INFORMATION TO USERS

This material was produced from a microfilm copy of the original document. While the most advanced technological means to photograph and reproduce this document have been used, the quality is heavily dependent upon the quality of the original submitted.

The following explanation of techniques is provided to help you understand markings or patterns which may appear on this reproduction.

1. The sign or "target" for pages apparently lacking from the document photographed is "Missing Page(s)". If it was possible to obtain the missing page(s) or section, they are spliced into the film along with adjacent pages. This may have necessitated cutting thru an image and duplicating adjacent pages to insure you complete continuity.

2. When an image on the film is obliterated with a large round black mark, it is an indication that the photographer suspected that the copy may have moved during exposure and thus cause a blurred image. You will find a good image of the page in the adjacent frame.

3. When a map, drawing or chart, etc., was part of the material being photographed the photographer followed a definite method in "sectioning" the material. It is customary to begin photoing at the upper left hand corner of a large sheet and to continue photoing from left to right in equal sections with a small overlap. If necessary, sectioning is continued again — beginning below the first row and continuing on until complete.

4. The majority of users indicate that the textual content is of greatest value, however, a somewhat higher quality reproduction could be made from "photographs" if essential to the understanding of the dissertation. Silver prints of "photographs" may be ordered at additional charge by writing the Order Department, giving the catalog number, title, author and specific pages you wish reproduced.

5. PLEASE NOTE: Some pages may have indistinct print. Filmed as received.

Xerox University Microfilms
300 North Zeeb Road
Ann Arbor, Michigan 48106

Downloaded from SHAREOK. Persistent Handle URL: https://hdl.handle.net/11244/4399

7815385

TSAO, PETER KUO-HSIUNG
THE EFFECTS OF ERROR RATE, KNOWLEDGE OF CORRECT RESULTS AND TEST ANXIETY IN LINEAR PROGRAM.

THE UNIVERSITY OF OKLAHOMA, PH.D., 1977

University Microfilms International 300 N. ZEEB ROAD, ANN ARBOR, MI 48106

THE UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

THE EFFECTS OF ERROR RATE, KNOWLEDGE OF CORRECT RESULTS AND TEST ANXIETY IN LINEAR PROGRAM

A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

degree of

DOCTOR OF PHILOSOPHY

BY

PETER TSAO

Norman, Oklahoma

1977

THE EFFECTS OF ERROR RATE, KNOWLEDGE OF CORRECT RESULTS AND TEST ANXIETY IN LINEAR PROGRAM

APPROVED BY

Barbara A Nelson

William H Graves

Robert A. Simmons

Leija P. Williams

DISSERTATION COMMITTEE

ACKNOWLEDGEMENT

The author wishes to express his gratitude for the encouragement and guidance of Dr. Barbara Nelson in the development of this dissertation. Sincere appreciation is expressed to Dr. William Graves, Dr. Albert Smouse and Dr. Lloyd Williams for their valuable suggestions and their willingness to serve on the committee.

The author also wishes to express sincere appreciation to those who participated in the experiment.

Special thanks are due to Dr. Sigmund Tobias, City College of the University of New York, for the programmed material.

In addition, the author wishes to thank his wife, Jane, and children, Sam and Ruth, for their encouragement and support.

TABLE OF CONTENTS

	Page
LIST OF TABLES	v
LIST OF FIGURES	vi
INTRODUCTION	1
METHOD	8
RESULTS	12
DISCUSSION	20
SUMMARY	22
REFERENCES	24
APPENDIX: PROSPECTUS	28

LIST OF TABLES

Table		Page
1.	Means and Standard Deviations for Low Error Rate Program	14
2.	Analysis of Variance for Low Error Rate Program	15
3.	Means and Standard Deviations for Moderate Error Rate Program	16
4.	Analysis of Variance for Moderate Error Rate Program	17

LIST OF FIGURES

Figure Page

1. Interaction between Anxiety and Treatment on the Low Error Rate Program 18

2. Interaction between Anxiety and Treatment on the Moderate Error Rate Program 19

THE EFFECTS OF ERROR RATE, KNOWLEDGE OF CORRECT RESULTS AND TEST ANXIETY IN LINEAR PROGRAM

INTRODUCTION

Operant conditioning principle provides the theoretical framework for programmed learning. According to Skinner (1954), an organism learns a response when he emits that response and is immediately reinforced. An optimal learning condition is a situation in which the organism is guided toward predetermined goals through a series of small steps of actions and receives immediate reinforcement. These small steps of actions form a chain of progressive approximations of desired behavior until the target behavior is performed by the organism. By breaking down a complex behavior into a series of small actions and reinforcing right after each successful action, the frequency of reinforcement can be raised to maximum, while the aversive consequences of failure can be reduced to minimum or be completely avoided. This "maximum success and minimum failure" condition provides error-free learning which, according to Cook and Mechner (1962) is not only simpler, but its effects improve morale, motivation and retention.

Following this principle, in programmed learning, the programmer presents a small amount of material followed by a question in frames. The frames are so simple and interrelated that few of the subjects will miss

the question. In addition, the most powerful strategy being used in the programmed learning is to set up a contingency of reinforcement in the learning process. The contingency is between the response and the reinforcer. A common reinforcer in programmed instruction is knowledge of correct result (KCR) which is the correct answer following right after a frame. Many psychologists, such as Taber, Glaser, and Schaefer (1965), believe that KCR is an important variable in human learning. Angell (1949), Melton (1947), and Pressey (1950) found that KCR significantly enhanced performance in learning situations. Campeau (1968), and Anderson, Kulhavy, and Andre (1972) found that KCR enhanced learning in programmed instruction.

Surprisingly, other psychologists (Becker, 1964; Feldhusen & Birt, 1962; Hough & Revin, 1963; Kulhavy, Vekovich, & Dyer, 1976; Moore & Smith, 1961, 1964; Ripple, 1963; Travers, Wagenen, Haygood, & McCormick, 1964) reported that no significant difference was found in acquisition or retention, between KCR and no-KCR conditions. One explanation for these apparently contradictory results involves the difficulty of the program. It is believed that when the program is easy, the subject is confident of his answer, therefore, by-passing KCR. Melching (1966) conducted an experiment which supported this explanation. In his experiment, feedback was given only when subjects asked for it. He found that low ability subjects asked 45 percent of the time, whereas, high ability subjects asked for feedback on only 14 percent of the frames. Errors were made on only 4 percent of the frames on which subjects did not ask for feedback. On the other hand, errors were made on 28 percent of the frames on which feedback was requested. In addition, it is believed that the

easy program consists of too many copying behaviors, so the subject reacts to the frames less actively. As a result, the subject learns less well. Under such conditions, it is argued that KCR shows no effect.

Some psychologists (Cram, 1961; Crowder, 1961; Lumdaine, 1965) questioned the idea of using "error-free" program to maintain the maximum success and minimum failure conditions. They believed that the aversive consequence caused by error in the program may even be an important variable in the learning process. They contended that a learning situation should produce a slight rise in tension followed by tension reduction after the response is emitted. Error in programmed instruction can serve this purpose.

Following this belief, instead of an "error-free" program, an ideal program should have a moderate error rate to maintain the subject's motivation. This belief violates Skinner's idea of maximum reinforcement in the learning situation. Many psychologists (Berglund, 1969; Glaser & Taber, 1961; Hartley, 1974; Holland, 1965) supported the idea of moderate error rate in the program. They contended that KCR was more important when the program had a moderate error rate.

In programmed instruction, the motivational aspect has been defined in terms of experimentally manipulable external conditions. The internal source of motivation has usually been ignored. Some psychologists (Taylor, 1951; Taylor & Spencer, 1952) looked at the internal drive state of the subject and found that there was a relationship between the performance in the learning situation and the level of total drive. They developed a drive theory based on Hull's (1943) system. According to this

theory, total effective drive is determined by a summation of all extant need states, both primary and secondary. Thus, the higher the drive level, the greater the response strength.

One operational definition of internal drive is anxiety as measured by either the Manifest Anxiety Scale (Taylor, 1953) or the Achievement Anxiety Test (Alpert & Haber, 1960). Anxiety is assumed to interact with the number and comparative strengths of correct and incorrect tendencies. When the correct response is weaker than other competing response tendencies, the high drive subject should be inferior in performance to low drive subject, because the competing responses divide his strength of response tendency. While in situations where the correct response is stronger than other response tendencies, the high drive subject, because of a higher strength of response tendency for a single response, will be superior in performance than the low drive subject.

Wine (1971) concluded that the performance difference between high and low test anxious subjects was largely due to a difference in the attentional focuses of high and low test anxious subjects during task performance. When performing a task, the low test anxious subject focuses on task relevant variables, while the high test anxious subject focuses on self-evaluative, self-deprecatory thinking, and perception of autonomic response. As a result, in a difficult learning situation which requires full attention for adequate performance, the high test anxious subject might divide his attention between internal cues and task cues. He, therefore, performs poorly. Taylor's (1951) conditioned eyelid response experiment and Nicholson's (1958) verbal learning experiment supported this kind of explanation.

Sarason and Ganzer (1963) contended that high anxious subjects were more motivated to receive reinforcement than were low anxious subjects. Campeau (1968) stated that KCR produced superior achievement for high test anxious subjects for two reasons: 1) providing KCR would constitute a low threat condition, because the test-like aspect of the learning task is removed, and 2) providing KCR as confirmation will reinforce task relevant response. In his experiment, he found that high test anxious female subjects did significantly better under KCR conditions than under no-KCR conditions, while low test anxious female subjects showed no significant difference under KCR and no-KCR conditions. But, under no-KCR conditions, low test anxious female subjects did significantly better than high test anxious female subjects. Kight and Sassenrath (1966), using a linear program on test construction and evaluation, found that the high test anxious subjects worked faster and made fewer errors than the low test anxious subjects. They explained that the high test anxious subjects might be able to derive greater benefit from KCR and thereby had a better performance.

Based on these findings, this study attempts to clarify some of the apparent contradictions and to relate error rate and KCR with test anxiety.

If, as reinforcement theory stresses, a subject learns from the consequence of his responding, not from the making of response itself, then KCR in programmed instruction is the key factor in maintaining the response tendency. It is, therefore, argued that KCR should facilitate learning, especially when the material is relatively difficult. Though study after study indicates that KCR in low error rate program did not

show an effect as a reinforcer, and many psychologists hypothesized that KCR should facilitate learning in a moderate error rate program, very few studies have been conducted to test this hypothesis. Therefore, this study will try to find out the effect of KCR in low error rate program and moderate error rate program.

Traditionally, in programmed instruction, the internal aspect of motivation has long been ignored, though many psychologists have shown that drive level as measured by test anxiety affects learning in many situations, the relationship among error rate, KCR and test anxiety is not clear.

Since drive level indicates the strength of response potentiality, the high test anxious subject will be superior in performance in these situations: 1) where the stimulus elicits strong task relevant responses, accompanied by few weak competing task irrelevant responses, such as in an easy learning situation, 2) where KCR is provided. Therefore, it is hypothesized that the performance of subjects with high test anxiety will be superior to that of low test anxiety subjects in low error rate program, especially with KCR.

Therefore, the following hypotheses will be tested:

1. Providing KCR in the low error rate program will enhance learning for both high and low test anxiety subjects. The subject working under KCR condition will be superior in performance than the subject working under no-KCR condition.

2. Providing KCR in the moderate error rate program will enhance performance for both high and low test anxiety subjects. The subject working under KCR will be superior in performance than the subject working under no-KCR condition.

3. In a low error rate program, since test anxiety produces greater response strength in an easy task, the high test anxiety subject will do significantly better than the low test anxiety subject.

4. In addition to task cues, the high test anxiety subject also focuses on internal cues which are irrelevant to task performance. Therefore in a moderate error rate program, the high test anxiety subject will do significantly worse than the low test anxiety subject.

5. In the moderate error rate program, the high test anxiety subject will do significantly better in KCR condition and significantly worse than the low test anxiety subject under no KCR condition.

METHOD

Subjects

One hundred and forty-four university level undergraduate students were selected from introductory psychology classes (70 students) and educational psychology classes (74 students) in the spring semester 1977. They were required to participate in an experiment for the respective courses in which they enrolled.

Materials

1. The Achievement Anxiety Test developed by Alpert and Haber (1960) was used to measure test anxiety. This test consists of two measures: a 10-item debilitating anxiety scale, and a 9-item facilitating scale. For the purpose of this study, only the debilitating anxiety scale was used. The test-retest reliability for a 10-week interval is .83, over an 8-month period is .76. The debilitating scale consists of 10 items which required the subject to respond to statement on a five-point scale.

2. Two different error rate lessons were used in this study: one with error rate of about 5 percent, the other with an error rate of about 25 percent. The program selected for this study was The Diagnosis of Myocardial Infarction, originally developed by Mechner, and revised

by Tobias (1968). This program consists of two parts: the familiar and the technical, both dealing with various kinds of damage to the heart, their seriousness and reversibility, and the diagnostic significance of ECG tracings taken from the fifth precordinal lead. The familiar part consists of 54 frames, while the technical part consists of 89 frames. Due to the time limit, only the first 60 items were used. According to Tobias (1968), program difficulty, determined by the percentage of correct response to the program, was 96.6 percent and 81.3 percent for the familiar and technical parts, respectively, a difference significant beyond the .001 level.

To determine whether the error rate obtained by Tobias held true for this group of subjects, a pilot study was run to determine the error rate. Fifteen subjects took the familiar part, and 19 subjects took the technical part. An error rate of 6.5 percent for the familiar part, and an error rate of 24.7 percent for the technical part were obtained. An error rate for the familiar part based on 40 subjects in this study is 5.0 percent, and 22.4 percent for technical part based on 40 subjects.

Four different lessons were constructed as follows:

1. Low error rate lesson with KCR. The low error rate lesson with KCR contained the 54 frames of familiar information. Each frame was presented on a 4 x 6 index card. Following each frame containing a question was a frame containing the correct responses.

2. Low error rate lesson with no KCR. The low error rate lesson with no KCR was the same as the low error rate lesson with KCR except that KCR had been omitted.

3. Moderate error rate lesson with KCR. The moderate error rate lesson with KCR contained the first 60 frames of the technical part. Each frame was presented on a 4 x 6 index card.

4. Moderate error rate lesson with no KCR. The moderate error rate lesson with no KCR was the same as the moderate error rate lesson with KCR except KCR had been omitted.

Two tests developed by Tobias (1968) were used. One test consisting of 17 completion items, with 27 possible points, assessed acquisition on the familiar part. A second test consisting of 6 completion items with 61 possible points, assessed acquisition on the technical part. The test for familiar part has an alpha reliability of .66, while the test for technical part has an alpha reliability of .85. The reliability data was based on a total number of 114 subjects. A scoring key is also provided by Tobias.

Procedures

This study required two sessions. In the first session, subjects were given the Achievement Anxiety Test. Subjects' scores on the test were ranked. The upper one-third were considered as high test anxious, while the lower one-third were considered as low test anxious. The high test anxious group had a range of 31-47 and a mean score of 35.9 (total possible score was 50), while the low test anxious group had a range of 17-27, and a mean score of 23.8. The high and low test anxiety subjects were randomly assigned to one of the following learning tasks: 1) low error rate lesson with KCR, 2) low error rate lesson with no KCR, 3) moderate error rate lesson with KCR, and 4) moderate error rate lesson with no KCR.

In each learning task, there were 10 low test anxiety subjects and 10 high test anxiety subjects. They were required to respond actively to the program by giving a response to the frame. A booklet was provided for them to record their responses. At the end of the program, subjects were given a test.

RESULTS

Since two different error rate programs and two different tests were used in this study, data were analyzed separately for each program.

For the low error rate program, the means and standard deviations are reported in Table I. The mean score for the high test anxiety subjects was 20.6 under KCR condition, and 19.5 under no-KCR condition. The mean score for low test anxiety subjects was 20.8 under KCR condition and 20.8 under no-KCR condition. A 2 x 2 analysis of variance with two levels of treatment (KCR and no-KCR) and two levels of anxiety (high and low) was performed. The results are reported in Table II. No significant difference was found between the performance of the high test anxiety subject and the performance of the low test anxiety subject under KCR and no-KCR conditions ($F = 0.369$ and 0.502, respectively). The interaction effect between KCR and test anxiety was not significant. Figure 1 presents this interaction.

For the moderate error rate program, the same analysis was performed. The means and standard deviations are reported in Table III. For the high test anxiety subjects, the mean score under KCR condition was 44.7 (total possible score was 61) and 41.1 under no-KCR condition. The mean score for the low test anxiety subjects was 36.8 under KCR condition and 43.4 under no-KCR condition. A two-way ANOVA was performed.

The results are reported in Table IV. Neither of the F values for main effects was significant (F = 0.108 and 0.376, respectively). The interaction effect between KCR and test anxiety was not significant (F = 1.247, p = 0.271). Figure 2 presents this interaction. Therefore, all hypotheses were rejected.

TABLE I

MEANS AND STANDARD DEVIATIONS FOR LOW ERROR RATE PROGRAM

Test Anxiety Level	KCR M	KCR SD	NO-KCR M	NO-KCR SD
High Anxious	20.7 (N = 10)	3.4	19.5 (N = 10)	3.7
Low Anxious	20.8 (N = 10)	1.3	20.8 (N = 10)	3.4

TABLE II

ANALYSIS OF VARIANCE FOR LOW ERROR RATE PROGRAM

Source	SS	df	F	p
Treatment	3.602	1	0.369	0.554
Anxiety	4.902	1	0.502	0.510
Treatment x Anxiety	3.598	1	0.368	0.555
Error	351.801	36		

TABLE III

MEANS AND STANDARD DEVIATIONS FOR MODERATE ERROR RATE PROGRAM

Test Anxiety Level	KCR M	KCR SD	NO-KCR M	NO-KCR SD
High Anxious	44.7 (N = 10)	10.5	41.1 (N = 10)	13.3
Low Anxious	36.8 (N = 10)	14.8	43.4 (N = 10)	18.1

TABLE IV

ANALYSIS OF VARIANCE FOR MODERATE ERROR RATE PROGRAM

Source	SS	df	F	p
Treatment	22.500	1	0.108	0.743
Anxiety	78.375	1	0.376	0.551
Treatment x Anxiety	260.125	1	1.247	0.271
Error	7511.000	36		

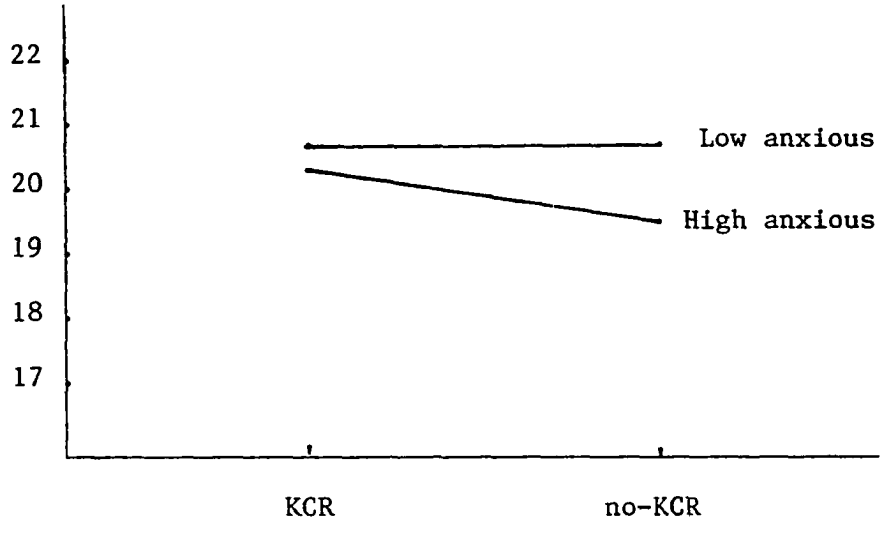

Figure 1. Interaction between Anxiety and Treatment on the Low Error Rate Program.

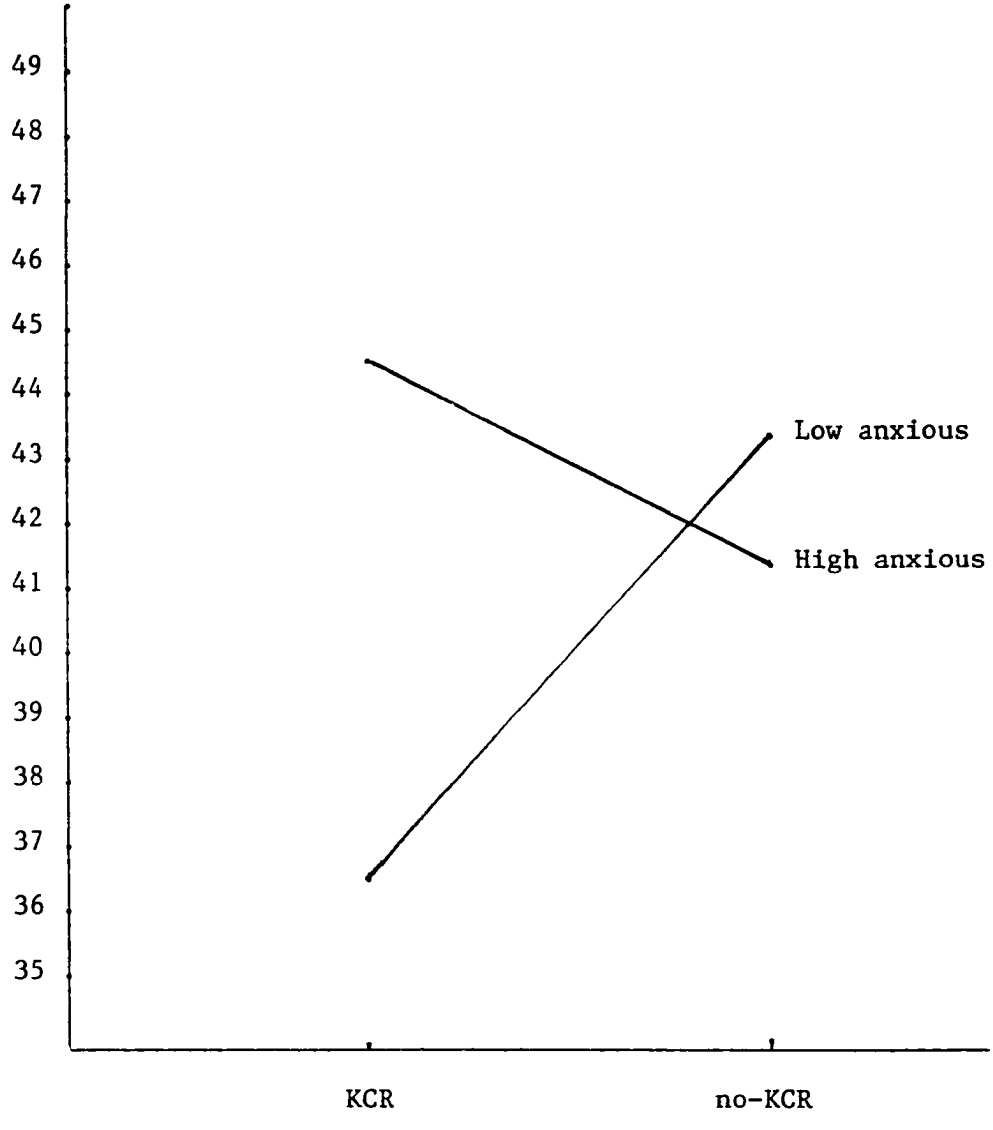

Figure 2. Interaction between Anxiety and Treatment on the Moderate Error Rate Program.

DISCUSSION

The results of this study are in agreement with the results reported by Hall (1969) in that no significant difference was found between test anxiety levels and task difficulty levels under KCR conditions and no-KCR conditions. Hypothesis 1--that providing KCR in the low error rate program will enhance learning for both high and low test anxiety subjects--is not supported. Both subjects working under no-KCR conditions did as well as subjects working under KCR conditions. Hypothesis 2--that in a moderate error rate program, providing KCR will enhance learning--is not supported. This study indicates that providing KCR does not enhance learning not only in the low error rate program, but also in the moderate error rate program. Hypothesis 3--that high test anxiety subjects will be superior in performance in the low error rate program to the low test anxiety subjects--is not supported. Hypothesis 4--that high test anxiety subjects will be inferior in performance in the moderate error rate program--is not supported. In this study, test anxiety levels do not affect learning under either KCR or no-KCR conditions in either low error rate program or moderate error rate program.

In view of the results, KCR does not affect learning either in the low error rate program or in the moderate error rate program. The function of KCR in programmed instruction is not clear.

Hypothesis 5--that in the moderate error rate program, the high test anxiety subjects will be superior in performance under KCR condition while being inferior in performance under no-KCR condition--is not supported in this study. The interaction effect among KCR, test anxiety and error rate is not found.

There are several limitations in this study. One possible reason that this study did not yield a significant difference might be due to the selection of the subjects. Since subjects were required to participate in the experiment for their respective courses, it was their intention to participate in this study in order to obtain credit. They understood that participation was the only thing required and their performance in the program was irrelevant. Under such condition, anxiety might not be actually aroused. As a result, the relationship between KCR and test anxiety does not appear. For anxiety to be meaningfully aroused, the task condition should be stressful and evaluative, so that the subject will internalize his poor performance which causes feelings of negative self-regard. Since this study did not present this kind of stressful and evaluative situation, it is argued that the effect of test anxiety may not fully operate in this study. Also, subjects came from two different courses. Though they were randomly assigned to the learning tasks, there might be some variances which were not controlled.

Another limitation is the program and tests used in this study. The program and tests have not been standardized, though the error rates of both parts were found constant. But, the reliabilities of the tests were relatively low (.66 for the familiar part and .85 for the technical part).

SUMMARY

One hundred and forty-four undergraduates were administered the Achievement Anxiety Test. Based on the scores on the Debilitating Anxiety Scale, 40 subjects in the upper one-third were considered as high test anxious, while 40 subjects in the lower one-third were considered as low test anxious. The high test anxiety subjects were randomly divided into four groups, each group consisting of 10 subjects. The low test anxiety subjects were divided in the same manner. Then, the four groups were randomly assigned to one of the following learning conditions: 1) low error rate lesson with KCR, 2) low error rate lesson without KCR, 3) moderate error rate lesson with KCR, and 4) moderate error rate lesson without KCR. Therefore, in each condition, there are 10 high test anxiety and 10 low test anxiety subjects.

The Diagnosis of Myocardial Infarction was used as the program. The familiar part of this program was used as low error rate lesson, while the technical part was used as moderate error rate lesson. In the no-KCR conditions, the frames remained the same as in the KCR condition, except KCR is omitted. In the learning task, subjects were required to respond actively to the program, by recording their responses to the frames in the booklet. After the learning task, subjects were given a test. This study took two sessions and each session took about an hour.

Two 2-way ANOVA were performed. No significant difference was found in either main effects or interaction between treatments (KCR and no-KCR) and anxiety levels (high and low) in both low and moderate error rate programs. This study indicates that providing KCR does not enhance learning in either low error rate program or moderate error rate program, and that subjects' anxiety level does not affect their performance in the low error rate program and the moderate error rate program under KCR and no-KCR conditions. The hypothesis that high test anxiety subjects will be superior in performance in the low error rate program, while being inferior in performance in the moderate error rate program is not supported by this study.

REFERENCES

Alpert, R., & Haber, R. N. Anxiety in academic achievement situation. Journal of Abnormal and Social Psychology, 1960, 61(2), 207-215.

Anderson, R., Kulhavy, R., & Andre, T. Conditions under which feedback facilitates learning from programmed lessons. Journal of Educational Psychology, 1972, 63(3), 186-188.

Angell, G. The effect of immediate knowledge of quiz results on final examination scores in freshman chemistry. Journal of Educational Research, 1949, 42, 391-394.

Becker, J. The effect of withholding information in auto instructional programs. In Ofiesh, G., & Meierhenry, D. (Eds.), Trends in Programmed Instruction. (Washington, National Education Association and National Society for Programmed Instruction, 1964.)

Berglund, G. W. The effect of partial reinforcement in programmed instruction. Programmed Learning & Educational Technology, 1969, 6(2), 102-108.

Campeau, P. Test anxiety and feedback in programmed instruction. Journal of Educational Psychology, 1968, 59(3), 159-163.

Cook, D., & Mechner, F. Fundamentals of programmed instruction. In Margulies & Elgen's Applied Programmed Instruction. New York: John Wiley & Son, Inc., 1962.

Cram, D. Explaining "Teaching Machine" and Programming. San Francisco: Fearon Publishers, 1961.

Crowder, N. Characteristics of branching programs. In C. Hough, The University of Kansas Conference on Programmed Learning (Vol. 2). Lawrence: University of Kansas Press, 1961.

Feldhusen, J., & Birt, A. Study of nine methods of presentation of programmed learning material. Journal of Educational Research, 1962, 55(9), 461-466.

Glaser, R., & Taber, J. Investigations of the characteristics of programmed learning sequence. University of Pittsburgh. Programmed Learning Laboratory Cooperation Research Project 691, 1961.

Hall, B. W. Anxiety, stress, task difficulty and achievement via programmed instruction. Unpublished doctoral dissertation, Florida State University, 1969.

Hartley, J. Programmed instruction 1954-1974: A review. Programmed Learning & Educational Technology, 1974, 2(6), 278-290.

Holland, P. Research on programming variables. In R. Glaser, Teaching Machines and Programmed Learning II. (Washington, National Educational Association, 1965.)

Hough, J., & Revsin, B. Programmed instruction at the college level: A study of several factors influencing learning. Phi Delta Kappan, 1963, 44, 286-291.

Hull, C. L. Principle of behavior. New York: D. Appleton-Century, 1943.

Kight, H., & Sassenrath, J. Relation of achievement motivation and test anxiety to performance in programmed instruction. Journal of Educational Psychology, 1966, 57(1), 14-17.

Kulhavy, R., Vekovich, F., & Dyer, J. Feedback and response confidence. Journal of Educational Psychology, 1976, 68(5), 529-535.

Lumdaine, A. Assessing the effectiveness of instructional programs. In R. Glaser, Teaching Machine and Programmed Learning II. (Washington, National Educational Association, 1965.)

Mandler, G., & Sarason, S. A study of anxiety and learning. Journal of Abnormal and Social Psychology, 1952, 47, 166-173.

Mann, N., Fernald, L., & Fernald, P. Introduction to Psychology. Boston: Houghton Mifflin Company, 1969.

Melching, W. H. PI under a feedback schedule. National Society for Programmed Instruction Journal, 1966, 5, 14-15.

Melton, A. (Ed.), Apparatus Test, AAF Aviation Psychology program research report No. 4, 1947.

Montague, E. The role of anxiety in serial rote learning. Journal of Experimental Psychology, 1953, 45, 91-96.

Moore, J. W., & Smith, W. I. Knowledge of results in self-teaching spelling. Psychological Reports, 1961, 9, 717-726.

Moore, J. W., & Smith, W. I. Role of knowledge of results in programmed instruction. Psychological Reports, 1964, 14, 407-423.

Nicholson, W. M. Influence of anxiety on learning: interference or drive increment? Journal of Personality, 1958, 26, 303-319.

Pressey, S. L. Development and apprisal of devices providing immediate automatic scoring of objective tests and concomitant self-instruction. Journal of Psychology, 1950, 29, 417-447.

Ripple, R. Comparison of the effectiveness of a programmed text with three other methods of presentation. Psychological Reports, 1963, 12, 227-237.

Sarason, I. B., & Ganzer, V. J. Effects of test anxiety and reinforcement history on verbal behavior. Journal of Abnormal and Social Psychology, 1963, 67, 513-519.

Skinner, B. F. The science of learning and the art of teaching. Harvard Educational Review, 1954, 26(2), 86-96.

Taber, J. L., Glaser, R., & Schaefer, H. H. Learning and Programmed Instruction. Reading, Mass.: Addison-Wesley Publishing Co., Inc., 1965.

Taylor, J. A. A personality scale of manifest anxiety. Journal of Abnormal and Social Psychology, 1953, 48, 285-290.

Taylor, J. A. The relationship of anxiety to the conditioned eyelid response. Journal of Experimental Psychology, 1951, 41(2), 81-91.

Taylor, J. A., & Spence, K. W. The relationship of anxiety level to performance in serial learning. Journal of Experimental Psychology, 1952, 44, 61-64.

Tobias, S. The effect of creativity, response mode, and subject matter familiarity on achievement from programmed instruction. New York: MSS Educational Publishing Company, 1968.

Travers, R. M. W., Van Wagenen, R. K., Haygood, D. H., & McCormick, M. Learning as a consequence of the learner's task involvement under different conditions of feedback. Journal of Educational Psychology, 1964, 55, 167-173.

Wine, J. Test anxiety and direction of attention. Psychological Bulletin, 1971, 76, 92-104.

APPENDIX: PROSPECTUS

INTRODUCTION

Since Skinner's (1954) article on teaching, programmed instruction, in the forms of teaching machines and textbooks, has attracted very much attention. The ideas that educational practices should not be aversive and that contingency of reinforcement should be arranged into the learning process provide fresh guidelines for teaching methods.

According to operant conditioning principle, an ideal learning situation is a process whereby the subject is guided to behave toward predetermined goals through a series of small steps of actions and consequent reinforcement. These small steps of actions form a chain of progressive approximation of behavior until the target behavior is performed by the subject. It is believed that the subject learns a response, when he emits that response and is immediately reinforced. The breaking down of a complex response into a series of actions and reinforcing right after each successful action, provide maximum reinforcement for the subject. It is obvious that the subject learning under such a condition will experience maximum success and minimum failure.

Following this principle, in programmed instruction, the programmer presents a small amount of material followed by a question in frames. The frames are so simple and interrelated that few of the subjects will miss the questions. In addition, immediately after the subject

makes a response, he can read the correct response. Therefore, he receives knowledge of correct result (KCR) immediately after responding so that a contingency between the question and response is established. This contingency, according to Skinner, provides an optimal learning situation for the subject.

To achieve a goal of optimal learning, the program is constructed as "error-free" as possible. The purposes for this practice are based on two assumptions:

1. To most human beings, to know that they have acted correctly is reinforcing. In addition, to progress in a series of actions without making a mistake,which has aversive consequence, has strong motivational effect. As Taber, Glaser, and Schaefer (1965) said:

> . . . Being able to move on, to get into and discover the fine details of subject matter without being incorrect, frustrated or punished for being wrong may be the most potent reinforcing consequence in a programmed instructional sequence. (p. 10)

2. Though making a wrong response is aversive, once a wrong response occurs, it will be strengthened. It is not desirable to practice a wrong response and then to unlearn it because an opportunity to reinforce a correct response has not been utilized. Though KCR can serve as a corrective device, the tendency for the error to recur may not be completely eliminated. In fact, making a wrong response, even though the consequences are aversive, may actually increase the probability that it will reappear.

Senter's law (Seeman, 1964) states that it is impossible to write an item so simple that no subject will miss it. Usually, a 5 to 10 percent error rate is regarded as acceptable. Error rate is calculated by dividing incorrect responses by total responses. However, not all

psychologists feel that an incorrect response will impair learning, especially by those who believe in Configurationist theory. According to this theory, in some instances, error may actually be beneficial to the learning process.

Crowder (1961) considered error to be important with respect to motivation. He said:

> . . . in connection with the motivational function served by the questions in the material, that I have never been an advocate of questions so easy that the learner rarely, if ever, makes an error. I believe that the questions should be of sufficient level of difficulty that the student has the feeling of earning the satisfaction that he receives from getting an answer correct and I think experience is accumulating that shows that if the questions asked are too easy, the student loses motivation after a while. (p. 25)

Lumdaine (1965) also held the belief that too low an error rate might impair performance.

On the other hand, Cram (1961) argued that error in programmed instruction really did not affect achievement much because of:

1. The law of frequency. The subject may sometimes get a wrong answer, but in each frame, he ultimately gets a correct answer. By chance, he will get more right than wrong answers.

2. The law of recency. No matter how many wrong answers a subject may try in response to a frame, the right answer is always the last one and is more likely to be remembered because it comes closest to KCR.

Theoretically, in programmed instruction, KCR should facilitate learning. But, as Schram (1964) pointed out, study after study has shown that programs teach as well when KCR is omitted. In order to have an "error-free" program, cues or prompts are used to reduce the difficulty level of the frame. As a result, the subject can get required information from the frame rather than from KCR. "Error-free" programs may involve

little more than copying behavior. The subject, working in the well-cued program, acts less actively than in the program with higher error rate and, as a result, may learn less well.

Here the contradiction arises. In order to have an "error-free" program so that the subject may experience a maximum reinforcement, frames are constructed to be as easy as possible. But, if the program is too easy, the subject may not pay attention to KCR because he is confident of his response. Therefore, KCR may not have a chance to show its effectiveness as a reinforcer. Thus, the idea of maximum reinforcement is debatable. Even Skinner's own experiment on schedule of reinforcement with animals indicates that variable-ratio schedule of reinforcement is a better method in the maintenance of a behavior. The variable-ratio schedule of reinforcement violates the idea of maximum success and minimum failure.

Many psychologists (Glaser and Taber, 1961; Hartley, 1974; and Holland, 1965) argued that KCR was doubtlessly more important when the probability of error was kept low, as in a typical linear program, it became less important to have KCR. According to this view, a moderate difficulty level should be maintained so that KCR can function as a reinforcer.

One of the problems in applying operant conditioning principle to programmed instruction is the motivational effect. In experiments with animals, the motivational effect is well controlled by depriving the animal of food for a period of time. With humans, this kind of manipulation is impossible. Although it is impossible to manipulate the level of motivation with humans as successfully as with animals, it is possible to look at the level of anxiety of humans which is one indirect measure of motivation. A theory of test anxiety advanced by Mandler and Sarason (1952),

has been used to relate drive levels of the subject to the learning tasks of different difficulty levels. This theory is based on Hull's (1943) theory which states that the total effective drive is determined by the summation of all extant need states, both primary and secondary. Therefore, according to this theory, the higher the drive, the greater the response strength.

Based on this theory, Mandler and Sarason (1952) developed a theory relating the level of test anxiety to the degree of task difficulty. According to this theory, when the task is presented to the subject, it elicits anxiety. Since anxiety is an uncomfortable state, the subject tries to reduce it by performing some responses. Thus, anxiety, in this case, works as a drive to increase the response tendency. However, the effect of anxiety as a drive depends on the degree of complexity of the learning situation. In an easy learning task, such as classical conditioning, the task elicits a strong task relevant response and few weak task irrelevant responses. Under such condition, increasing anxiety increases the strength of the response tendency and, thereby, facilitates performance. In a difficult learning task, such as verbal learning, the task may elicit a weak task relevant response and numerous strong task irrelevant responses. Under such condition, increasing anxiety will impair performance.

Since test anxiety is a specific anxiety, elicited by some characteristics of the learning task, KCR has an effect on the performance because providing KCR removes the test-like characteristics of the task, which is assumed to elicit anxiety. This would especially facilitate learning for the high anxiety subject.

PURPOSES

Since KCR has been shown to be a powerful device in many learning situations, the effect of KCR under different conditions should be explored. As many research results indicate, incorporating KCR into the learning process may not facilitate performance under all conditions. There may be an interaction of KCR with other variables. Since research results have indicated that the omission of KCR does not affect performance in low error rate programs, it is the purpose of this study to find out whether there is a relationship between KCR and error rate.

A second purpose of this study is to propose and investigate a reason for the relationship between KCR and error rate. This difference exists because different levels of error rate affect the subject's anxiety state. Thus, a high error rate program would produce relatively high anxiety. The presence of KCR would reduce the anxiety, while KCR would be less important in a low error rate program because the program would generate less anxiety.

REVIEW OF LITERATURE

KCR

As Porter (1957) points out, almost all tasks require some sort of sensory feedback from the environment. KCR in programmed instruction serves that kind of function. In the experimental situation, the group that receives KCR can learn more rapidly, and reach a higher level of proficiency, than the group that does not receive KCR. This effect has been demonstrated for widely different tasks, from the range-finding experiment to college quiz situations (Pressey, 1950; Angell, 1949). The subject can correct his performance on the basis of information about the direction and the amount of error. For example, in Melton's (1947) training experiments with gunners using the B-29 Pedestal Sight Manipulation test, the gunners who received KCR could do much better than those gunners who received no KCR.

KCR also has a motivational effect. Ammons (1956) believed that the most common effect of KCR was to increase motivation. Elwell and Grindley (1938), in a two-hand coordination test, reported that the subjects who received KCR were more alert and reported enjoying themselves, while those subjects who were deprived of KCR were bored, more often late to experimental sessions, and less careful. However, the relationship between KCR and motivation is not linear. Ammons (1956) said:

> In general, the more a subject knows about what and how he is doing, the more highly motivated he is likely to be. However, motivation does not always increase with increasing knowledge. There is probably little affect when the subject is already performing at a high level of proficiency, and increasing knowledge may actually lead to a decrease in motivation when he is doing poorly. (p. 286)

Under what conditions can KCR facilitate learning? Thorndike (Hartley, 1974) contended that KCR led to better learning when: 1) the learner is motivated, 2) KCR is informative, and 3) the learner knows or is told what to do to correct the error.

Mann, Fernald Jr., and Fernald (1969) argued that the improved performance associated with KCR may be attributed to the following circumstances: 1) repetition of responses known to be successful, 2) attempts to correct responses known to be inadequate, and 3) enhances motivation, in the sense that subjects working with KCR find the task more interesting and try harder to improve their performance.

Error Rate

Error rate has been considered as the factor which influences the effect of KCR in programmed instruction. According to Amsel (1960), elimination of errors in performance might not always promote the most efficient learning. He argued that in a situation where a stimulus elicited several weak responses, making an error might confuse the subject further.

In his review of programmed instruction, Holland (1964) found that six experiments which reported no significant difference between the group receiving KCR and the group receiving no KCR had in common the use of programs with low error rate. He explained that in low error rate programs, the subjects had little doubt of the correctness of their

answers, so KCR is unimportant. He further pointed out that most studies showing an advantage used multiple-choice items with high error rate. He contended that the relationship between item difficulty and KCR might be indicative of the nature of the reinforcer in the program. With difficult, high error rate programs, KCR might be important. Hartley (1974), after reviewing programmed instruction over a period of 20 years (1954-1974), reported the same finding.

There are two studies reporting significant difference between the group recieving KCR and the group receiving no KCR using moderate error rate programs. Anderson, Kulhavy, and Andre (1972), using a lesson on diagnosis of Myocardial infarction, reported that the subjects receiving KCR showed greater learning than those subjects receiving no KCR. Another study reporting significant difference between the group receiving KCR and the group receiving no KCR was conducted by Meyer (1960). She used a program which built vocabulary by using prefixes and suffixes. This program has an error rate of 14 percent.

On the other hand, there are many studies reporting no significant difference between the group receiving KCR and the group receiving no KCR using low error rate programs. Ripple (1963) compared teaching material in a variety of forms, including a standard programmed test with or without KCR. He reported that KCR did not contribute to increased learning.

Moore and Smith (1964), using Holland-Skinner's psychology program (Holland and Skinner, 1961), reported that there was no significant difference between the subjects who received KCR and the subjects who received no KCR. They explained that this was due to two reasons:

1. The group receiving no KCR might have received feedback from succeeding frames or from the frames being studied, since low error rate programs are usually well-prompted.

2. The group receiving no KCR might have been forced to respond more actively to the program. As a result, they learned as well as the group receiving KCR.

Feldhusen and Birt (1962) presented a short program with an error rate of 14 percent to college students under nine different conditions. They concluded that the subjects receiving no KCR did not learn significantly different from the subjects receiving KCR.

Hough and Revsin's (1963) study provided a test of Holland's conclusion. They used a program with an error rate of 2 percent on three different presentation modes. They contended that in low error rate programs, when the students knew that their responses were right, KCR was redundent. This finding supports Holland's conclusion.

Kulhavy, Vekovich, and Dyer (1976) provided a model which assumed that confidence in a response was at least as important as its correctness in determining how KCR was used. When the subject selects a right response that he is sure of, the chances are good that he does little more than briefly check to see that it matches KCR before continuing instruction. However, when the subject is confident of the response, and discovers it is wrong, in this case, KCR should have its greatest corrective effect because the subject understands the material and is likely to spend additional time trying to locate and correct the mistake. Travers, Van Wagenen, Haygood, McCormick (1964) found no difference between saying "right" and giving no comment, when the subject was correct. When he was wrong, there was a great advantage in giving him the right response

in addition to telling him that he was wrong. This finding seems to support Kulhavy's assumption.

Becker (1964) stated that the subject, using a program in which the steps were kept small and the program was well-prompted, would learn without KCR. He used a program on Time Credit Loans, with 180 frames, and reported that the group that received KCR did not learn significantly differently from the group that received no KCR.

Test Anxiety

Test anxiety has been considered as a drive and a stimulus. According to Hull (1943), test anxiety adds to the total drive present and increases the reaction potential of all responses being evoked in the situation. Since reaction potential is a multiplicative function of habit strength and drive, an increase in drive would result in a relatively greater augmentation of reaction potential for those responses with strong habit strength than those which are weaker.

Mandler and Sarason (1952) held an alternative position. According to them, test anxiety can serve as drive-stimulus which may elicit competing responses, facilitating responses or both. Competing responses are those responses which are task irrelevant. According to this position, when the material is presented to the subject, it elicits anxiety. Since test anxiety can work as a drive to increase the reaction potential, the subject with high test anxiety has higher reaction potential and has better performance in the learning task.

Taylor (1951) maintained that anxiety could produce a total effective drive state, and that this value was a determiner of the strength of the conditioned response. Using MMPI to measure anxiety levels of her

subjects in a conditioned eyelid response experiment, she demonstrated that anxious group was consistently superior in degree of conditioning throughout the course of the conditioning trials. Mandler and Sarason (1952) stated that anxiety interfered with the performance only of those subjects who have a habitual class of self-oriented interfering responses. For those subjects who do not have a habitual class of interfering responses, anxiety may facilitate response which is task relevant. Since eyelid response is a classical conditioning response with few competing responses, high anxious subjects have a higher drive level. As a result, they performed better in Taylor's experiment.

Wine (1971) contended that the difference between high and low test anxiety subjects was largely due to the attentional focus difference during the task performance. The low test anxiety subject is internally focused on self-evaluative, self-deprecatory thinking, and perception of his autonomic responses. Thus, he has a disadvantage in a difficult task or evaluative situation. Since he has to divide his attention between internal cues and task cues, he can not pay full attention to the task and perform the task adequately.

Nicholson (1958) argued that difficult tasks were more likely to increase the anxiety level of high test anxiety subjects than easy tasks. The difficulty of the hard task would cause an evaluation on the part of the high test anxiety subject that he was a failure because of his inefficient learning. This feeling of inadequacy will be a threat to his self-esteem and raise the level of anxiety. Consequently, the subject will have a disadvantage in performance with difficult tasks as opposed to easy tasks. In his experiment, he compared the verbal learning of his

high and low test anxiety subjects under task-orienting and ego-orienting instruction. He reported a significant difference between anxiety levels and performance under ego-orienting task, but not under task-orienting tasks.

Mandler and Sarason (1958) investigated the influence of test anxiety on the performance of typical intelligence test items. They reported the following findings:

1. As the learning process proceeded, the scores of high test anxiety subjects tend to improve.

2. A progress report (success or failure) elicited improved performance for the low anxiety group but depressed performance for the high test anxiety group.

3. The optimal conditions for a high test anxiety group are those in which no further reference is made to the testing situation, and the optimal conditions for a low anxiety group are those in which the subjects are given a failure report.

Meunier and Rule (1967) conducted an experiment to assess the role of judgmental confidence in determining differential conformity for high and low test anxiety subjects. They found that following a success, failure, or no feedback experience on matching lengths of lines, high and low test anxiety subjects interpreted the lack of feedback on performance differently. The confidence level of high test anxiety subjects receiving no feedback on performance coincided with their confidence following failure, whereas, the confidence level of low test anxiety subjects receiving no feedback on performance coincided with their confidence level following success.

Montague (1953), using three different values of association (25.5%, 42.7% and 90%) in a paired associated learning task involving nonsense syllables, tested the hypothesis that the effect of test anxiety as a drive in a learning situation depends on the degree of complexity of the learning task. He reported that high test anxiety subjects performed less well than low test anxiety subjects on the high association value items and showed greater improvement of performance as the learning task became easier, and surpassed low test anxiety subjects on the task with the least number of incorrect tendencies.

Campeau (1968) contended that this negative effect happens only in the test-like situation. When the threat of evaluation is removed from the situation, task irrelevant response may be reduced and thereby facilitate performance. He assumed that KCR produced superior achievement for high test anxiety subjects because of two reasons:

1. Providing KCR would constitute a low threat condition which would minimize task-irrelevant responses to anxiety by reducing that anxiety.

2. Task-relevant responses would be reinforced by providing KCR as confirmation. Under KCR learning situation, since KCR is expected to reduce test-like aspects of the task, subjects with high test anxiety would perform better than subjects with low test anxiety. Under no KCR condition, since withholding KCR is expected to accentuate the test-like aspects of the task, anxiety produced by this condition would increase the arousal of task-irrelevant responses, thereby impairing performance. In his experiment, he found: 1) high test anxiety female subjects did significantly better under KCR condition than under no-KCR condition;

2) low test anxiety female subjects did significantly better than high test anxiety female subjects under no-KCR condition; 3) low test anxiety female subjects did as well under KCR condition as they did under no-KCR condition; and 4) these differences cannot be found in male subjects. Therefore, he concluded that programmed procedure should be adapted to individual differences in test anxiety level and sex.

Programmed instruction has been considered as one valuable technique to test the hypothesis of the effect of test anxiety on performance because the subject's rate of performance can be easily recorded and the error rate is kept intentionally low. As Grimes and Allinsmith (1961) pointed out, high test anxiety children work best in highly structured situations. Since programmed instruction does represent a fairly well-structured, non-stressful situation, it would seem plausible to expect the high test anxiety subjects to do better. Kight and Sassenrath (1966), using a linear program on test construction and evaluation, reported that high test anxiety subjects worked faster and made fewer errors than low test anxiety subjects. They explained that the high test anxiety subjects were able to derive greater benefit from KCR and thereby had a better performance.

HYPOTHESES

Based on these findings, this study attempts to clarify some of the apparent contradictions by relating error rate and KCR with test anxiety. Five hypotheses will be tested:

1. Providing KCR in the low error rate program will enhance learning for both high and low test anxiety subjects. The subject working under KCR condition will be superior in learning to the subject working under no-KCR condition.

2. Providing KCR in the moderate error rate program will enhance learning for both high and low test anxiety subjects. Subjects working under KCR will be superior in learning to subjects working under no-KCR.

3. In a low error rate program, since test anxiety produces greater response strength in an easy task, the high test anxiety subjects will do significantly better than the low test anxiety subjects.

4. In addition to task cues, the high test anxiety subjects also focus on internal cues which are irrelevant to task performance. Therefore, in a moderate program, high test anxiety subjects will do significantly worse than low test anxiety subjects.

5. In the moderate error rate program, the high test anxiety subject will do significantly better under KCR condition and significantly worse under no-KCR condition than the low test anxiety subject.

METHOD

Subjects

One hundred and fifty university level undergraduate students will be selected from introductory psychology and educational psychology classes.

Materials

1. The Achievement Anxiety Test developed by Alpert and Haber (1960) will be used to measure test anxiety. This test consists of two measures: a 10-item debilitating anxiety scale and a 9-item facilitating scale. As test anxiety has been defined by the score on the debilitating scale, only the debilitating anxiety scale will be used. The test-retest reliability for a 10-week period is .83. The test-retest reliability over an 8-month period is .75. The item in the scale is a statement followed by a 5-point scale. One item is given as an example as follows:

"Nervousness while taking an exam or test hinders me from doing well."

5	4	3	2	1
always		often		never

2. Two learning lessons are needed in this study: one with error rate of about 5 percent and other with moderate error rate of about 25 percent. The program selected for this study will be the Diagnosis

of Myocardial Infarction originally developed by Mechner and revised by Tobias (1968). This program consists of two parts: familiar and technical. Both deal with various kinds of damage to the heart, their seriousness and reversibility, and the diagnostic significance of ECG tracings from the fifth precordinal lead. The familiar part consists of 54 frames, while the technical part consists of 89 frames. According to Tobias (1968), program difficulty, determined by the percentage of correct response to the program, was 96.6 percent and 81.3 percent for the familiar and technical parts, respectively.

The familiar part will be used as the low error rate program in this study. The technical part will be used as the moderate error rate program. Because of time limit, only the first 60 frames out of 89 frames of the technical part will be used. Both parts will be given in a pilot study to subjects similar to the subjects who will be used in this study.

One item for each part is given as an example as follows:

Familiar part: Heart disease causes more than half of all deaths in the U.S. Consequently, less than _____ of all deaths are due to other causes. (half)

Technical part: Risk factors increase the probability of developing a variety of heart impairments. One such impairment is Myocardial infarction which refers to damage of the heart muscle, or myocardium.

Which part of the word "myocardium" means heart?_____ Which part means muscle?_____. (cardium, myo)

Each part will be used both in KCR and no-KCR conditions except in the no-KCR conditions, KCR is omitted. Each frame is put on a separate 6 x 4 index card.

3. There are two tests developed by Tobias to measure the acquisition of the material covered by the program. The test for the familiar part has an alpha reliability of .66, while the test for the technical part has an alpha reliability of .85. The test for the familiar part consists of 17 completion items with 27 possible points. The test for the technical part consists of 6 completion items with 61 possible points.

Procedures

This study requires two sessions. In the first session, subjects will be given the Achievement Anxiety Test. Subjects' scores on the debilitating anxiety scale will be ranked. The upper one-third will be considered as high test anxious, while the lower one-third will be considered as low test anxious. Only the high and low test anxious subjects will be requested to come back for the second session.

In the second session, high and low test anxious subjects will be randomly assigned to one of the following tasks: 1) low error rate lesson with KCR, 2) low error rate lesson with no-KCR, 3) moderate error rate lesson with KCR, or 4) moderate error rate lesson with no-KCR. Each task group will consist of 10 high test anxious subjects and 10 low test anxious subjects.

Statistical Analysis

Since two different error rate lessons and two different tests will be used in this study, statistical analysis will be performed

separately for the moderate error rate lesson and the low error rate lesson.

Hypotheses 1 and 3 will be tested by a 2 x 2 analysis of variance with two levels of treatment: KCR and no-KCR, and two levels of anxiety: high and low. Scores obtained from the low error rate lesson test will be used for this analysis.

Hypotheses 2, 4, and 5 will be tested by a 2 x 2 analysis of variance with two levels of treatment: KCR and no-KCR, and two levels of anxiety: high and low. Scores obtained from the moderate error rate program will be used for this analysis.

The Conversational Statistical Package will be used.

REFERENCES

Alpert, R., & Haber, R. N. Anxiety in academic achievement situation. Journal of Abnormal and Social Psychology, 1960, 61(2), 207-215.

Ammons, R. B. Effect of knowledge of performance: A survey and tentative theoretical formulation. The Journal of General Psychology, 1956, 54, 279-299.

Amsel, A. Error response and reinforcement schedules in self-instruction. In A. Lumdaine and R. Glaser (Eds.), Teaching machines and programmed instruction. Washington: National Education Association, 1960.

Anderson, R. Educational psychology. Annual Review of Psychology, 1967, 18, 103-164.

Anderson, R., Kulhavy, R., & Andre, T. Conditions under which feedback facilitates learning from programmed lessons. Journal of Educational Psychology, 1972, 63(3), 186-188.

Angell, G. The effect of immediate knowledge of quiz results on final examination scores in freshman chemistry. Journal of Educational Research, 1949, 42, 391-394.

Becker, J. The effect of withholding information in auto instructional programs. In G. Ofiesh & D. Meierhenry (Eds.), Trends in programmed instruction. Washington: National Education Association and National Society for Programmed Instruction, 1964.

Campeau, P. Test anxiety and feedback in programmed instruction. Journal of Educational Psychology, 1968, 59(3), 159-163.

Child, I. Personality. Annual Review of Psychology, 1954, 5, 149-170.

Cram, D. Explaining "Teaching Machines" and programming. San Francisco: Fearon Publishers, 1961.

Crowder, N. Characteristics of branching programs. The University of of Kansas conference on programmed learning by C. Hough. Lawrence: University of Kansas Publication, 1961, 2(2), 22-27.

Elwell, J., & Grindley, G. The effect of knowledge of results on learning and performance: A coordinated movement of the two hands. British Journal of Psychology, 1938, 39, 39-54.

Feldhusen, J., & Birt, A. Study of nine methods of presentation of programmed learning material. Journal of Education Research, 1962, 55 (9), 461-466.

Glaser, R., & Taber, J. Investigations of the characteristics of programmed learning sequence. University of Pittsburgh. Programmed Learning Laboratory Cooperation Research Project 691, 1961.

Grimes, J., & Allinsmith, W. Compulsivity, anxiety, and school achievement. Merrill-Palmer Quarterly, 1961, 7, 247-269.

Hartley, J. Programmed instruction 1954-1974: A review. Programmed Learning and Educational Technology, 1974, 2(6), 278-290.

Holland, J. Research on programming variables. In R. Glaser (Ed.), Teaching machines and programmed learning II. Washington: National Educational Association, 1965.

Holland, J. G., & Skinner, B. F. The analysis of behavior. New York: McGraw-Hill, 1961.

Hough, J., & Revsin, B. Programmed instruction at the college level: A study of several factors influencing learning. Phi Delta Kappan, 1963, 44, 286-291.

Hull, C. C. Principle of behavior. New York: D. Appleton-Century, 1943.

Kight, H., & Sassenrath, J. Relation of achievement motivation and test anxiety to performance in programmed instruction. Journal of Educational Psychology, 1966, 57(1), 14-17.

Kulhavy, R., Vekovich, F., & Dyer, J. Feedback and response confidence. Journal of Educational Psychology, 1976, 68(5), 529-535.

Lumdaine, A. Assessing the effectiveness of instructional programs. In R. Glaser (Ed.), Teaching machine and programmed learning II. Washington: National Educational Association, 1965.

Mandler, G., & Sarason, S. A study of anxiety and learning. Journal of Abnormal and Social Psychology, 1952, 47, 166-173.

Mann, N., Fernald, L., Jr., & Fernald, P. Introduction to psychology. Boston: Houghton Mifflin Company, 1969.

Melton, A. (Ed.) Apparatus Test. AAF Aviation Psychology Program Research Report, 1947, 4.

Meunier, C., & Rule, B. Anxiety, confidence and conformity. Journal of Personality, 1967, 35, 498-504.

Montague, E. The role of anxiety in serial rote learning. Journal of Experimental Psychology, 1953, 45, 91-96.

Moore, J. W., & Smith, W. I. Knowledge of results in self-teaching spelling. Psychological Reports, 1961, 9, 717-726.

Moore, J. W., & Smith, W. I. Role of knowledge of results in programmed instruction. Psychological Reports, 1964, 14, 407-423.

Nicholson, W. M. Influence of anxiety on learning: Interference or drive increment? Journal of Personality, 1958, 26, 303-319.

Porter, D. A critical review of a portion of the literature on teaching devices. Harvard Educational Review, 1957, 27(2), 126-142.

Pressey, S. L. Development and appraisal of devices providing immediate automatic scoring of objective tests and concomitant self-instruction. Journal of Psychology, 1950, 29, 417-447.

Ripple, R. Comparison of the effectiveness of a programmed text with three other methods of presentation. Psychological Reports, 1963, 12, 227-237.

Schramm, W. The research on PI: An annotated bibliography. Washington: U. S. Office of Education, 1964, 558-584.

Seeman, W. Phenomenon. American Psychologist, 1964, 772.

Skinner, B. F. The science of learning and the art of teaching. Harvard Educational Review, 1954, 24(2), 86-96.

Taber, J. L., Glaser, R., & Schaefer, H. H. Learning and programmed instruction. Reading, Mass.: Addison-Wesley Publishing Co., Inc., 1965.

Taylor, J. A. The relationship of anxiety to the conditioned eyelid response. Journal of Experimental Psychology, 1951, 41(2), 81-91.

Tobias, S. The effect of creativity, response mode, and subject matter familiarity on achievement from programmed instruction. New York: MSS Educational Publishing Company, 1968.

Travers, R. M. W., Van Wagenen, R. K., Haygood, D. H., & McCormick, M. Learning as a consequence of the learner's task involvement under different conditions of feedback. Journal of Educational Psychology, 1964, 55, 167-173.

Wine, J. Test anxiety and direction of attention. Psychological Bulletin, 1971, 76, 92-104.