become familiar with the format of the book. Work through it. If you do not understand how to work through the program, raise your hand and ask the proctor to help you.

When you have completed the entire book, so signify to the proctor.

YOU MAY TURN THE PAGE AND BEGIN
This is a sample frame. The remainder of this book is identical in format to this frame. When you finish reading this paragraph you may answer the question below. Choose the one answer which you find most correct.

The psychologist who developed the first IQ test was:

(a) Binet
(b) Truman
(c) Webster

Use the special crayon to shade in one of the answer blocks (a, b, or c). Notice that a numeral (1, 2, or 3) will appear. Below each of the thirty frames that follow will be printing that indicates which of the numbers is correct. In the above example, the correct answer is Binet.

On any given frame, you may choose one, two, or all three of the answers before you choose the correct one. Be sure to draw a circle around your first choice on those where you shade in all three choices.

KEEP CHOOSING UNTIL YOU FIND THE RIGHT ANSWER FOR EACH FRAME. Stop shading answer blocks once you have obtained the correct response for each question.
The front or foremost covering of the eyeball is a transparent membrane known as the cornea. To the rear, behind the cornea are two cavities, connecting with one another, which are called, going from the outside inward, the anterior and posterior chambers. In the normal eye these two chambers are filled with a clear fluid known as the aqueous humour. (See Fig. 1)

Frame 2

The anterior and posterior chambers are separated by a pigmented structure, known as the iris, which gives the eye its color. The iris forms an adjustable diaphragm in front of the lens; the aperture of this diaphragm is called the pupil. (See Fig. 1)

Frame 3

Located directly behind the iris is the lens of the eye. During the visual processes the lens, because of its elastic structure, is contracted and expanded by its two supporting structures (one on either side) which are called the suspensory ligaments. (See Fig. 1)

Frame 4

To the rear of the lens is located the largest chamber of the eye. This chamber extends from the back of the lens to the rear wall of the eyeball. The chamber is filled with a clear fluid, mostly water, called the vitreous humour. (See Fig. 1)

Frame 5

Regarding the eyeball structures, which of the following is true?
(a) The anterior chamber contains vitreous humour.
(b) The anterior chamber contains aqueous humour.
(c) The posterior chamber contains vitreous humour.

Frame 6

Regarding the eyeball structure, which of the following is true?
(a) The iris surrounds the pupil.
(b) The lens forms an adjustable diaphragm around an aperture.
(c) The pupil surrounds the iris.

Frame 7

Regarding eyeball structures, which of the following is true? The function of the suspensory ligaments is to contract and expand the
(a) lens
(b) pupil
(c) iris
The human eye is covered by three tissue coats. The outer-most of these coats is called the sclerotic coat, and helps to form the characteristic shape of the eyeball. The sclerotic coat also provides an attachment for the extrinsic movement muscles of the eye. The second or middle tissue coat contains pigment and is known as the choroid coat.

Regarding eyeball structures, which of the following is true?
(a) The innermost coat is the sclerotic.
(b) The outermost coat is the sclerotic.
(c) The innermost coat is the choroid.

The third and innermost tissue coat of the eye is the retina. The retina contains a specialized visual area, known as the fovea, which occupies an indented region located in the center of the rear wall of the eye. The retina is composed of neural tissue, and is the only part of the central nervous system which can be observed without the use of surgical techniques.

Regarding eyeball structures, which of the following is true?
(a) The fovea is the tissue coat in front of the retina.
(b) The retina is the tissue coat which contains the fovea.
(c) The fovea is the tissue coat which contains the retina.

The retina contains three layers of cells. The innermost layer, which lies against the vitreous humour, is called the ganglion layer. The middle layer is called the bipolar layer, and the outermost layer is called the rod and cone layer. Each of these three layers is named after the type of cells from which it is constructed. (See Fig. 1)

Incoming light waves strike which layer of the retina first?
(a) Ganglion
(b) Bipolar
(c) Rod and cone

At a point slightly to the nasal side of the fovea, the optic nerve pierces the rear wall of the eye at an area called the optic disc. The optic nerve is made-up of nerve fibers coming from the ganglion layer of the retina. (See Figs. 1 and 2)

Regarding eyeball structures, which of the following is true?
The optic nerve is made-up of nerve fibers coming from the
(a) outermost, or bipolar layer of the retina
(b) innermost, or ganglion layer of the retina.
(c) middlemost, or ganglion layer of the retina.
Each optic nerve exchanges neural fibers with its counterpart at an area known as the optic chiasma, which is located internally mid-way between the eyes. From the optic chiasma the neural pathways (right and left) which contain fibers from each optic nerve, continue inward to the lateral geniculate bodies where connecting fibers terminate in the primary visual center of the occipital lobe located on their respective side of the brain.

In the brain, the primary visual center is located in the
(a) Optic Chiasma
(b) Occipital lobe
(c) Parietal lobe

The stimuli to which the human eye is sensitive are radiations from the electromagnetic spectrum. The electromagnetic spectrum is composed of waves of energy varying in length from very short gamma waves to the extremely long radio waves. The eye can see (sense) only those electromagnetic waves which lie in the visual area located between the shorter ultraviolet waves and the longer infrared waves. Thus, the visual area is confined to energy waves having an approximate length of about 400 to 700 millimicrons. (See Fig. 3)

The stimuli from the electromagnetic spectrum which the retina is ordinarily sensitive to are
(a) longer than the ultraviolet waves.
(b) shorter than the gamma waves.
(c) longer than the infrared waves.

The phenomenon we perceive as color is influenced by three physical attributes of the electromagnetic waves. These three variables are the wavelength, the intensity, and the relative purity of a particular wavelength. However, the colors which a person perceives can also be described in terms of psychological dimensions which correspond approximately to the above physical ones. The psychological dimensions of color are:

hue, which corresponds to physical wavelength;
brightness, which corresponds to physical intensity;
saturation, which corresponds to the physical purity of the electromagnetic wave.

The perception of color is influenced by which of the following physical properties of electromagnetic stimulation?
(a) Brightness, wavelength, purity
(b) Wavelength, intensity, saturation
(c) Intensity, purity, wavelength
The eye perceives four primary colors from the electromagnetic spectrum. These four primary colors are blue (450 millimicrons); green (550 millimicrons); yellow (590 millimicrons); red (700 millimicrons). (See Fig. 3) Combinations of the primary colors can be perceived as intermediate colors. White (or gray) is perceived by combining all of the primary colors, and black is the total absence of color stimulation. Certain colors are said to be complementary to one another; that is, if they are mixed together the resulting combination will appear as gray. Three complementary pairs of color stimuli are: red-green, blue-yellow, and black-white.

In the visual portion of the electromagnetic spectrum the four primary colors (from longest to shortest wavelength) are:
(a) red, yellow, green, violet.
(b) blue, green, yellow, red.
(c) red, yellow, green, blue.

Waves of light entering the eye are refracted by the eye's internal structures, but most importantly by the lens. The phenomenon of refraction occurs whenever there are changes in the density of the media through which light passes. As light rays pass through a surface from a less dense to a more dense medium—as is the case when light passes from the aqueous humour to the lens—the rays, in effect, bend or refract toward a line perpendicular to the surface at the point of crossing. The degree of refraction phenomenon depends upon the angle at which light enters the lens which, in turn, depends upon the degree of curvature of the front lens surface. (See Fig. 4)

When a light ray passes from the aqueous humour to the lens it will refract
(a) toward a line perpendicular to the surface at the point of crossing.
(b) toward a line tangent to the surface at the point of crossing
(c) away from a line perpendicular to the surface at the point of crossing.

As light rays pass through a surface from a more dense to a less dense medium—as is the case when light rays pass from the lens to the vitreous humour—the light rays, in effect, bend or refract away from a line perpendicular to the surface at the point of crossing. The degree of bending depends upon the angle at which the light leaves the lens which, in turn, depends upon the degree of curvature of the rear lens surface. (See Fig. 4)

When a light ray passes from the lens to the vitreous humour it will refract
(a) away from a line tangent to the surface at the point of crossing.
(b) away from a line perpendicular to the surface at the point of crossing.
(c) toward a line perpendicular to the surface at the point of crossing.
Frame 15

The lens of the eye is geometrically biconvex in form, that is, both the front and rear surfaces are convex in shape. The cumulative effect of both refractions (at the front and rear surfaces of the lens) is to cause the light waves to converge and thus focus on a point rearward of the lens...and then to diverge and project an image on the retina which is both inverted (upside-down) and real (reversed). The inverted and real image is perceived as upright and normal by the viewer, a phenomenon which is learned by the organism. The inverted and real image is clearest on a certain plane. Optimally this plane of clear image will fall on the visual receptors of the retina. Whether or not the plane of clear image falls on the retina is controlled by the degree of convexity of bulging of the lens, that is, the lens bulges as the eye fixates near objects, and flattens as the eye fixates far objects. This variable focusing movement is called accommodation, and is made necessary by the change in the angle of entering light rays due to change in distance. (See Fig. 4)

To change focus from a distant to a near object the lens would
(a) flatten
(b) bulge
(c) become more dense

Frame 16

In some eyes, either the eyeball is abnormally long, or the lens is unable to flatten enough to allow the plane of clear image for far objects to fall on the retina. When one of these defects occurs, the resulting abnormal condition is known as myopia or nearsightedness. (See Fig. 5)

If an eyeball were abnormally long, which condition would most likely result?
(a) Farsightedness
(b) Nearsightedness
(c) Under-refraction

Frame 17

In some eyes the eyeball is abnormally short or the lens is unable to bulge enough to allow the plane of clear image for near objects to fall on the retina. When defects of this type occur, the resulting abnormal condition is known as hypermetropia or farsightedness.

If the lens is unable to bulge enough to project the plane of clear image on the retina the condition most likely to result is
(a) Farsightedness
(b) Nearsightedness
(c) Over-refraction
Frame 18

As a person grows older the lens of the eye tends to lose some of its characteristic elasticity. Because of this phenomenon the lens is no longer able to accommodate to a degree adequate for normal vision, and thus, the viewed image is often blurred and out of focus. This condition is known as presbyopia, and is often accompanied by the formation of opaque areas in the lens called cataracts. The formation of cataracts prevents the incoming light rays from reaching the receptors in the retina, and so, a portion of the perceived image will be totally absent. As cataracts become larger and increase in number the person will eventually become blind.

Which of the following would most likely be a causative factor in the development of presbyopia?
(a) Opaque blindness
(b) Large cataracts
(c) Advancing age

Frame 19

The human visual system is binocular in structure, that is, it contains two eyes and their accessory structures. During the evolutionary process both eyes have moved to the front of the head; because of this arrangement man is able to focus both eyes simultaneously on the same object. This type of visual system is called stereoscopic. Stereoscopic vision provides man with many of the cues which are necessary for the perception of depth.

In regard to man's stereoscopic visual system, which of the following is true?
(a) It provides cues for depth perception.
(b) It allows binocular vision to evolve.
(c) It allows each eye to focus independently on different objects.

Frame 20

Fusion is a neurological phenomenon which is partially responsible for the perception of depth. In the process of fusion the separate images from each eye are seen as one by the observer. Fusion takes place primarily where the fibers from the separate optic nerves exchange at the optic chiasma before continuing inward to the visual centers of the brain.

Regarding fusion, which of the following is true?
(a) It allows the observer to see a separate object with each eye.
(b) It is caused, in part, by the perception of depth.
(c) It takes place primarily at the optic chiasma.
In order for fusion to occur the viewed image must fall on approximately the same retinal area of each eye simultaneously; thus, both eyeballs must adjust themselves to view an object at about the same angle relative to the plane of the central axis of each eye. This lining up action of the eyeballs is called convergence, and it is accomplished by the extrinsic muscles of each eye. (See Fig. 6)

In regard to convergence, which of the following is a true statement?
(a) It allows simultaneous stimulation of the same retinal area.
(b) It is caused by movements of the intrinsic eye muscles.
(c) It occurs as a result of fusion.

Sensory excitation in the eye takes place in the outermost of the three neural layers of the retina. This outer layer, in contact with the choroid coat, contains the eye's two types of stimuli receptors...the rods and cones. (See Fig. 2).

The rod and cones are located in the
(a) innermost layer of the retina
(b) next to the retina
(c) outermost layer of the retina

The rods are the eye's receptors for dim light vision. The rods are totally color blind, and see all visual stimuli as varying shades of gray. The dim light and color blind reception by the rods is known as scotopic vision. The rods are twice as numerous as the cones (the retina's second type of receptor), and are located in the peripheral areas of the retina. Two areas near the retina contain no rods; the first is the fovea, and the second is the optic disc which is often called the 'blind spot' because it contains no receptors of any kind.

Which of the following statements is true?
(a) There are no rods in the fovea
(b) There are approximately twice as many rods as cones in the optic disc.
(c) There are no cones in the fovea.

The rods adapt to dimmer light conditions by means of a visual pigment they contain...called rhodopsin. Rhodopsin is often called visual purple because of its characteristic dark blue color. The raw material from which rhodopsin is made is vitamin A, and, thus, a deficiency of vitamin A will result in poor dim-light vision.

Which of the following statements regarding rhodopsin is true?
(a) It becomes deficient in the presence of Vitamin A.
(b) It is dark blue in color.
(c) It contains a pigment called visual purple.
Frame 25

Receptors of a second type in the retina are the flask-shaped cones. These structures are responsible for the visual perception of bright light and color. This type of color and high intensity reception by the cones is known as photopic vision. There are approximately one-half the number of cones as there are rods in the retina.

Which of the following statements is true?
(a) The dimmer the light the more responsible for vision are the cones.
(b) The rods enable the visual perception of color.
(c) The dimmer the light the more responsible for vision are the rods.

Frame 26

Like the rods, the cones are scattered randomly throughout the periphery of the retina, but, unlike the rods, the majority of them are packed into the indented region of the fovea. Because of the concentration of receptors in its relatively small area, the fovea possesses the most acute bright light and color vision of any portion of the retina.

Which of the following is true?
(a) The periphery of the retina contains no cones.
(b) The periphery of the retina contains no rods.
(c) Most bright light receptors are in the fovea.

Frame 27

Visual acuity is the ability to distinguish detail in images projected on the retina. Visual acuity is better for close objects than for far objects, because at close range the eye is able to perceive much more accurately the spatial pattern of a viewed object. Visual acuity increases in direct relation to the number of receptors which are stimulated, and, thus, the fovea is the area of maximum acuity for bright light and color vision. For dim light vision, acuity is best in the peripheral areas of the retina where the greatest concentration of rods are located; however, visual acuity under dim light conditions is never as good as it is under bright light conditions.

Regarding visual acuity, which of the following is true?
(a) It is greatest under dim light conditions.
(b) It is greatest in the fovea.
(c) It is greatest in the periphery of the retina.
Color blindness is a sex-linked characteristic which occurs more often in males than in females. The most common type of color blindness is called dichromatism. A person afflicted with dichromatism is unable to perceive or define either of the two primary colors...red and green.

Which of the following would be the most probable if you knew only that a person was color blind?
(a) The color blindness is for reds, yellows, greens and blues.
(b) The color blindness is for blues and yellows only.
(c) The color blindness is for reds and greens only.

Occasionally, a person is born totally color blind; this condition is called achromatism, and is one in which the eye perceives all visual stimuli as varying shades of gray. In achromatism the fovea is totally blind and all visual perception is accomplished by the rods. An achromatic person is unable to see in very bright light.

Which of the following is true of a person having achromatism?
(a) He sees only the primary colors.
(b) He has no rod vision.
(c) He has no cone vision.

Color vision is not universal throughout the animal kingdom. Fish, bees and birds have color vision, but most mammals do not. An exception to this rule are the primates, the order to which man belongs. Monkeys and the great apes possess various degrees of color vision, and the chimpanzee has a structural and perceptual visual system which is almost identical to that of man.

Regarding color vision, which of the following is true?
(a) Primates have some color perception.
(b) Most mammals see at least the primary colors.
(c) Birds and bees are typically color blind.

You have now finished the text. Make sure that your name is clearly printed, last name first, where it is supposed to be on the answer sheet.

Return your answer sheet immediately to the proctor.
POST TEST RECALL

NAME ____________________________

DATE ____________________________

From the thirty frames you just read, please recall any six answers you can. If you cannot recall the exact answer to certain frames then list any facts, principles, or key phrases associated with a given frame.

Be specific as possible.

1. 

2. 

3. 

4. 

5. 

6. 
Give the answer you think is correct regardless of previous feedback on the frames.

1) Regarding eyeball structure, which of the following is true?
   a) The anterior chamber contains vitreous humor.
   b) The anterior chamber contains aqueous humor.
   c) The posterior chamber contains vitreous humor.

2) Regarding eyeball structure, which of the following is true?
   a) The pupil surrounds the iris.
   b) The lens forms an adjustable diaphragm around an aperture.
   c) The iris surrounds the pupil.

3) Regarding eyeball structure, which of the following is true?
   The function of the suspensory ligaments is to contract and expand the
   a) lens
   b) pupil
   c) iris

4) Regarding eyeball structure, which of the following is true?
   The vitreous humor is located
   a) between the iris and the lens.
   b) between the lens and the rear wall of the eye.
   c) between the cornea and the lens.

5) Regarding eyeball structure, which of the following is true?
   a) The innermost coat is the scleratic.
   b) The innermost coat is the choroid.
   c) The outermost coat is the scleratic.

6) Regarding eyeball structure, which of the following is true?
   a) The fovea is the tissue coat in front of the retina.
   b) The retina is the tissue coat which contains the fovea.
   c) The fovea is the tissue coat which contains the retina.

7) Incoming light waves strike which layer of the retina first?
   a) ganglion
   b) bipolar
   c) rod and cone
8) Regarding eyeball structure which of the following is true?
The optic nerve is made up of nerve fibers coming from the
a) outermost or bipolar layer of the retina.
b) middlemost or ganglion layer of the retina.
c) innermost or ganglion layer of the retina.

9) In the brain the primary visual center is located in the
a) optic chiasma.
b) occipital lobe.
c) parietal lobe.

10) The stimuli from the electromagnetic spectrum to which the retina is ordinarily sensitive are
a) longer than the ultraviolet waves.
b) shorter than the gamma waves.
c) longer than the infrared waves.

11) The perception of color is influenced by which of the following physical properties of electromagnetic stimulation:
   a) brightness, wavelength, purity.
   b) wavelength, intensity, saturation.
   c) intensity, purity, wavelength.

12) In the visual portion of the electromagnetic spectrum the four primary colors (from longest to shortest wavelength) are:
   a) red, yellow, green, violet
   b) blue, green, yellow, red
   c) red, yellow, green, blue

13) When a light ray passes from the aqueous humor to the lens it will refract:
   a) toward a line perpendicular to the surface at the point of crossing.
   b) toward a line tangent to the surface at the point of crossing.
   c) away from a line perpendicular to the surface at the point of crossing.

14) When a light ray passes from the lens to the vitreous humor it will refract:
   a) away from a line tangent to the surface at the point of crossing.
   b) away from a line perpendicular to the surface at the point of crossing.
   c) toward a line perpendicular to the surface at the point of crossing.
15) To change focus from a distant to a near object the lens would
   a) flatten
   b) bulge
   c) become more dense

16) If an eyeball were abnormally long which condition would result:
   a) farsightedness
   b) under-refraction
   c) nearsightedness

17) If the lens is unable to bulge enough to project the plane of clear
   image on the retina the condition most likely to result is:
   a) farsightedness
   b) nearsightedness
   c) over-refraction

18) Which of the following would most likely be a causative factor in
    the development of presbyopia?
   a) advancing age
   b) large cataracts
   c) opaque blindness

19) In regard to man's stereoscopic visual system which of the following
    is true?
   a) It allows binocular vision to evolve.
   b) It provides cues for depth perception.
   c) It allows each eye to focus independently on different
      objects.

20) Regarding fusion which of the following is true?
   a) It allows the observer to see a separate object with each
      eye.
   b) It takes place primarily at the optic chiasma.
   c) It is caused, in part, by the perception of depth.

21) In regard to convergence, which of the following is a true statement?
   a) It allows simultaneous stimulation of the same retinal area.
   b) It is caused by movements of the intrinsic eye muscles.
   c) It occurs as a result of fusion.

22) The rods and cones are located in the
   a) innermost layer of the retina.
   b) next to the retina.
   c) outermost layer of the retina.
23) Which of the following statements is true?
   a) There are no cones in the fovea.
   b) There are approximately twice as many rods as cones in the optic disc.
   c) There are no rods in the fovea.

24) Which of the following statements regarding rhodopsin is true?
   a) It contains a pigment called visual purple.
   b) It becomes deficient in the presence of vitamin A.
   c) It is dark blue in color.

25) Which of the following statements is true?
   a) The dimmer the light the more responsible for vision are the cones.
   b) The dimmer the light the more responsible for vision are the rods.
   c) The rods enable the visual perception of color.

26) Which of the following is true?
   a) The periphery of the retina contains no cones.
   b) The periphery of the retina contains no rods.
   c) Most bright light receptors are in the fovea.

27) Regarding visual acuity, which of the following is true?
   a) It is greatest in the fovea.
   b) It is greatest in the periphery of the retina.
   c) It is greatest under dim light conditions.

28) Which of the following would be most probable if you knew only that a person was color-blind.
   a) The color blindness is for reds, yellows, greens, and blues.
   b) The color blindness is for reds and greens only.
   c) The color blindness is for blues and yellows only.

29) Which of the following is true of a person having achromatism?
   a) He sees only the primary colors.
   b) He has no red vision.
   c) He has no cone vision.

30) Regarding color vision which of the following is true?
   a) Most mammals see at least some of the primary colors.
   b) Primates have some color perception.
   c) Birds and bees are typically color-blind.
APPENDIX C

Definition of EPPS Variables

1. Achievement
2. Deference
3. Order
4. Exhibition
5. Autonomy
6. Affiliation
7. Intraception
8. Succorance
9. Dominance
10. Abasement
11. Nurturance
12. Change
13. Endurance
14. Heterosexuality
15. Aggression
APPENDIX C

Definition of EPPS Variables

1. ach Achievement: To do one's best, to be successful, to accomplish tasks requiring skill and effort, to be a recognized authority, to accomplish something of great significance, to do a difficult job well, to solve difficult problems and puzzles, to be able to do things better than others, to write a play or novel.

2. def Deference: To get suggestions from others, to find out what others think, to follow instructions and do what is expected, to praise others, to tell others that they have done a good job, to accept the leadership of others, to read about great men, to conform to custom and avoid the unconventional, to let others make decisions.

3. ord Order: To have written work neat and organized, to make plans before starting on a difficult task, to have things organized, to keep things neat and orderly, to make advance plans when taking a trip, to organize details of work, to keep letters and files according to some system, to have meals organized and a definite time for eating, to have things arranged so that they run smoothly without change.

4. exh Exhibition: To say witty and clever things, to tell amusing jokes and stories, to talk about personal adventures and experiences, to have others notice and comment upon one's appearance, to say things just to see what effect it will have on others, to talk about personal achievements, to be the center of attention, to use words that others do not know the meaning of, to ask questions others cannot answer.

5. aut Autonomy: To be able to come and go as desired, to say what one thinks about things, to be independent of others in making decisions, to feel free to do what one wants, to do things that are unconventional, to avoid situations where one is expected to conform, to do things without regard to what others may think, to criticize those in positions of authority, to avoid responsibilities and obligations.

6. aff Affiliation: To be loyal to friends, to participate in friendly groups, to do things for friends, to form new friendships, to make as many friends as possible, to share things with friends, to do things with friends rather than alone, to form strong attachments, to write letters to friends.

7. int Intracception: To analyze one's motives and feelings, to observe others, to understand how others feel about problems, to put one's self in another's place, to judge people by why they do things rather than by what they do, to analyze the behavior of others, to predict how others will act.

8. suc Succorance: To have others provide help when in trouble, to seek encouragement from others, to have others be kindly, to have others be sympathetic and understanding about personal problems, to receive a great deal of affection from others, to have others do favors cheerfully.
to be helped by others when depressed, to have others feel sorry when one is sick, to have a fuss made over one when hurt.

9. dom Dominance: To argue for one's point of view, to be a leader in groups to which one belongs, to be regarded by others as a leader, to be elected or appointed chairman of committees, to make group decisions, to settle arguments and disputes between others, to persuade and influence others to do what one wants, to supervise and direct the action of others, to tell others how to do their jobs.

10. aba Abasement: To feel guilty when one does something wrong, to accept blame when things do not go right, to feel that personal pain and misery suffered does more good than harm, to feel the need for punishment for wrong doing, to feel better when giving in and avoiding a fight than when having one's own way, to feel the need to confess errors, to feel depressed by inability to handle situations, to feel timid in the presence of superiors, to feel inferior to others in most respects.

11. nur Nurturance: To help friends when they are in trouble, to assist others less fortunate, to treat others with kindness and sympathy, to forgive others, to do small favors for others, to be generous with others, to sympathize with others who are hurt or sick, to show a great deal of affection toward others, to have others confide in one about personal problems.

12. chg Change: To do new and different things, to travel, to meet new people, to experience novelty and change in daily routine, to experiment and try new things, to eat new and different places, to try new and different jobs, to move about the country and live in different places, to participate in new fads and fashions.

13. end Endurance: To keep at a job until it is finished, to complete any job undertaken, to work hard at a task, to keep at a puzzle or problem until it is solved, to work at a single job before taking on others, to stay up late working in order to get a job done, to put in long hours of work without distraction, to stick at a problem even though it may seem as if no progress is being made, to avoid being interrupted while at work.

14. het Heterosexuality: To go out with members of the opposite sex, to engage in social activities with the opposite sex, to be in love with someone of the opposite sex, to kiss those of the opposite sex, to be regarded as physically attractive by those of the opposite sex, to participate in discussions about sex, to read books and plays involving sex, to become sexually excited.

15. agg Aggression: To attack contrary points of view, to tell others what one thinks about them, to criticize others publicly, to make fun of others, to tell others off when disagreeing with them, to get revenge for insults, to become angry, to blame others when things go wrong, to read newspaper accounts of violence.
The dissertation submitted by Edward J. Carels has been read and approved by the following Committee:

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The final copies have been examined by the director of the dissertation and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the dissertation is now given final approval by the Committee with reference to content and form.

The dissertation is therefore accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

May 12, 1975

Date

Joy Rogers
Director's signature