8-1976

A Study of the Relationships of Personality Characteristics to Performance on Programmed Instruction

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by

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A Dissertation
Submitted to the
Faculty of The Graduate College
in partial fulfillment
of the
Degree of Doctor of Education

Western Michigan University
Kalamazoo, Michigan
August 1976

ACKNOWLEDGEMENTS

It is with great pleasure that I express my appreciation to the many people who helped bring this study and doctoral program to completion.

To Ken Dickie, my advisor and chairman, for his patience, help, and guidance throughout all phases of this study.

To Hardy Carroll and Uldis Smidchens, my committee members, for their friendship, advice, and professional guidance.

To the students and faculty at Western Michigan University for their willingness to cooperate and help in this research study.

To Dave Cowden and Nellie Stell for their friendship and support in all phases of my program.

To Dick Houchard for his assistance on the many phases of my computer work.

To my parents for their love and guidance without which none of this would have been possible.

To the many others who are not noted individually, but whose help is gratefully acknowledged.

Fredrick A. Michels

76-26,757

MICHELS, Fredrick Arthur, 1946-
A STUDY OF THE RELATIONSHIPS OF PERSONALITY CHARACTERISTICS TO PERFORMANCE ON PROGRAMMED INSTRUCTION.

Western Michigan University, Ed.D., 1976
Education, general

Xerox University Microfilms, Ann Arbor, Michigan 48106

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CHAPTER I

THE PROBLEM AND ITS BACKGROUND

Purpose of the Study

In recent decades instructional media educators have become increasingly concerned with individual learner differences when prescribing instructional approaches. Research concerned with studying the effects of individual learner differences as they relate to instructional approaches indicates that such differences may be useful in prescribing different instructional approaches (Haskell, 1971). Consequently, the purpose of this study was to investigate the possible relationships between personality characteristics of learners and their achievement under one specific method of instruction--a linear-type programmed instructional text.

In the past, instructional media research has generally pitted one instructional method against another in a given subject producing the same monotonous results of finding no statistically significant differences in facilitating learning (Saettler, 1968). Frequently this research involves the comparison of "traditional" classroom instruction versus some method of programmed instruction. Speaking about research in this area Snow and Salomon (1968) stated, "almost all of the research evidence accumulated to date applies to some generalized 'average student,' and thus to no one" (p. 341). Silberman's (1962) survey of research on programmed instruction versus traditional instruction exemplifies the state of such methodological research:

> The most popular findings in the studies reported, . . .is that no significant differences were obtained among treatment comparisons. Where significant differences were obtained, they seldom agreed with findings of other studies on the same problem. It is to be expected that (non significant) differences are the rule rather than the exception. (p. 186)

Schramm's survey of research studies on programmed instruction versus traditional instruction depicts equally inconclusive results. In surveying 36 such studies Schramm (1964) reported 18 studies showed no significant differences, 17 favored the programmed approach, and one favored the conventional approach. He also noted the inconsistency of findings across studies and especially noted the possibility of the Hawthorne effect existing in relation to the programmed approach.

Many of the studies of learning under different instructional approaches simply assign students to two or more different treatments, compare average performance and find no differences. Instructional research of the type just cited often fails to account for individual differences among learners. Statistical techniques used in these studies usually employ some method of averaging and thus tend to cancel out the effects of individual differences by treating all individuals as units without consideration of these differences. The inadequacies of these studies in failing to account for individual differences indicate the research value of studying these differences in relation to instructional methods.

The failure of these studies has also honed the awareness of educational researchers that instructional approaches must be conceptualized as some combination of learning theory and individual learner differences (Snow & Salomon, 1968). One of the goals of research in instructional media is to determine how to assign different media to the learning task. Through the judicious assignment of media appropriate to the learning task, content, and individual differences a greater level of instructional effectiveness can be reached (Majer, 1970). In speaking about the relationship between individual differences and the instructional environment Haskell (1971) stated:

> Researchers have only begun to identify the vast array of possible relationships between learner characteristics and the instructional environment. . . .Current research findings are sketchy, and much more information is needed. (p. 295)

Except for the area of subject knowledge, individualized instruction in the form of programmed instruction has generally failed to compensate for individual differences (Snow & Salomon, 1968). There is a growing awareness among educational researchers that the effectiveness of individualized programmed instruction will vary from student to student dependent upon certain individual differences. To underline the problem and introduce the solution proposed here the statement by Cronbach (1957) is particularly apt:

> Applied psychologists should deal with treatments and persons simultaneously. Treatments are characterized by many dimensions; so are persons. . . .We should design treatments, not to fit the average person, but to fit groups of students with particular aptitude patterns. (p. 681)

Gagné (1964) supports Cronbach when he suggested that individual aptitudes must be ranked among the most important variables in studying complex learning. Aptitude is defined as any individual difference variable that functions selectively in relation to learning, that is, it facilitates learning in some situations for some students while interfering with learning for others. The point being made is that the effectiveness of instruction may not be in the method of instruction per se but rather in an interaction between learner characteristics and instructional approach.

Research which has investigated the effects of individual learner differences in relation to instructional methods has provided an indication that such learner characteristics may be useful in perscribing instructional approaches (Haskell, 1971). Snow and Salomon (1968) have indicated that potential interactions with instructional approaches are likely to reside in three main classes of variables: (1) intellectual abilities; (2) specific personality variables; and (3) cognitive style factors. In addition to these three major classes additional classes such as predispositional factors and interest factors could be added. In reviewing research on individual learner differences and media characteristics Allen (1969) stated:

> The conclusion that may be drawn from the research and development on learner characteristics is that these factors are highly important in learning from instructional media and that there is doubtless some pattern of media-learner relationships. Except for some evidence about mental ability, however, this pattern is not yet discernible. (p. 137)

In studying research related to individual learner differences and instructional treatments Cronbach and Snow (1969) stated that it is likely personality characteristics will have a significant bearing on an individual's response to a given method of instruction. They further stated: "There is considerable reason to think that the student's personality does affect his response to the classroom, and there ought to be a steady research effort on this problem" (Cronbach & Snow, 1969, p. 191).

Consequently the following research study concentrated on personality characteristics for the following reasons: (1) the statements of needed research in this area as exemplified by Haskell (1971), Allen (1969), and Cronbach and Snow (1969); (2) the evidence already collected concerning intellectual ability and instructional media (Allen, 1969); and (3) the contention by Briggs (1968) that the majority of variance as reflected by cognitive style could be accounted for by the learner's general ability, special aptitudes and entering competencies. In summary, this research study was undertaken to study the relationships between certain personality characteristics of learners and their performance using a linear-type programmed instructional test.

The remainder of this chapter has a two-fold purpose. First, it will present a selected review of literature concerning personality characteristics and student performance in programmed instruction. It will focus on research studies on personality characteristics in an attempt to determine the potential usefulness of using personality characteristics in prescribing an instructional method that will maximize learning for individual students. It will show that personality differences do affect an individual's response in a given instructional situation. In addition, inconsistencies and similarities of research findings will be pointed out. Further, it is intended to show the need and possibility of using personality characteristics in predicting student performance in programmed instruction. The first part has been divided into four major areas and will be presented as follows: (1) problems encountered in interpreting and comparing research findings in the area of personality research; (2) IQ as an aptitude variable and student performance in programmed instruction; (3) learner attitudes toward programmed learning or instructional content and their performance in programmed instruction; and (4) personality characteristics and student performance in programmed instruction. In conclusion, the second purpose is to delineate the specific research hypotheses investigated in this research study.

As mentioned earlier, many other research studies have attempted to utilize personality variables in predicting academic performance or achievement. Generally these studies have been concerned with two types of personality assessments: (1) the learner's individual basic personality style (introversion, extroversion, sociability, aggression, etc.); or (2) the learner's motivational state (anxiety, achievement motivation, and/or level of interest in the subject matter) (Haskell, 1969). Allen (1969), Briggs (1969), and Cronbach and Snow (1969) provide some of the most comprehensive reviews of research on predicting academic achievement from individual learner characteristics.

Interpretation and comparison of these studies are difficult. Numerous personality assessments were used (California Personality Inventory, Edwards Personal Preference Schedule, Guilford-Zimmerman Temperament Survey, etc.) and the variables were sometimes studied singularly and at other times in a multivariate approach. In addition, there also is a problem in trying to compare personality characteristics from different personality inventories. What is meant by "creativity" or "sociability" in one personality inventory may have a different connotation in another. Finally, problems arise from the fact that different amounts of relevant prior learning existed and different age groups and subject matter were used in the studies.

Many problems also exist in the interpretation of research findings because of the manner in which the data were analyzed. Because aptitude-treatment interaction studies are relatively new, several bad procedures have been widely used (Cronbach & Snow, 1969). Many of the studies on personality and achievement in programmed instruction have only focused on means and correlations without stating the standard deviations. However, the regression slope and thus the interaction is influenced by differences in standard deviations. Interpretations are also often made from the correlations rather than the regression slopes. Frequently the characteristic is "blocked" producing two groups or, in some cases, three with a high, medium and low aptitude group. This allows a 2 x 2 or 2 x 3 analysis of variance. However, this analysis technique does not take into account differences within these blocks as a regression test would and thus weaker interactions may be lost (Cronbach & Snow, 1969). Nevertheless, the findings of these investigations are encouraging and relationships between personality variables and achievement are beginning to emerge (Barton, Dielman & Cattell, 1972; Dallos, 1975; Haskell, 1971).

Probably the factor which has received the greatest attention in the prediction of academic achievement has been some measure of the aptitude variable intelligence. This measure was usually reported as an IQ score or a grade point average (GPA). Achievement from instructional programs has been found to be positively correlated with IQ; higher IQ scores correlated with lower error rate, less time to complete the program, and higher retention scores (Barton, Dielman & Cattell, 1972; Dallos, 1975). However, an interesting fact that has emerged from these studies was that even when the subjects were equated for IQ, considerable differences in achievement scores persisted. In fact only about 30 percent of the total variance in achievement scores can be accounted for in terms of IQ (Dallos, 1975). A plausible hypothesis that can be drawn from these studies is that other factors, perhaps personality variables, may also be related to achievement.

In studying the relationships of personality variables interacting with student achievement in programmed instruction the learner's attitude toward the content or mode of delivery would appear to be an important determinant of achievement. Usually in the programmed learning approach the student operates on his own and maintaining a favorable attitude would seem important in order for the student to operate efficiently and effectively. However, this contention was not generally supported in the research studies on programmed instruction.

A research study conducted by Fiks (1964) using three different linear-type constructed response programs (one in psychology, another in space travel, and the third in automobile safety) found no statistically significant relationship between "liking" programmed instruction and subject matter content or posttest scores. Over 1,000 subjects' attitudes toward programmed instruction were measured in this research study and ages ranged from below 20 to over 60. An important finding resulting from this study showed that the older subjects showed a significantly lower learning performance ($p < .01$) and higher mean attitude ($p < .001$) toward programmed instruction, but the exact reverse was true for the 20-39 year old group who learned the most and liked the method of presentation the least (Fiks, 1964). These results tended to contradict the contention held by some that programmed instruction works because people like it. It also indicated that subjects can perform well even if they have a low attitude to this particular mode of presentation.

The results reported by Fiks were also supported by Armstrong (1971). In a survey of research studies involving attitudes and programmed instruction Armstrong reported there was no relationship between a learner's attitude toward programmed instruction and his achievement in programmed instruction provided the learner made an effort to complete the programmed instruction. Similar results were reported earlier by Roe et. al. (1960) and Sutter and Reid (1969). The former study compared six different instructional methods and found no relationship between "liking" programmed instruction and posttest scores. In the latter study using paired and unpaired groups in a computer-assisted instructional programmed approach to problem solving the authors found no statistically significant difference between student attitudes toward the instructional medium and achievement. Armstrong (1971) also reported that the majority of students had favorable attitudes toward programmed learning but these attitudes regressed toward indifference with time.

In trying to identify those personality characteristics which interacted with computer-assisted instruction (CAI) Majer (1970) studied multiple personality characteristics in relation to achievement in this type of programmed instruction. Majer administered three different personality tests (FACTS Questionnaire, College Student Questionnaire, and the Omnibus Personality Inventory) plus a scholastic achievement test to students in an introductory college physics course. Two separate stepwise multiple regression analyses were performed regressing the dependent variable (final test score) on the personality variables and other measures obtained prior to the treatment for those who took the computer-assisted instruction and those who took the traditional classroom instruction. For the CAI/Media group the $\underline{R}^2$ was .51 and for the control group it was .76 (Majer, 1970). Positive correlations of .22 and .10 (CAI group) and .45 and .38 (control group) were found between final test performance and scholastic achievement test scores and Religious Orientation scores on the Omnibus Personality Inventory (OPI). Those students who were more academically prepared or intellectually capable and those students who had more liberal religious views were more successful than their counterparts with either mode of instruction.

Variables unique to the CAI/Media group regression equation, as opposed to the traditional classroom instruction group regression equation, were measures of academic maturity, altruism, estheticism and social conscience. The students who performed well on the performance criteria on the computer-assisted instruction were characterized by a low degree of concern for inquiry, diverse interest, and artistic activities, and a high degree of concern for affiliation, trust, social injustices and institutional wrongdoing (Majer, 1970). The research findings in the area of creativity were also supported in the research done by Doty and Doty (1964) and Ripple and O'Reilly (1966) using programmed instruction. Both of these research studies reported a negative correlation between creativity and success using a linear-type programmed instructional text.

Sutter and Reid (1969) compared achievement scores in problem solving using computer-assisted instruction between individuals and students paired in relation to certain personality characteristics. They reported undergraduate students who scored high in sociability (as defined by the California Personality Inventory) and low in test anxiety (as defined by Sarason's Test Anxiety scale) achieved better in pairs while students low in sociability and high in test anxiety achieved better alone. Without regard to the personality variables, the achievement scores of the students working alone were not statistically different than the students working in pairs. Dominance as defined by the California Personality Inventory was not statistically significantly correlated with achievement for either group (Sutter & Reid, 1969). Similar findings were reported by Reid et. al. (1973) using the same personality inventories, and individuals and paired college students working on computer-assisted instruction in scientific notation and exponentiation.

Haskell (1971) studied student achievement in relation to multiple personality characteristics under a linear-type programmed instructional booklet approach and a lecture-discussion presentation approach in a high school arch welding class. Individual scores on each of the ten personality traits of the Guilford-Zimmerman Temperament Survey (GZTS) were used, as well as general mental ability scores. Those students who scored high on either the Restraint or Emotional Stability scales performed better ($p < .001$) than their counterparts in both instructional modes. The programmed approach favored significantly ($p < .05$) those who were slow and methodical (low General Activity) and/or could be characterized as "easy to get along with," or friendly (high Friendliness).

Using personality characteristics from the Edwards Personal Preference Schedule (EPPS), Blitz and Timothy (1973) investigated whether different relationships existed between these personality characteristics and student performance using a CAI and programmed text (PT) approach. The subjects were third-year dentistry students taking an oral pathology course via the two programmed approaches. The only correlations of CAI and PT scores with each personality characteristic measured on the EPPS that were statistically different ($p < .05$) from each other were for the characteristic "order," with a negative correlation (-.30) reported for the CAI group, and a positive correlation (.28) reported for the programmed text group. The correlations were not analyzed for statistically significant differences for each group and their performance on the programmed instruction. The strength and direction of the correlations were also too weak or inconsistent to formulate any conclusions concerning their relationship with the findings reported in the above studies (Haskell, 1971; Majer, 1970; Sutter & Reid, 1969; etc.).

In investigating specific personality characteristics in relation to achievement in programmed instruction, it seems logical that some measure of the personality characteristic "sociability" would interact with an individualized programmed approach as was indicated in the Sutter and Reid (1969) and Reid et. al. (1973) studies. Social reinforcers have been shown to be important determinants of human behavior. The student characterized by a strong need for social recognition might perform less adequately in an individualized instructional programmed approach than his counterpart who is rewarded by meeting self-imposed standards. Although Haskell (1971) was not able to find such a relationship Doty and Doty (1964) and Traweek (1964) reported that sociability was related to the programmed instructional approach. In the former study the introductory psychology students who performed well on the programmed instructional task--physiological psychology--were characterized by a lower need for social interaction ($p < .01$); and in the latter study Traweek reported the fourth grade students who were more withdrawn were the more successful students ($p < .01$) in the programmed approach on fractions. A relationship was found in the Doty and Doty (1964) study between achievement on the programmed instruction and student GPA's ($p < .01$), but the Traweek (1964) study was not able to identify this difference. Beach (1960), Ripple et. al. (1967), and Sutter and Reid (1969) also found a relationship between sociability and achievement under different instructional environments with the instructional situation providing the least opportunity for interaction favoring the students who scored lower on the sociability tests.

Another personality characteristic that appears to interact with programmed instruction is the need for autonomy. Lublin (1965) reported that college students in an introductory psychology course who had lower autonomy scores on the Edwards Personal Preference Schedule (EPPS) achieved significantly ($p < .05$) higher scores on the programmed instructional material. Traweek (1964) reported that students who had lower scores on the self-reliance subscore of the California Test of Personality were the more successful ($p < .05$) in the programmed approach.

Two other personality characteristics often studied in relation to achievement in programmed instruction are test anxiety and achievement motivation. It would certainly seem plausible that a relationship would exist between anxiety and achievement in programmed instruction. Specifically, it would seem that the sequential, systematic, step-by-step approach, the high ratio of reinforcement, and the reduction of uncertainty which characterizes most programmed instruction would be advantageous to high-anxious students. However, the research findings are inconsistent concerning the relationship between anxiety and programmed instruction. Campeau (1965) found an interaction between anxiety and feedback in programmed instruction on earth-sun relationships for fifth grade girls, but not for boys. The high-anxious girls' group achieved significantly ($p < .025$) higher scores on the programmed instruction than the low-anxious girls' group with the constructed response form. Her findings also indicated that low-anxious girls would profit from learning conditions where motivation was kept high. Traweek (1964) reported a relationship between test anxiety ($p < .01$), but not general anxiety and achievement on programmed instruction for fourth grade children. The successful children scored significantly ($p < .01$) higher on the Sarason Test Anxiety scale for children than the unsuccessful children. In a study with eighth-grade students Ripple et. al. (1967) reported that high-anxious students achieved less under both the conventional and programmed approach in vocabulary development. Ripple and O'Reilly (1966) reported similar results with sixth grade students in achievement using a linear-type programmed instructional text on latitude and longitude.

Kight and Sassenrath (1966) suggested that the multi-dimensional aspect of anxiety was important. Specifically, low-anxious students perform better than high-anxious students when the task is complex or involves stress-motivating instructions. In a study involving undergraduate students in psychology, and what the authors defined as easy material (low item difficulty) dealing with the construction and analysis of classroom achievement tests, Kight and Sassenrath (1966) reported that students with high-test-anxiety scores required less time to complete the programmed material ($p < .05$) and made fewer errors ($p < .05$) on the material than did the low-test-anxiety group. However, there were no differences found on the short term retention test. Shrable and Sassenrath (1970), replicating the Kight and Sassenrath (1966) study, found the same interaction between test-anxiety and number of errors on the programmed material, but were not able to identify differences in the amount of time required to complete the program. Herbert and Sassenrath (1973), using similar material on educational measurement and upper division college students, reported no differences between test-anxiety and achievement on the programmed instruction for time to complete the program, error rate, or retention. In contrast to these results, Tobias and Abramson (1971) reported debilitating anxiety interacted with stress on easy programmed material but not with complex technical content.

Three of the studies cited above (Herbert & Sassenrath, 1973; Kight & Sassenrath, 1966; Shrable & Sassenrath, 1970) also studied achievement motivation in relation to performance on the programmed materials. In all three studies achievement motivation was assessed by the achievement imagery score (AI) from the Iowa Picture Interpretation Test (IPIT). Kight and Sassenrath (1966) reported a significant ($p < .01$) interaction between achievement motivation and performance on programmed instruction. Those students with high-achievement-motivation completed the program in less time, made fewer errors and received higher retention scores than low-achievement-motivated groups.

In contrast to these results, the research findings by Shrable and Sassenrath (1970) and Herbert and Sassenrath (1973) failed to associate higher scores on any of these three criterion measures and achievement-motivation. Doty and Doty (1964), using achievement need scores from the Edwards Personal Preference Schedule, also failed to show a relationship between achievement need and performance on programmed instruction.

This review of the literature has indicated that personality characteristics do affect an individual's response in a given instructional situation and patterns are beginning to emerge. Many of the studies reviewed (Doty & Doty, 1964; Majer, 1970; Ripple & O'Reilly, 1966) have shown a negative relationship between creativity and performance in programmed instruction. Sociability has also been shown to be negatively correlated to performance on programmed instruction (Doty & Doty, 1964; Reid et. al., 1973; Sutter & Reid, 1969; Traweek, 1964). Negative correlations were also generally reported for autonomy (Lublin, 1965; Traweek, 1964) and student performance on programmed instruction.

While patterns are beginning to emerge, a great deal of inconsistency still remains; an excellent example in point is that of anxiety. Kight and Sassenrath (1966) and Traweek (1964) reported a positive relationship between test anxiety and performance on programmed instruction, but Herbert and Sassenrath (1973) and Ripple and O'Reilly (1966) found no differences. Ripple et. al. (1967) reported high-anxious students achieved less under both the conventional and programmed approach. Achievement-motivation was found to be significantly ($p < .05$) related to performance by Kight and Sassenrath (1966), but Shrable and

Sassenrath (1970) and Herbert and Sassenrath (1973) reported no differences. Similar inconsistencies existed for other personality characteristics.

Although personality characteristics have been shown to differentially affect learner responses in interacting with programmed instruction, the conflicting research results concerning this interaction and the data analysis techniques generally used necessitates further research before a general instructional theory can be formulated and utilized with confidence. Of particular concern to this investigator were personality characteristics measured by the Edwards Personal Preference Schedule that might differentially affect learner responses in interacting with programmed instruction. The objective of this study was to investigate the predictive ability of these variables in estimating learner performance with a linear-type programmed instructional text.

Based on the results reported in former research studies, the data analysis techniques used, and the expressed need for further research the following research hypothesis was tested:

> There is a predictive relationship between certain personality characteristics of students as measured by the Edwards Personal Preference Schedule and student performance on a linear-type programmed instructional text on the construction of odd magic squares.

Performance was measured in three ways: (1) posttest scores on the programmed material on the construction of odd magic squares; (2) the number of items correct on the posttest per unit of time measured in minutes to complete the posttest instrument; and (3) the time taken to complete the programmed instructional text.

To test the above hypothesis a subhypothesis was formulated for each personality characteristic measured by the Edwards Personal Preference Schedule (EPPS). Each of these subhypotheses is listed below with the accompanying manifest needs associated with that personality characteristic as given in the Edwards Personal Preference Schedule (Edwards, 1959). The relationship between a personality characteristic identified in each of the following subhypotheses and student performance was measured using the same three-fold criteria of performance listed above.

1. There is a relationship between achievement need as measured by the EPPS and student performance on this linear-type programmed instructional text. Achievement need is the need to do one's best, to be successful, to be a recognized authority, to do a difficult job well, to be able to do things better than others.

2. There is a relationship between deference as measured by the EPPS and student performance on this linear-type programmed instructional text. Deference is the need to get suggestions from others, to follow instructions and do what is expected, to accept the leadership of others, to conform to custom and to let others make decisions.

3. There is a relationship between order as measured by the EPPS and student performance on this linear-type programmed instructional text. Order is the need to have things organized, to make plans before starting on a task, to keep things neat, to have things arranged so that they run smoothly and without change.

4. There is a relationship between exhibition as measured by the EPPS and student performance on this linear-type programmed instructional text. Exhibition is the need to say witty and clever things, to tell jokes and amusing stories, to talk about personal adventures, to be the center of attraction, to use words the others do not know the meaning of, to ask questions others cannot answer.

5. There is a relationship between autonomy as measured by the EPPS and student performance on this linear-type programmed instructional text. Autonomy is the need to be able to come and go as desired, to do what one wants, to do things that are unconventional, to criticize those in positions of authority, to avoid responsibility and obligations.

6. There is a relationship between affiliation as measured by the EPPS and student performance on this linear-type programmed instructional text. Affiliation is the need to be loyal to friends, to participate in friendly groups, to make new friends, to share things with friends, to do things with friends rather than alone, to form strong attachments.

7. There is a relationship between intraception as measured by the EPPS and student performance on this linear-type programmed instructional text. Intraception is the need to analyze one's motives and feelings, 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 motives of others.

8. There is a relationship between succorance as measured by the EPPS and student performance on this linear-type programmed instructional text. Succorance is the need to have others provide help when in trouble, to seek encouragement from others, to receive a great deal of affection from others, to be helped by others when depressed, to have a fuss made over one when hurt or sick.

9. There is a relationship between dominance as measured by the EPPS and student performance on this linear-type programmed instructional text. Dominance is the need to argue one's point of view, to be a leader in groups to which one belongs, to be elected or appointed chairman of committees, to persuade and influence others to do what one wants, to supervise and direct the actions of others.

10. There is a relationship between abasement as measured by the EPPS and student performance on this linear-type programmed instructional text. Abasement is the need to feel guilty when one does something wrong, to feel the need for punishment for wrong doing, to feel depressed by an inability to handle situations, to feel timid in the presence of superiors, to feel inferior to others in most respects.

11. There is a relationship between nurturance as measured by the EPPS and student performance on this linear-type programmed instructional text. Nurturance is the need to help friends when they are in trouble, to treat others with kindness and sympathy, to forgive others, to be generous with others, to have others confide in one about personal problems.

12. There is a relationship between change as measured by the EPPS and student performance on this linear-type programmed instructional text. Change is the need to do new and different things, to travel and meet new people, to try new and different jobs, to participate in new fads and fashions.

13. There is a relationship between endurance as measured by the EPPS and student performance on this linear-type programmed instructional text. Endurance is the need to keep at a job until it is finished, to work hard at a task, to work at a single job before taking on others, 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.

14. There is a relationship between heterosexuality as measured by the EPPS and student performance on this linear-type programmed instructional text. Heterosexuality is the need to go out with members of the opposite sex, to be in love with someone of the opposite sex, to be regarded as physically attractive by those of the opposite sex, to listen to or to tell jokes involving sex, to be sexually excited.

15. There is a relationship between aggression as measured by the EPPS and student performance on this linear-type programmed instructional text. Aggression is the need to attack contrary points of view, to criticize others publicly, to get revenge for insults, to become angry, to blame others when things go wrong, to read accounts of violence.

CHAPTER II

DESIGN AND METHODOLOGY

This chapter is divided into four parts and presented as follows: (1) subjects; (2) instrumentation; (3) procedures; (4) data analysis.

Subjects

The experimental subjects that were used for this research study were students attending Western Michigan University, Kalamazoo. The students were drawn from five introductory Audio-Visual Media I classes during the Winter semester of 1976. This course is offered every semester at Western Michigan University. The sample population represented all the classes in Audio-Visual Media I that were offered on campus during the Winter semester. The Audio-Visual Media I classes were selected for the following reasons: (1) the students were easily accessible to the researcher; (2) they represented a mixture of both graduate and undergraduate students; and (3) the students were those who might readily use programmed instruction as part of their regular class.

A total of 67 students completed both the Edwards Personal Preference Schedule and programmed instructional unit on the construction of odd magic squares. Four of these students did not take the posttest, saying they did not want to be tested on the content and were therefore dropped from the final data analyses. The class profile data shown in Table 1 on page 22 were obtained from the student information sheets (Appendix B) filled out by the students prior to completing the programmed instructional unit on the construction of odd magic squares.

It was evident that the majority of students in the Audio-Visual Media I classes were graduate students and female. For those students who reported their undergraduate grade point average (GPA) the mean was 3.22. Approximately 40 percent or 26 students indicated they had taken no college mathematics courses.

TABLE 1

Audio-Visual Media I Class Profile

	Population			
	Juniors	Seniors	Graduates	Total
Males	0	1	16	17
Females	10	12	24	46
Mean undergraduate GPA	3.20	3.45	3.17	3.24
Semester hours of college math	2.30	3.77	5.15	4.41

Instrumentation

The programmed instruction

A linear-type programmed instructional booklet on the construction of odd magic squares (Appendix C) was utilized for this research study. An odd magic square is a matrix in which consecutive numbers of a given interval are placed such that the numbers in any row, column or diagonal total to the same sum. It is possible to place the numbers in the cells correctly through a trial-and-error method but the larger the matrix the more difficult this becomes. There are five basic rules a student must learn to construct an odd magic square. They are as follows: (1) where you place the first number; (2) what happens when a number falls in the top row; (3) what happens when a number falls in the right hand column; (4) what happens when a number falls in the top right hand cell; and (4) what happens when a number falls somewhere other than in the top row or right hand column. Once these rules have been mastered they can be used to construct any size odd magic square from a 3 x 3 to a 99 x 99.

This program represented several unique advantages to the researcher. First, it was a task that could be learned in one presentation and yet difficult enough to require some skill in completing the task. The task was difficult enough so that the student could not learn the necessary skills through a cursory reading of the programmed instructional unit. Second, actual performance of the task was easily measured on the posttest instrument. Performance on the criterion task required integrated use of the rules and could be analyzed into a comprehensible hierarchy of skills (Armstrong, 1971). Questions concerning rule learning could also be asked to test the transfer of learning to different but similar situations. Third, the necessary entry level skills could usually be safely assumed. Fourth, there is almost total ignorance of the rules on how to construct odd magic squares. Finally, the content of the programmed instructional text was not directly associated with any particular subject matter area (although a mathematics background might possibly be an asset) and therefore prior knowledge should not be a determining factor. Since the programmed instructional unit was introduced to the students as part of a research study, and not as class work for which they would be graded, the motivational level of the students should have been relatively equal.

Pilot test

The programmed instructional unit on the construction of odd magic squares was pilot tested with two media classes the semester prior to the experimental study. The primary purpose of this pilot test was to validate the programmed unit and obtain reliability data. It was also designed to yield information about the approximate time needed to complete the program, identify any problems and obtain data to perfect program procedures. The two classes used to pilot test the programmed instructional unit were Audio-Visual Media I (n=13) and Instructional Development (n=13). The pretest, programmed instruction and posttest were all given during one class period. The material was presented to the students as part of a research project being conducted by a doctoral student. Attached to the posttest was a short ten-item questionnaire which asked the students to evaluate the programmed unit they had just taken and to give any suggestions they might have which would improve the program.

The assumption of almost universal ignorance of the rules on how to construct an odd magic square was substantiated on the pretest. Of those students who did attempt to answer the pretest items, none were able to construct an odd magic square or knew any of the rules underlying its construction. Time to complete the programmed instruction varied from 19 minutes to one hour. The postcourse achievement instrument consisted of a 12-item constructed response objective test. Two of the test items required the entire completion of a five-by-five and seven-by-seven odd magic square matrix. Each test item was scored dichotomously as either right or wrong including the two magic square matrices. Two reliability coefficients were computed for the posttest instrument. The Kuder-Richardson Formula 21 (Gronlund, 1971, p. 107) yielded a reliability coefficient of .74, and the Spearman-Brown odd-even split half reliability (Gronlund, 1971, p. 106) was .91.

Analysis of the comments made on the posttest concerning the instructional program indicated areas where changes, corrections, and revisions were needed in both the programmed instruction and posttest achievement instrument. Most of the changes made in both the programmed instruction and posttest were editorial in nature. Changes in the programmed instruction consisted of the following: (1) adding one frame and dropping two others; (2) combining two frames; and (3) changing wording for better clarification and consistency. The postcourse achievement instrument was only slightly modified by dropping one test item, adding another, and clarifying one question. The format of the pretest was also changed so that it more closely paralleled the posttest and therefore facilitated student responses to the questions.

Validity

Content and face validity can be judged by assessing whether the objectives outlined for the programmed instructional unit on the construction of odd magic squares were reflected in the posttest achievement instrument. The objectives (Appendix G) listed for the programmed unit consisted of one terminal objective, nine enabling objectives, and six entry level skills. The terminal objective as well as the integrated use of the majority of enabling objectives were assessed by item ten on the posttest (Appendix F) which required the complete construction of an odd magic square. Specifically, this test item required demonstrated competency of the terminal objective and integrated use of enabling objectives one, five, six, seven, eight, and nine. The enabling objectives one, two, three, five, six, seven, eight, and nine were assessed by test items seven, one, eight, two, five, four, six, and three respectively. Test itmes eleven and twelve were rotated odd magic squares and tested whether the student was able to use rule learning--a higher order learning strategy.

The Edwards Personal Preference Schedule

Student personality characteristics were measured by the Edwards Personal Preference Schedule (Edwards, 1953). This instrument was designed primarily for research and counseling purposes to provide a measure of the normal (nonpathological) individual's personality characteristics. The EPPS provides a measure of the following 15 personality characteristics: (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; and (15) aggression. In addition to these 15 personality traits the EPPS also provides a measure of test consistency. Test consistency is based on the comparison of the number of identical choices made between the same two statements repeated 15 times. The EPPS consists of 225 pairs of statements relating to personality traits. The individual is forced to choose between two statements and mark the one which is more characteristic of what he would like to do or how he feels. If neither of the statements is accurate, he is forced to choose the one statement that he feels is the least inaccurate.

The Edwards Personal Preference Schedule was chosen for this research study for the following reasons: (1) it was primarily designed for research purposes; (2) it was a measure of diverse personality characteristics which was important in attempting to identify characteristics that might be related to performance on programmed instruction; and (3) it contained measures of personality characteristics found to be related to performance in the research studies reviewed on programmed instruction. Reliability coefficients for the EPPS range from .55 to .87 with a median of .73. Use of the EPPS is widespread in research and it has been used in similar studies (Blitz & Timothy, 1973; Doty & Doty, 1964). Appropriateness and validity of this instrument in measuring personality characteristics have been supported by several sources (Barron, 1959; Lublin, 1965; Radcliffe, 1965).

Procedures

First, a letter (Appendix H) was sent to each of the instructors teaching an introductory Audio-Visual Media I class asking for permission to utilize their classes in the research study. Approximately one week later a personal visit was made to each instructor. At this time the purpose of the study was explained in greater detail, classroom procedures to be used were discussed, and dates and times to administer the Edwards Personal Preference Schedule and the programmed instruction were set. The instructors from all five sections agreed to let their classes participate in the research study.

After obtaining the instructors' permission to use their classes, the EPPS was administered to all the students during a regular class period. The inventory was administered to all the classes within a nine day period. The instructor of each class told the students that participation was on a voluntary basis--all students volunteered to participate. The students were told that they would be taking a personality inventory and at a later date a programmed instructional unit on the construction of odd magic squares. The only other information provided the students at this time was that the information was being collected for a research study and the full details of the study could not be explained to them until after all the data had been collected.

Prior to administering the inventory, the general directions for completing the Edwards were discussed with the students (Edwards, 1953). Responses were recorded on mark sense sheets designed and authorized to be used with the EPPS and published by the Optical Scanning Corporation (Appendix I). The answer sheets were then machine scored using the procedures outlined in the EPPS manual (Edwards, 1959, p. 7). Percentile scores for each student were then recorded for the 15 personality characteristics measured by the Edwards Personal Preference Schedule.

At a later date in the semester the students were given the programmed instructional unit on the construction of odd magic squares (Appendix C). First, a pretest (Appendix E) was given to all the students before handing out the programmed instruction to assess whether any of the students already knew how to construct an odd magic square. After everyone had completed the pretest, the programmed instruction, along with the confirmation booklet (Appendix D), were given to the students. A cover sheet (Appendix A) and student information sheet (Appendix B) were attached to the programmed instruction. The students were instructed to work through the programmed instruction at their own pace. As the students finished, they were to turn in their programmed booklet, pick up a posttest, complete the posttest, and turn it in. As each student handed in his programmed instructional text the time was recorded on the text. The same procedure was followed for the posttest. Time to complete the programmed instruction was computed by subtracting the time the students started the program from the time they finished. As indicated above, the starting time was the same for all students. Time to complete the posttest was computed by subtracting the time marked on the programmed instruction from that on the posttest.

Scoring

Each of the test items on the pretest (Appendix E) and posttest (Appendix F) was scored dichotomously as either right or wrong except for the items that required the completion of an odd magic square (question eight on the pretest and questions ten and eleven on the posttest). Test item number one on the posttest can be used to illustrate the dichotomous scoring technique used. The correct responses for item one were illustrations A and B and both of these responses had to be checked before the item was counted correct. If only A or only B was checked, or if the student checked another response in addition to A and B, the item was scored as incorrect. The same procedure was followed for the rest of the items except for the three noted above.

The two test items on the completion of an empty odd magic square (item number eight on the pretest and number ten on the posttest) were worth five points each. One point was given for the correct application of each of the five rules needed to construct an odd magic square. The five rules used were those presented in the programmed instruction and are as follows:

1. Where you place the first number.
2. What happens when a number falls in the top row.
3. What happens when a number falls in the top right cell.
4. What happens when a number falls in the extreme right column.
5. What happens when a number falls somewhere other than in the top row or extreme right column.

Rules one and four required only one correct application in the construction of a correct odd magic square. Rules two and three required four correct applications before a point was given for each rule. Rule five had to be correctly applied in each of the remaining cells. For posttest item number twelve (a rotated odd magic square), only four points were given because rule one had already been used in supplying the student with the correct starting cell and number. This scoring technique resulted in a total of 12 possible points on the pretest (one point for items one through seven, and five points for item eight) and 19 possible points on the posttest (one point for items one through nine and eleven, five points for item ten, and four points for item twelve).

Reliability

The reliability of the posttest instrument was measured by means of the Kuder-Richardson Formula 21 (Gronlund, 1971, p. 107). The following formula given in Gronlund was used to compute the reliability of the test:

$$\text{Reliability Coefficient (KR21)} = \frac{K}{K-1}\left(1 - \frac{M(K - M)}{Ks^2}\right)$$

where K = the number of items in the test
M = the mean (arithmetic average) of the test scores
s = the standard deviation of the test scores

This formula can be appropriately applied to test results any time the instrument was scored on the number of responses correct. Use of this formula will yield approximately the same value as the Kuder-Richardson Formula 20, although in most cases the reliability coefficient will be smaller (Gronlund, 1971). Also, since the primary purpose of the post-test instrument was to measure a single concept, that is, whether the student could construct an odd magic square, the Kuder-Richardson formula was highly appropriate because it stresses the equivalence of all test items and, as stated by Ary (1972), is "especially appropriate when the intention of the test is to measure a single trait" (p. 208). Consequently the above formula was utilized and a reliability coefficient of .88 was obtained.

Data Analysis

The data were primarily analyzed by means of a stepwise multiple regression analysis (Houchard, 1974). Stepwise multiple regression analyses were performed to assess the effectiveness of each independent variable and different combinations of variables in the prediction of performance using a linear-type programmed instructional text. Three separate stepwise multiple regression analyses were performed. The first analysis regressed the dependent variable performance--as measured by the posttest scores--on the personality characteristics of the Edwards Personal Preference Schedule; the second analysis regressed the dependent variable performance--as measured by the number of items correct on the posttest per unit of time in minutes to complete the posttest--on the personality characteristics. Although there were no restraints on the amount of time taken to complete the programmed instruction, time may well be an important consideration when prescribing an instructional approach. Consequently, the third analysis regressed the variable performance--as measured by time to complete the programmed instructional text on the construction of odd magic squares--on the personality characteristics of the EPPS.

The regression analysis indicated the predictive strength of the identified personality characteristics of the Edwards Personal Preference Schedule in estimating performance on the linear-type programmed instructional text on odd magic squares. The stepwise multiple regression analysis provided the increase in the coefficient of determination contributed by each independent variable as it was added to the regression equation and the regression coefficients of the independent variables. The correlation coefficients between the personality characteristics on the Edwards Personal Preference Schedule and performance on the programmed instructional unit on odd magic squares were also checked for statistical significance. In addition, each of the independent variables was plotted against the dependent variable to determine if any curvilinear relationships existed. Although not originally stated as a research hypothesis, a multiple regression analysis was also performed regressing the students' posttest scores for test items ten and twelve which required rule learning--a higher order learning strategy--on the personality characteristics of the EPPS. The appropriateness of the statistical technique of regression analysis has been previously discussed and widely used throughout personality research (Barton, Dielman & Cattell, 1972; Majer, 1970; Tobias & Abramson, 1971). Additional analyses were performed to test if differences existed for subgroups within the sample population as defined by sex, class standing, grade point average, or semester hours of college mathematics.

CHAPTER III

RESULTS AND DISCUSSION

Scores on the pretest instrument substantiated the assumption (as did the pilot test) that the students did not know how to construct an odd magic square and were unfamiliar with the rules underlying its construction. Table 2 summarizes the results from the pretest. As indicated in Table 2 the majority of students (83%) were totally unfamiliar with the rules on constructing odd magic squares. The highest score achieved by any student was four items out of a possible 12 or 33%.

TABLE 2

Pretest Scores for Subjects

Score	Frequency	% of Students
0 (0%)	52	83
1 (8%)	7	11
2 (17%)	3	5
4 (33%)	1	1

Results from the posttest (Table 3, p. 35) tended to support the assumption that the task was difficult enough so that the content could not be mastered through a cursory reading of the programmed material. The mean score on the posttest instrument was 14,22 or 75%. While this mean appeared somewhat low for programmed instruction, it was comparable to what had been reported in similar studies (Blitz & Timothy, 1973) and the median was at the 84% level of success which was considerably above the mean.

TABLE 3

Posttest Scores for Subjects

Score	Frequency	% of Students
2 (10%)	1	2
3 (16%)	1	2
5 (26%)	2	3
8 (42%)	2	3
9 (47%)	8	12
10 (53%)	3	5
11 (58%)	2	3
12 (63%)	2	3
13 (68%)	3	5
14 (74%)	2	3
15 (79%)	5	8
16 (84%)	4	6
17 (89%)	4	6
18 (95%)	13	22
19 (100%)	11	17

Mean = 14.22
SD = 4.60
N = 63

To test the main research hypothesis--there is a relationship between certain personality characteristics of students as measured by the Edwards Personal Preference Schedule and their performance on the programmed instructional text on the construction of odd magic squares--a stepwise multiple regression analysis was used (Houchard, 1974). The model for the computer program on the stepwise regression analysis used was adapted from Ralston and Wilf (1960, p. 191-203). This program uses a step up or forward-selection procedure. The computer first selects the independent variable, X_a, contributing the greatest reduction in sum of squares of the dependent variable, Y, and calculates regression statistics. After fitting X_a in the regression, it then selects the independent variable, X_b, which contributes the greatest additional reduction in sum of squares, and calculates regression statistics. This process continues until the additional contribution to the reduction in sum of squares is too small to satisfy a specified $\underline{F}$ value.

However, before analyzing the data using this multiple regression technique, scatter plots were produced (Houchard, 1974) to determine if any curvilinear relationships existed between the independent variables--personality characteristics--and the dependent variable--performance on the programmed instruction. Examination of scatter plots failed to indicate any curvilinear relationships existing between the dependent and independent variables and, consequently, stepwise multiple regression analyses were performed. Three separate stepwise multiple regression analyses were performed regressing the dependent variable "performance" on the personality measures obtained from the Edwards Personal Preference Schedule. A separate regression analysis was performed for each measure of performance: (1) posttest scores on the programmed instructional text on odd magic squares; (2) number of items correct on the posttest per unit of time in minutes to complete the posttest; and (3) time to complete the programmed instructional text on odd magic squares.

The results from the first regression analysis are summarized in Table 4 (p. 37).

TABLE 4

Stepwise Regression for Posttest Scores

	Step 1 Int	Step 2 Chg	Step 15 All
F value	3.45	2.52	0.22
Probability	.07	.12	.73
Standard error of estimate	4.51	4.46	4.69
Multiple correlation coefficient	.23	.30	.45
Constant	12.21	14.24	17.39

The F test was used to determine if an independent variable, X_a, offered a statistically significant contribution in accounting for the variance in the dependent variable, Y. When each independent variable was added, the increase in the R^2 was calculated and tested for statistical significance using an F test. The probabilities listed in Table 4 refer to this F test. A formula for this F test is outlined in Kerlinger (1973, p. 625) as follows:

$$F = \frac{\left(R^2_{y.12\ldots k_1} - R^2_{y.12\ldots k_1}\right) / (k_1 - k_2)}{\left(1 - R^2_{y.12\ldots k_1}\right) / (N - k_1 - k_2)}$$

where k_1 = number of independent variables of the larger R^2
k_2 = number of independent variables of the smaller R^2
N = number of observations or cases

Only the first two steps of the stepwise multiple regression analysis were provided in Table 4 (because of the lack of statistical significance associated with these variables in increasing R^2) and the final step which included the multiple correlation coefficient for all 15 personality characteristics. After all 15 personality characteristics had been entered, the optimum regression function yielded a multiple correlation coefficient of .45 which was not statistically significant at the .05 level, F (15, 47) = .78, p = .69.

Further analyses are provided in Table 5 which indicates the regression coefficient, standard error of the regression coefficient, beta weight, t ratio, and probability associated with the regression coefficient for each personality characteristic.

TABLE 5

t tests of Regression Coefficients
for Posttest Scores

Personality Characteristic	Regr. Coeff.	Std. Error of Coeff.	Beta Weight	t	p
Achievement	.02	.03	.11	0.51	.61
Deference	-.03	.03	-.20	-1.00	.32
Order	.02	.04	.11	0.47	.64
Exhibition	-.01	.04	-.04	-0.19	.85
Autonomy	-.04	.04	-.25	-1.21	.23
Affiliation	.00	.03	.01	0.05	.93
Intraception	.04	.03	.23	1.07	.29
Succorance	-.02	.04	-.14	-0.60	.55
Dominance	-.02	.04	-.15	-0.63	.53
Abasement	-.00	.04	-.00	-0.00	.99
Nurturance	.02	.03	.14	0.57	.57
Change	-.03	.04	-.16	-0.67	.50
Endurance	-.02	.04	-.13	-0.52	.60
Heterosexuality	.01	.05	.07	0.24	.81
Aggression	.02	.03	.09	0.49	.62

The beta weights are standard partial regression coefficients. These would be used if the scores on the independent variables were expressed as standard scores with a mean of zero and a standard deviation of one. Partial means that the effects of the independent variables, other than the one to which the weight applies, are held constant. These beta weights can be obtained with the following formula (cf. Kerlinger, 1973, p. 625):

$$\beta_j = \frac{b_j S_j}{S_y}$$

where b_j = regression weight
S_j = standard deviation of variable j
S_y = standard deviation of Y

A t test of a regression coefficient indicates whether or not a regression weight differs significantly from zero; if it does, the variable associated with that regression coefficient contributes significantly to the regression--the other variables being taken into account (Kerlinger, 1973, p. 619). As indicated in Table 5, the regression coefficients associated with each of the personality characteristics also failed to reach a statistically significant level.

A multiple regression analysis (Houchard, 1974) was used to separately analyze the posttest scores on test items ten and twelve which required rule learning--a higher order learning strategy. The results of this analysis yielded a multiple correlation coefficient of .51 which was not statistically significant, F (15, 47) = 1.15, p = .34. The regression coefficients also were not significant at the .05 level.

The second stepwise regression analysis regressed the dependent variable performance, as measured by the number of items correct on the posttest per unit of time (measured in minutes) to complete the posttest, on the 15 personality characteristics of the EPPS. The results from this data analysis are summarized in Table 6 (p. 40).

TABLE 6

Stepwise Regression for Posttest Scores Over Time

	Step 1 Dom	Step 2 Het	Step 15 All
F value	3.60	2.16	0.32
Probability	.06	.15	.96
Standard error of estimate	1.21	1.20	1.28
Multiple correlation coefficient	.24	.30	.44
Constant	2.53	1.85	2.91

TABLE 7

t tests of Regression Coefficients for Posttest Scores Over Time

Personality Characteristic	Regr. Coeff.	Std. Error of Coeff.	Beta Weight	t	p
Achievement	.01	.01	.16	0.73	.47
Deference	-.01	.01	-.18	-0.90	.37
Order	-.00	.01	-.13	-0.56	.58
Exhibition	-.00	.01	-.01	-0.06	.96
Autonomy	-.00	.01	-.07	-0.32	.75
Affiliation	-.01	.01	-.17	-0.71	.48
Intraception	-.00	.01	-.07	-0.34	.74
Succorance	-.00	.01	-.11	-0.49	.63
Dominance	-.01	.01	-.25	-1.03	.31
Abasement	.00	.01	.01	0.04	.96
Nurturance	.00	.01	.16	0.64	.52
Change	.00	.01	.06	0.23	.82
Endurance	.00	.01	.10	0.39	.70
Heterosexuality	.01	.01	.17	0.61	.54
Aggression	-.01	.01	-.19	-1.00	.32

As in the former stepwise regression analysis the best single predictor, dominance, failed to reach a statistically significant level. The final multiple correlation coefficient (.44) also was not statistically significant at the .05 level F (15, 47) = .74, p = .73. Further analyses provided in Table 7 (p. 40) show the lack of relationship between the predictor variables and the dependent variable. The high probabilities associated with the regression coefficients in this analysis and the former indicate that these variables contribute little to the regression when all other personality characteristics are taken into account.

The third and final stepwise regression analysis regressed the dependent variable performance--as measured by time to complete the programmed instructional text on odd magic squares--on the personality characteristics of the students measured by the Edwards Personal Preference Schedule. Results of this analysis are summarized in Table 8 (p. 42). In the first step the personality characteristic of deference was extracted as contributing significantly ($p < .01$) to the regression but dropped to the .32 level of significance with the addition of abasement being added in step two of the regression analysis. The final multiple correlation coefficient (.47) also was not statistically significant at the .05 level. Further analyses, as shown in Table 9 (p. 42), indicated that the t ratios of the regression coefficients did not reach statistically significant levels, although, as indicated by the probabilities, the characteristics of abasement, endurance, and heterosexuality appeared to interact more with this measure of performance than the former two measures. Also, as indicated in the table, when all the personality characteristics were taken into account, the

TABLE 8

Stepwise Regression for Time
to Complete the Programmed Instruction

	Step 1 Def	Step 2 Aba	Step 15 All
F value	6.92	1.02	0.46
Probability	.01	.32	.50
Standard error of estimate	7.35	7.34	7.80
Multiple correlation coefficient	.32	.12	.47
Constant	34.28	33.22	-25.26

TABLE 9

$\underline{t}$ tests of Regression Coefficients
for Time to Complete the Programmed Instruction

Personality Characteristic	Regr. Coeff.	Std. Error of Coeff.	Beta Weight	t	p
Achievement	.02	.05	.07	0.34	.74
Deference	-.05	.05	-.18	-0.95	.34
Order	.07	.06	.25	1.14	.26
Exhibition	.09	.06	.33	1.48	.15
Autonomy	.04	.06	.14	0.68	.50
Affiliation	.08	.06	.33	1.43	.16
Intraception	.05	.05	.19	0.93	.36
Succorance	.06	.06	.20	0.87	.39
Dominance	.09	.06	.35	1.56	.14
Abasement	.12	.06	.46	1.82	.08
Nurturance	.06	.06	.24	1.00	.32
Change	.11	.07	.36	1.53	.13
Endurance	.12	.07	.42	1.68	.10
Heterosexuality	.15	.09	.46	1.67	.10
Aggression	.05	.05	.18	0.93	.33

regression coefficient for deference did not contribute significantly to the regression ($\underline{t}$ = -.95; p < .34).

In summary, the statistical technique of stepwise multiple regression analysis on the research data failed to reject the null hypothesis and, therefore, no support was found for the main research hypothesis in this study. The analysis of the data failed to support a relationship between personality characteristics of students measured by the EPPS and student performance on a linear-type programmed instructional text in terms of posttest scores, number of items correct on the posttest per unit of time to complete the posttest, or time to complete the programmed instruction. The only personality characteristic that was found to interact with performance on the programmed instruction, measured in terms of time to complete the programmed instruction, was the personality characteristic of deference. In all three analyses the multiple regression coefficient was very stable, only deviating a total of three one-hundredths (.47 to .44), and the probabilities associated with these multiple regression coefficients were also very high. The lack of a predictive relationship between these personality characteristics and performance on the programmed instruction was further substantiated by the low $\underline{t}$ ratios and resulting high probabilities associated with the regression weights for each of the personality characteristics measured by the EPPS. It would appear that the variance in performance of students using this programmed instructional text cannot be explained by differences in personality characteristics--at least not in this study.

To test each of the 15 subhypotheses for statistical significance, Pearson product-moment correlations (Houchard, 1974) were obtained between each of the respective personality characteristics measured by the Edwards Personal Preference Schedule and performance on the programmed instructional unit on odd magic squares. Performance was measured by the same three-fold criterion: (1) number of items correct on the posttest; (2) number of items correct on the posttest per unit of time to complete the posttest; and (3) time to complete the programmed instruction. Each of the correlation coefficients was then checked for statistical significance. The data results are summarized in Table 10.

TABLE 10

Correlations Between Performance and Personality Characteristics

Personality Characteristic	Posttest Score	Posttest / Time	Prog. Inst. Time
Achievement	-.02	.11	-.13
Deference	-.15	-.14	-.32*
Order	.03	-.04	-.04
Exhibition	-.04	.03	.10
Autonomy	-.21	.09	.02
Affiliation	.08	-.11	-.05
Intraception	.23	-.02	.02
Succorance	.03	-.02	-.02
Dominance	-.10	-.24	.04
Abasement	.02	-.04	.04
Nurturance	.12	.06	-.07
Change	-.18	.09	.03
Endurance	.01	.06	.04
Heterosexuality	.04	.16	.18
Aggression	.04	-.11	.19

*$p < .05$

The only personality characteristic that was related to any of the three measures of performance was deference ($p < .05$; two-tailed test). As expected, this was the same personality characteristic that, when taken alone, was extracted by the stepwise regression analysis as offering a significant ($p < .01$) contribution to the regression in predicting time to complete the programmed instruction.

Deference is defined in the EPPS as the need to get suggestions from others, to find out what others think, to do what is expected, to conform to convention, to let others make decisions (Edwards, 1959). The negative correlation (-.32) between time to complete the programmed instructional text and the personality characteristic of deference would seem to indicate that students with a high deference score may need more guidance, interaction, or explanation than was offered in the programmed instruction. The nature of programmed instruction, at least in the manner presented in this research study, assumes adequate information and instructions are included in the programmed instruction to allow the student to progress through the material without further explanation. The negative correlation would tend to indicate that those students with high deference scores may need more guidance and direction than their counterparts. While students with high deference needs probably wanted to do what was expected and wanted to follow instructions they also may have needed more direction. The negative correlation between deference and posttest scores (-.15) would seem to support this assumption. It might also be that those students with high deference needs were more careful and checked every response, needing the reinforcement provided by the confirmation of a correct response.

Analyses of the data provided on the student information sheets were performed to determine what influences or differences, if any, these variables had upon student performance. To test what influence GPA's or semester hours of college mathematics had upon student performance, a simple regression analysis of the form:

$$Y' = ax + b$$

where Y' = predicted scores of the dependent variable
a = regression coefficient
x = score on the independent variable
b = intercept constant

was performed for each of the three measures of performance. The multiple regression analysis in Statpack (Houchard, 1974) was used to analyze the data. This analysis produces the same result as a simple regression analysis when only one independent variable is entered.

Results of the data analyses are summarized in Tables 11 and 12.

TABLE 11

Analysis of Variance for the Regression Using Math

Source	df	MS	F	p
Posttest score				
Regression	1	30.58	1.46	.23
Residuals	61	21.02		
Posttest/time				
Regression	1	1.11	0.72	.40
Residuals	61	1.54		
PI time				
Regression	1	8.42	0.14	.71
Residuals	61	59.97		

TABLE 12

Analysis of Variance for the Regression Using GPA

Source	df	MS	F	p
Posttest score				
Regression	1	23.03	1.27	.26
Residuals	53	18.07		
Posttest/time				
Regression	1	0.81	0.51	.48
Residuals	53	1.60		
PI time				
Regression	1	17.67	0.28	.60
Residuals	53	64.15		

As indicated by the results in these tables, neither the *F* ratios for GPA's nor semester hours of college mathematics reached statistical significance at the .05 level on any of the three measures of performance. It would appear that the programmed instruction did not favor those who had more math or higher GPA's, nor were these variables any better predictors of success than the personality characteristics.

To test if differences in performance existed between male and female students, a *t* test (Houchard, 1974) was performed between the sex of the respondents and their performance on the programmed instruction. The results of these data analyses are summarized in Table 13 (p. 48). The results of these data analyses indicated no statistically significant differences between the sex of the respondents and their performance on the programmed instructional text on odd magic squares.

TABLE 13

t tests of Significance
Between Males and Females

Source	Mean (N=17) M	Mean (N=46) FM	Mean (N=17) M	Mean (N=46) FM	t	p
Posttest	13.59	14.46	5.00	4.48	0.66	.51
Posttest/time	2.11	1.94	1.96	0.86	-0.46	.64
PI time	30.88	31.15	6.65	8.11	0.12	.90

A one way analysis of variance (Houchard, 1974) was used to test for differences between performance on the programmed task and class standing.

TABLE 14

Analysis of Variance on Class Standing

Source	df	MS	F	p
Posttest score				
Between	2	103.6	5.62	.01**
Within	60	18.43		
Posttest/time				
Between	2	5.50	3.93	.02*
Within	60	1.40		
PI time				
Between	2	49.92	0.84	.44
Within	60	59.45		

*$p < .05$
**$p < .01$

Audio-Visual Media I classes are open to upper classmen (juniors and seniors) and graduate students. As indicated in Table 14, a significant *F* ratio was obtained between class standing and performance on the programmed instructional unit for the performance criteria measuring number of items correct on the posttest ($p < .01$) and number of items correct on the posttest per unit of time to complete the posttest ($p < .02$).

Since a significant *F* ratio was obtained for two of the measures of performance, a multiple comparison technique was used to test the significance among means. The Scheffe (Glass & Stanley, 1970) method of multiple comparisons was used because of the unequal sample sizes. This post hoc analysis revealed seniors achieved significantly higher scores ($p < .05$) on the posttest than the juniors and graduates (see Table 15, p. 50). However, with the small sample size, any hypotheses would be tenuous at best and probably the only safe conclusions that can be reported are the data results.

The results from the data analyses indicated little support for a predictive relationship between personality characteristics and performance on programmed instruction. The only personality characteristic found to be related to performance on the programmed instruction was deference--and then only on the time to complete the programmed text. No relationship was found between this variable and posttest scores, or posttest scores per unit of time to complete the posttest. Increase in time spent on the programmed instruction did not increase efficiency on the posttest instrument; in fact, a negative correlation was found between deference and both of these performance criteria. Analyses of the other background variables obtained in this study (sex, GPA, and

TABLE 15

Post Hoc Analyses on Class Standing

Contrasts	Ratio of $\hat{\psi}$ to $\hat{\sigma}_{\hat{\psi}}$
Posttest score	
$\bar{X}_1 - \bar{X}_2$	-3.56*
$\bar{X}_1 - \bar{X}_3$	0.24
$\bar{X}_2 - \bar{X}_3$	3.31*
$\frac{\bar{X}_1 + \bar{X}_2}{2} - \bar{X}_3$	2.09
Posttest/time	
$\bar{X}_1 - \bar{X}_2$	-2.51
$\bar{X}_1 - \bar{X}_3$	-1.43
$\bar{X}_2 - \bar{X}_3$	2.46
$\frac{\bar{X}_1 + \bar{X}_2}{2} - \bar{X}_3$	0.93

$\bar{X}_1$ = juniors
$\bar{X}_2$ = seniors
$\bar{X}_3$ = graduates

*$p < .05$

semester hours of math) indicated these variables did not interact with the dependent variable. Although differences were found between class standing and posttest scores, sample sizes were too small to draw any substantive conclusions. On the basis of this study and data analyses, performance on the programmed instruction could not be explained by these background measures or differences in personality. While deference was found to be related to one measure of performance on the programmed instruction, this did not constitute much support for the research hypotheses.

CHAPTER IV

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This research was concerned with studying the effects of individual student differences as they relate to instructional approaches. Specifically, the study investigated the predictive relationships between certain personality characteristics of students and their performance on a linear-type programmed instructional unit. The assumption underlying this study was that some individuals learn better under one instructional mode while others under another--there is no one best way.

The research study was conducted to measure what extent performance on a programmed instructional task could be predicted from a linear combination of personality characteristics. The subjects used for this research study were students enrolled in five sections of Audio-Visual Media I at Western Michigan University. All the students taking Audio-Visual Media I participated in the study, other than those who were absent on the days the personality inventory and programmed instruction were administered. Students in these classes were juniors, seniors, and graduate students.

First, the Edwards Personal Preference Schedule--a personality inventory that was designed for research and counseling purposes--was administered to the students. At a later date in the term the students were given a linear-type programmed instructional text on the construction of odd magic squares. This program was a modification of an instructional program designed by Kenneth Dickie, Associate Professor and media consultant at Western Michigan University. The pretest, programmed instruction, and posttest were all administered during one class period. Performance was measured by a three-fold criterion: (1) posttest scores on the instructional program; (2) number of items correct on the posttest per unit of time to complete the posttest; and (3) time taken to complete the programmed instruction.

The data were analyzed by means of a stepwise multiple regression analysis (Houchard, 1974). Three separate regression analyses were performed regressing the dependent variable performance, as measured by the three-fold criterion, on the personality measures obtained from the students on the Edwards Personal Preference Schedule. The results of these data analyses were not statistically significant at the .05 level. The only measure that reached statistical significance was the personality characteristic deference--and then only when it was considered separately from all the other personality characteristics. A significant ($p < .05$) relationship was found between this variable and time to complete the programmed instruction. Analyses of the other background variables (GPA, semester hours of college math, and sex of respondent) also failed to reach statistical significance in predicting performance on the programmed instruction. Although significant differences ($p < .05$) were found between class standing and performance on the programmed instruction measured in terms of pos-test scores, sample sizes were too small to draw any substantive conclusions.

While this study found no support for a predictive relationship between personality characteristics, as measured by the Edwards Personal Preference Schedule, and performance on programmed instruction, the reader is cautioned against the possible false conclusion that this means there is no relationship between these personality characteristics and achievement on programmed instruction. The failure to find a statistically significant relationship between these personality characteristics and performance on programmed instruction does not mean there is no relationship between the variables; but rather, there was not enough evidence to reject the hypothesis, there is no relationship between personality characteristics and performance on programmed instruction.

The nature of the programmed instruction is such that it can readily be used with other students and at varying grade levels to determine if different interactions are obtained. Although no predictive relationships between personality characteristics and performance on programmed instruction were found for this group of students, this may not necessarily be true for other groups of learners. As indicated in the Fiks study (1964), significant ($p < .05$) differences were found in performance on programmed instruction for different age groups and educational levels. An indication that this may also be true in relation to the present programmed instruction was evidenced by the significant ($p < .05$) differences found in performance between the seniors, and the junior and graduate students.

Factors unknown to this researcher may also have been operating within the environmental situation. The antipathy felt by some students towards a program of this type may have contaminated the results. Since the programmed instruction was not directly related to the students' classwork, apathy may have also acted as a contaminant. In an attempt to control for the possible influence of motivation or interest concerning the programmed material on student performance, this researcher may have inadvertently introduced an apathetic feeling towards the programmed material. This apathy may have had an overriding influence on the students' performance and concealed any relationships that may have existed between the personality characteristics and performance on the programmed instruction. If the programmed instruction had been introduced as part of the students' regular classwork, on which they would be graded, different results might have been obtained. In addition, varying program characteristics (step size and amount of feedback), and environmental factors (stress, anxiety, etc.) might produce quite different results. Fruitful results might also be obtained by studying other personality characteristics or identifying other relevant variables that might interact with a programmed instructional approach.

In conclusion, considering the above mentioned factors, the research findings preceding this study, and factors which may have been operating within the instructional environment over which this research had no control, it is recommended that further study be conducted to verify the results of this study (keeping in mind the necessity to maintain student interest in the programmed material) and to study the influence of varying other variables upon student performance.

APPENDIX A

Cover Sheet

The following booklet is a short example of a programmed instruction designed to teach you how to construct an odd magic square. The program is divided into small steps called "frames" which usually includes: (1) some information, (2) questions to answer, and (3) an opportunity to check your responses with those provided in the confirmation (answer) booklet. After completing the programmed instruction you will take a short posttest, similar to the pretest you have already taken, to determine how much you have learned. I hope you will enjoy this short learning experience with programmed instruction.

INSTRUCTIONS:

1. Please fill out the short student information sheet following this page.
2. Read each page of the programmed instruction carefully and answer any questions asked. Write directly in the programmed booklet.
3. Check your answers with those provided in the confirmation booklet. Try not to look ahead at the answers before responding.
4. After checking your responses go on to the next page unless instructed to do otherwise in the confirmation booklet.
5. After completing the programmed instruction hand in this booklet and pick up a posttest.
6. Complete the posttest and hand it in.

APPENDIX B

Student Information Sheet

STUDENT INFORMATION

Please answer the following questions.

1. Social Security Number____________________

2. Class standing

   a. Junior   b. Senior   c. Graduate   d. Other

3. Sex

   a. Male

   b. Female

4. Undergraduate cummulative grade point average (this information will be held in the strictest of confidence) __________

5. Semester hours of college math taken_______

APPENDIX C

The Programmed Instruction

? AN ODD MAGIC SQUARE ?

? CAN YOU CONSTRUCT ONE ?

8	1	6
3	5	7
4	9	2

The figure above is a completed odd magic square. This is an example of the type of figure you will learn to construct. This is not just an ordinary figure with numbers placed at random but is a calculated arrangement in which the numbers in each of the rows, columns and diagonals total to the same sum. In the pages that follow you will learn the procedures for constructing a figure like this. At the conclusion of this program you will be able to construct an odd magic square.

No response necessary. Go on to the next page.

8	1	6
3	5	7
4	9	2

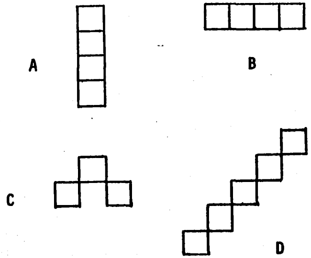
Study the odd magic square above. An odd magic square is made up of a series of blocks called <u>cells</u> that contain numbers and are joined together. If you count the number of blocks in the odd magic square you will find that it contains nine____________

These cells are joined together to form rows, diagonals, and columns. Match the following: (A letter may only be used once)

( ) Column

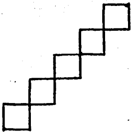
( ) Diagonal

( ) Row



B

A

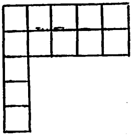


C

In the illustrations above (A) represents a row of cells, (B) represents a column of cells, and (C) represents a diagonal arrangement of cells.

Using the illustration below fill in the blanks with the appropriate words.

There is/are two_______________and one________________of five cells each. The longest diagonal arrangement contains_____________ cells.



	A	B	C	D	E
1					e
2				d	
3			c		
4		b			
5	a				

Refering to the illustration above, match the following:

(A letter may only be used once.)

( ) Columns

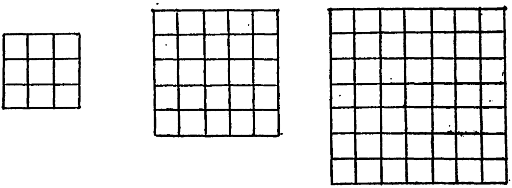
( ) Diagonals

( ) Rows

A. Represented by numbers

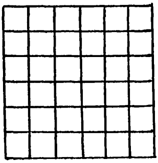
B. Represented by capital letters

C. Represented by lower case letters

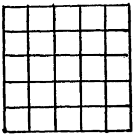


Study the figures above. These are empty odd magic squares. An odd magic square has an odd number of rows and columns which are: ( ) equal, ( ) unequal. (Check the appropriate response.)

Which of the figures below is not an empty odd magic square? (Check the appropriate response.) Can you tell why not?



( ) A



( ) B

Check the letter(s) that identify the illustration(s) that could be odd magic squares.

( ) A

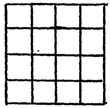
( ) B

( ) C

( ) D

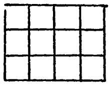
( ) E

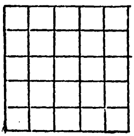
A



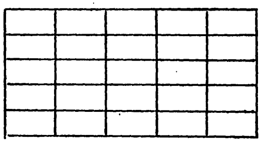
B

C





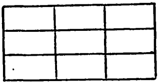
D



E

The shape of the structure at E may have fooled you. An odd magic square does not have to be a square, it can be a rectangle; however, there must be an equal number of rows and columns. Could the structure below be an odd magic square? (Check the appropriate response.)

( ) Yes ( ) No



	A	B	C
1	8	1	6
2	3	5	7
3	4	9	2

Study the figure above. This is a completed odd magic square. What is the sum of the following:

a. Column A__________

b. Row 2__________

c. A diagonal__________

d. Any column, row, or diagonal___________

A quick way of finding the sum of a row, column, or diagonal in an odd magic square is to multiple the number in the center cell by the number of rows or columns. Try it on the odd magic square above.

Check all the letters representing illustrations of correct odd magic squares.

( ) A

11	4	9
6	8	10
7	12	5

( ) B

12	5	4
6	8	11
7	10	9

( ) C

6	10	7
11	9	8
4	5	12

(Remember the quick way of finding the sum of a row, column, or diagonal in an odd magic square is to multiply the number in the center cell by the number of rows or columns)

1, 2, 3, 4, 5, . . .

2, 4, 6, 8, 10, . . .

12, 13, 14, 15, . . .

20, 23, 26, 29, . . .

Study the horizontal number arrangements shown above. These would all be suitable number arrangements for constructing an odd magic square. Refering to the arrangements above check all the appropriate responses to complete the statement below.

The sequence of numbers used in constructing an odd magic square must:

( ) be arranged in consecutive order

( ) start with any value

( ) have an equal increment (interval) between numbers

Which of the following sequences of numbers would be appropriate for constructing an odd magic square. Check all appropriate responses.

( ) A 4, 5, 6, 7, 8, 9, . . .

( ) B 9, 12, 15, 18, 21, . . .

( ) C 1, 2, 4, 6, 9, . . .

( ) D 6, 8, 10, 12, 14, . . .

( ) E 10, 12, 16, 14, 18, . . .

The sequence of numbers can start with any number; however, the construction of an odd magic square must begin with the smallest number in a sequence. Write a suitable nine number sequence starting with the number 8.

8	1	6
3	5	7
4	9	2

17	24	1	8	15
23	5	7	14	16
4	6	13	20	22
10	12	19	21	3
11	18	25	2	9

12	5	10
7	9	11
8	13	6

Rule 1: where you put the first number.

Look at the illustrations above. These are correct odd magic squares. Find the lowest number and answer the following statement by checking all the appropriate responses.

The starting point for the first number in an odd magic square must be:

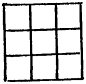
( ) Middle cell in the top row

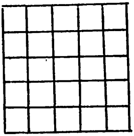
( ) Top cell in the third column

( ) Top cell in the middle column

( ) Second cell in the top row

Place the lowest number in the sequence 8, 9, 10, 11, 12, . . .
in the starting cells for the figures shown below.





8	1	6
3	5	7
4	9	2

17	24	1	8	15
23	5	7	14	16
4	6	13	20	22
10	12	19	21	3
11	18	25	2	9

Rule 2: what happens when a number falls in the top row.

Study the correct odd magic squares shown above. Find the starting number and determine the increment. Answer the following question by checking the appropriate responses.

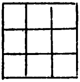
When a number falls in any cell in the top row, <u>except the top right cell</u>, the next number is placed:

( ) In any cell in the bottom row

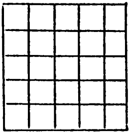
( ) In the bottom cell of the column to the right

( ) In the bottom cell of the same column

In the figures below place the number 1 in the correct starting cells.

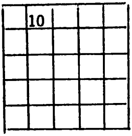


A

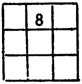


B

In the figures below place the next number in the correct cell. The increment is one.



C



D

8	1	6
3	5	7
4	9	2

Rule 3: what happens when a number falls in the top right cell.

Study the illustration above. With one exception we can say that when any number falls in a cell in the top row the next number will fall in the bottom cell of the column to the right. Can you state that exception?

8	1	6
3	5	7
4	9	2

17	24	1	8	15
23	5	7	14	16
4	6	13	20	22
10	12	19	21	3
11	18	25	2	9

Study the illustrations above. Determine the increments. Answer the following statement by checking the appropriate responses.

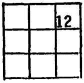
When a number falls in the top right cell the next number is placed:

( ) In the bottom cell of the row to the left

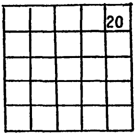
( ) In the cell of the row to the right

( ) In the cell directly below

In the illustrations below place the next number in the correct cell. The increment is one.

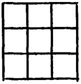


A



B

In the illustration below place the first <u>two</u> numbers of the sequence 8, 9, 10, 11, 12, . . . in the correct cells.



C

8	1	6
3	5	7
4	9	2

17	24	1	8	15
23	5	7	14	16
4	6	13	20	22
10	12	19	21	3
11	18	25	2	9

Rule 4: what happens when a number falls in the extreme right column.

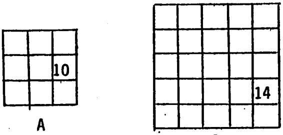
Study the odd magic squares above. Determine the increment and locate the numbers in the extreme right column. Answer the following statement by checking all appropriate responses.

When a number falls in any cell in the extreme right column, except top right cell, the next number is placed in the:

( ) cell above

( ) left end cell of the row above

( ) left end cell of the row below

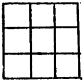


A B C

In the figures above place the next number in the correct cell.

The increment is 2.

In the figure below place the first <u>three</u> numbers in the correct cells. The starting number is 8 and the increment is 1.



8	1	6
3	5	7
4	9	2

17	24	1	8	15
23	5	7	14	16
4	6	13	20	22
10	12	19	21	3
11	18	25	2	9

Rule 5: what happens when a number falls other than in the top row or extreme right column.

Study the odd magic squares above. Determine the increment. Answer the following question by checking all appropriate responses.

Where is a number placed when the preceding number falls somewhere other than in the top row or extreme right column?

( ) In the cell diagonally above and to the right of the cell containing the last recorded number

( ) When the cell diagonally above and to the right is filled the next number is placed in the cell directly below the last recorded number

In the figures below place the next number in the correct cell.

	10	
14		
		12

A

		1		
7				
				5
			3	

B

		1		
			2	

C

Remember always move diagonally above and to the right, if this cell is filled place the next number in the cell directly below.

In the figures below place the next number in the correct cell.

	5	
7		
		6

A

		1		
4				
				3
			2	

B

In illustrations A and B place the next number in the correct cell. In illustration C place the first <u>five</u> numbers in the correct cells starting with the number 8 and having an increment of 1.

	4	
6		
7		5

A

		1		
	5			
4				
				3
			2	

B

C

You now know all the rules necessary to construct an odd magic square. Complete the magic square below beginning with the number five and having an increment of one.

8	1	6
3	5	7
4	9	2

Study the odd magic square above. These are all the rules that must be remembered. They apply to all odd magic squares.

1. The first number is placed in the middle cell of the top row (1)
2. When a number appears in the top row, except in the top right cell, the next number will be placed in the bottom cell of the column to the right (9, 2)
3. When a number falls in the top right cell the next number is placed in the cell directly below (7)
4. When a number falls in the extreme right column, except the top right cell, the next number is placed in the left end cell of the row above (3, 8)
5. When a number falls in any cell other than the top row or right column the next number is placed in the cell diagonally above and to the right (5, 6). If this cell is filled the next number is placed in the cell directly below (4)

Complete the odd magic square to the right, starting with the number five and having an increment of one.

Complete the odd magic square below starting with the number three and having an increment of one.

21	28	5	12	19
27	9	11	18	20
8	10	17	24	26
14	16	23	25	7
15	22	29	6	13

Study the completed odd magic square above. These are all the rules that must be remembered. They apply to all odd magic squares.

1. The first number is placed in the middle cell of the top row (5)
2. When a number appears in the top row, except in the top right cell, the next number will be placed in the bottom cell of the column to the right (22, 29, 6, 13)
3. When a number falls in the top right cell the next number is placed in the cell directly below (20)
4. When a number falls in the extreme right column, except the top right cell, the next number is placed in the left end cell of the row above (21,27,8,14)
5. When a number falls in any cell other than the top row or right column the next number is placed in the cell diagonally above and to the right (28,9,11,12,16,17,18,19,23,24,26,7). If this cell is filled the next number is placed in the cell directly below (15,10,25).

Complete the empty odd magic square above starting with the number one and having an increment of one.

APPENDIX D

Confirmation Booklet

CONFIRMATION BOOKLET

Page

2. Cells

   (A) Column

   (D) Diagonal

   (B) Row

   *If your answers are correct go to page <u>five</u>

   if not go to the next page.

3. There is/are two <u>ROWS</u> and one <u>COLUMN</u> of five cells each.

   The longest diagonal arrangement contains <u>THREE</u> cells.

4. (B) Columns

   (C) Diagonals

   (A) Rows

5. (X) Equal

   (X) A   There are an even number of rows and columns.

6. ( ) A

   ( ) B

   ( ) C

   (X) D

   (X) E

   *If you are correct go to page <u>eight</u>

   if not go to the next page.

7. (X) Yes

8. Column A = 15

Row 2 = 15

A diagonal = 15

Any column, row, or diagonal = 15

*IF you are correct go to page ten

if not go to the next page.

9. (X) A

10. (X) be arranged in consecutive order

(X) start with any value

(X) have an equal increment (interval) between numbers

11. (X) A

(X) B

( ) C

(X) D

( ) E

8, 9, 10, 11, 12, 13, 14, 15, 16, or

8, 10, 12, 14, 16, 18, 20, 22, 24, etc.

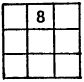
12. (X) Middle cell in the top row

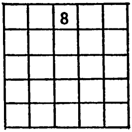
( ) Top cell in the third column

(X) Top cell in the middle column

( ) Second cell in the top row

13.



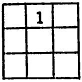


14. ( ) In any cell in the bottom row

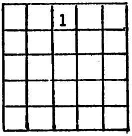
(X) In the bottom cell of the column to the right

( ) In the bottom cell of the same column

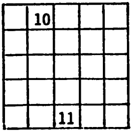
15.



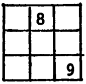
A



B



C



D

16. When the preceding number falls in the top right cell the next number is placed in the cell below.

( ) In the bottom cell of the row to the left

( ) In the cell of the row to the right

(X) In the cell directly below

17.

		12
		13

A

				20
				21

B

	8	
		9

C

18. ( ) Cell above

(X) Left end cell of the row above

( ) Left end cell of the row below

19.

12		
		10

A

16				
				14

B

		8
		10

C

	8	
10		
		9

20. (X) In the cell diagonally above and to the right of the cell containing the last recorded number

(X) When the cell diagonally above and to the right is filled the next number is placed in the cell directly below the last recorded number

21.

	10	
14		
16		12

A

		1		
	9			
7				
				5
			3	

B

		1		
				3
			2	

C

*If you are correct go to page 23

if not go to the next page.

22.

	5	
7		
8		6

A

		1		
	5			
4				
				3
			2	

B

23.

	4	
6	8	
7		5

A

		1		
	5			
4	6			
				3
			2	

B

	8	
10	12	
11		9

C

24.

12	5	10
7	9	11
8	13	6

*If you are correct go to page 26
if not go to the next page.

25.

12	5	10
7	9	11
8	13	6

26.

19	26	3	10	17
25	7	9	16	18
6	8	15	22	24
12	14	21	23	5
13	20	27	4	11

*If you are correct CONGRATULATIONS. You have finished the program and know how to construct an odd magic square.
If not go to the next page.

27.

17	24	1	8	15
23	5	7	14	16
4	6	13	20	22
10	12	19	21	3
11	18	25	2	9

CONGRATULATIONS!!!

APPENDIX E

Pretest

PRETEST

The purpose of this pretest is to determine what you may already know about the construction of an odd magic square. Answer any questions you are able. If you are unable to answer any questions or all the questions--DON'T PANIC--just leave them blank. Probably only one person in a thousand has any idea of the rules used in constructing a magic square.

PRETEST

Social Security Number________________________

1. An odd magic square has: (Circle the correct response)

   a. the same sum when the numbers in any row or column are added

   b. the same sum when the numbers in any diagonal are added

   c. an equal increment (interval) between numbers

   d. only (a) and (c) above

2. A person wants to construct an odd magic square starting with the number 2, the next number is 4, the third number should be: (Circle the correct response)

   a. 8

   b. 16

   c. 6

   d. some other number

   e. he can not construct a magic square

3. In the following figure where would you place the first number? (Circle the correct response)

   a. in cell A

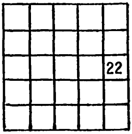
   b. in cell B

   c. in cell C

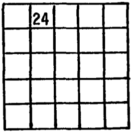
   d. in some other cell

	A	
	B	
		C

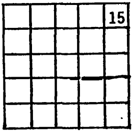
4. In the following figure place the number 23 in the correct cell.



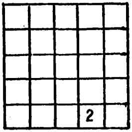
5. In the following figure place the number 25 in the correct cell.



6. In the following figure place the number 16 in the correct cell.



7. In the following figure place the number 3 in the correct cell.



8. Complete the following odd magic square below starting with the number <u>one</u> and having an increment of one.

APPENDIX F

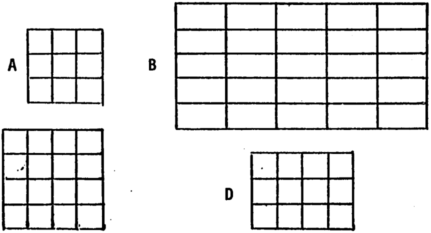
Posttest

POSTTEST

Social Security Number________________________

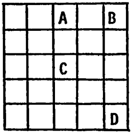
1. Check the letter(s) that identify the illustrations(s) that could be odd magic squares.

( ) A
( ) B
( ) C
( ) D



2. In the following figure where would you place the first number? (Circle the correct response)

a. in cell A
b. in cell B
c. in cell C
d. in cell D
e. in some other cell



3. In the following figure place the number 8 in the correct cell.

			7	

4. In the following figure place the number 10 in the correct cell.

				9

5. In the following figure place the number 18 in the correct cell.

	17			

6. In the following figure place the number 42 in the correct cell.

				41

7. In the following odd magic square the sum of a row or column could be found by multiplying the number of cells in any row or column by the number found in: (Circle the correct response)

a. cell A
b. cell B
c. cell C
d. cell D

		A		C
		B		
				D

8. An odd magic square: (Circle the correct response(s))

a. has the same sum when the numbers in any row or column are added
b. has the same sum when the numbers in any diagonal are added
c. has an equal increment (interval) between numbers
d. only (a) and (b) above

9. A person wants to construct an odd magic square starting with the number 90. The next number he uses is 100, the third number should be: (Circle the correct response)

a. 105
b. 115
c. 80
d. some other number
e. he can not construct and odd magic square

10. Complete the following odd magic square below starting with the number six and having an increment of one.

11. A student experimenting with a new scheme of constructing an odd magic square places the numbers 10 and 12 in the cells indicated below. He should place the next number in:

(Circle the correct response)

a. cell A

b. cell B

c. cell C

d. cell D

B	C	
	A	10
12		D

12. Another student was also experimenting with a new method of constructing an odd magic square. He placed the first three numbers in the cells indicated below. Complete this new odd magic square by filling in the empty cells with the correct numbers.

			3	
				2
1				

APPENDIX G

Objectives for the Programmed Instruction

Objectives for Odd Magic Squares

Terminal Objective

Given any empty odd magic square matrix, the starting number and the numerical increment the student will construct an odd magic square by filling in all the cells with the correct numbers within a time span that would preclude a trial-and-error solution.

Enabling Objectives

1. Given any matrix, the student will be able to identify rows, columns, and diagonals.

2. Given a set of matrices the student will identify those structures which could be made into odd magic squares.

3. The student will be able to identify the three essential characteristics of an odd magic square which must include the following points: (1) the set is an odd square matrix; (2) it has an equal increment between numbers; and (3) rows, columns, and diagonals sum to the same total.

4. Given completed matrices the student will identify those which are correct odd magic squares.

5. Given an empty odd magic square the student will identify the correct starting cell for the lowest number.

6. Given a partially completed odd magic square where a number falls in the top row the student will identify the correct cell which should contain the next number.

7. Given a partially completed odd magic square where a number falls in the top right cell the student will identify the correct cell which should contain the next number.

8. Given a partially completed odd magic square where a number falls in the extreme right hand column the student will correctly identify the cell which should contain the next number.

9. Given a partially completed odd magic square where a number falls other than in the top row or extreme right hand column the student will correctly identify the cell which should contain the next number.

Entry Level Skills

1. The student must be able to discriminate odd from even numbers.

2. The student must, with a minimum of review, be able to discriminate among rows, columns, diagonals, and cells.

3. The student must be able to locate a cell in a matrix given row and column coordinates.

4. The student must be able to add, subtract, and multiply whole numbers.

5. The student must be able to generate a number sequence of a given interval.

6. The student must be able to follow simple directions in moving from one cell to another.

APPENDIX H

Introductory Letter

Dear

As you know one of the ongoing pursuits of a university and especially doctoral students is that of research. The purpose of this letter is to solicit your help in allowing me to utilize your introductory Audio-Visual Media I classes in a research project for a doctoral dissertation on individual student differences and instructional media.

One of the goals of research in instructional media is to determine how to assign different media to the learning task. Through the judicious assignment of media appropriate to the learning task, content, and individual differences a greater level of instructional effectiveness can be realized. Specifically, the research is designed to investigate the possible relationships between personality characteristics of students and their achievement in programmed instruction. The procedure involves the class taking a personality inventory (45-50 minutes) and then at some later date in the semester a short instructional program (40-45 minutes).

I will be contacting you personally to discuss the utilization of your classes in this research. Your assistance and cooperation in this effort will be more than greatly appreciated.

Sincerely yours,

Fredrick Michels

Dr. Kenneth Dickie, Chairman

APPENDIX I

Mark Sense Answer Sheet

PRINT YOUR NAME IN THE BOXES PROVIDED. THEN BLACKEN THE LETTER BOX BELOW WHICH MATCHES EACH LETTER OF YOUR NAME.

YOUR LAST NAME | YOUR FIRST NAME | MI

IDENTIFICATION NUMBER (1–15) | SEX: M F | LAST GRADE COMPLETED: 10 11 12 13 14 15 16 17+

EDWARDS PERSONAL PREFERENCE SCHEDULE

PLACE ______ DATE ______

(Each item has response positions A and B.)

1	→2	→3	4	5	6	7	8	9	10	11	12
13	14	15	16	17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45	46	47	48
49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72
73	74	75	76	77	78	79	80	81	82	83	84
85	86	87	88	89	90	91	92	93	94	95	96
97	98	99	100	101	102	103	104	105	106	107	108
109	110	111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130	131	132
133	134	135	136	137	138	139	140	141	142	143	144
145	146	147	148	149	150	151	152	153	154	155	156
157	158	159	160	161	162	163	164	165	166	167	168
169	170	171	172	173	174	175	176	177	178	179	180
181	182	183	184	185	186	187	188	189	190	191	192
193	194	195	196	197	198	199	200	201	202	203	204
205	206	207	208	209	210	211	212	213	214	215	216
217	218	219	220	221	222	223	224	225			

CON

THE PSYCHOLOGICAL CORPORATION, NEW YORK, N.Y. 10017

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APPENDIX J

Percentile Scores of the Students
on the Personality Inventory

Percentile Scores of the Students on the Personality Inventory

	Personality Characteristics														
OBS	ACH	DEF	ORD	EXH	AUT	AFF	INT	SUC	DOM	ABA	NUR	CHG	END	HET	AGG
1	83	81	92	37	43	64	17	78	79	75	96	28	13	32	3
2	64	62	55	52	45	3	58	59	92	37	32	42	50	69	89
3	93	29	91	30	20	12	16	67	51	93	14	73	30	69	79
4	27	85	28	10	53	84	58	18	42	31	91	81	85	69	21
5	4	88	46	28	28	93	32	50	9	94	99	41	85	39	9
6	27	41	46	30	28	41	85	44	87	51	58	28	80	63	66
7	99	75	19	98	85	1	25	1	98	51	3	53	25	78	55
8	90	85	91	92	62	58	35	59	3	45	32	73	18	76	9
9	40	97	56	51	20	88	18	88	32	87	24	23	15	81	55
10	96	3	20	42	96	7	22	76	28	45	66	68	69	63	84
11	92	9	3	89	96	20	89	12	91	18	6	99	11	81	55
12	64	29	28	15	82	90	35	81	17	58	99	42	5	91	44
13	8	50	28	21	36	58	35	93	67	51	66	85	85	24	66
14	77	83	73	61	85	54	1	30	99	14	24	53	32	71	20
15	83	66	6	61	79	35	84	1	76	18	56	76	47	75	78
16	58	29	94	21	98	24	28	33	36	66	9	21	95	87	27
17	19	41	64	42	77	68	73	51	59	11	32	52	63	76	34
18	50	27	6	98	54	68	73	92	22	18	38	18	3	76	74
19	19	21	28	52	28	7	80	25	28	81	41	90	63	91	95
20	83	56	46	61	54	15	25	64	32	14	9	76	39	99	46
21	58	73	5	30	82	32	85	59	67	2	99	96	13	45	51

Percentile Scores of the Students on the Personality Inventory, continued

OBS	Personality Characteristics														
	ACH	DEF	ORD	EXH	AUT	AFF	INT	SUC	DOM	ABA	NUR	CHG	END	HET	AGG
22	60	1	1	93	72	7	62	64	98	7	3	68	5	99	99
23	13	29	46	42	87	77	16	25	28	74	97	42	18	94	79
24	50	3	19	51	96	20	52	78	85	43	18	94	1	81	96
25	81	42	33	47	15	94	87	19	85	94	20	31	59	69	1
26	91	25	55	57	98	12	44	26	80	9	15	82	7	85	76
27	29	12	47	3	46	75	69	93	44	21	81	94	29	85	16
28	97	18	11	82	77	58	28	65	25	49	15	76	52	52	46
29	5	5	6	9	45	63	93	99	56	7	99	68	20	97	38
30	21	37	24	98	45	35	70	72	76	4	72	76	3	99	9
31	77	27	4	99	36	73	52	8	91	7	2	87	25	96	83
32	36	6	46	42	99	32	66	51	51	51	66	52	18	96	44
33	9	19	46	61	97	7	5	12	85	75	9	81	32	95	93
34	81	86	3	75	77	31	69	42	50	49	26	94	3	82	54
35	37	42	40	47	88	12	77	42	63	62	26	82	44	69	46
36	60	75	30	42	89	35	52	55	32	75	6	98	25	84	9
37	56	79	77	9	88	91	10	13	14	62	70	98	52	24	62
38	64	9	5	92	77	84	43	59	51	11	26	68	18	91	98
39	65	4	94	97	97	12	21	8	37	81	1	38	67	69	91
40	72	41	77	6	53	94	97	18	36	11	82	42	76	19	79
41	19	14	72	42	62	77	66	90	42	2	66	35	30	94	89
42	19	14	55	88	36	50	9	81	74	11	91	85	9	98	74

Percentile Scores of the Students on the Personality Inventory, continued

	Personality Characteristics														
OBS	ACH	DEF	ORD	EXH	AUT	AFF	INT	SUC	DOM	ABA	NUR	CHG	END	HET	AGG
43	3	2	20	10	99	96	43	76	9	58	99	90	50	24	44
44	29	71	33	47	7	48	98	93	14	86	81	31	52	54	22
45	99	5	14	95	79	10	89	24	89	1	1	68	20	99	83
46	90	9	28	97	92	12	1	33	67	7	95	52	44	87	89
47	30	37	56	84	72	1	70	78	32	51	4	45	85	78	96
48	8	6	5	21	96	90	94	86	67	14	58	85	44	52	66
49	19	6	20	15	53	77	94	25	83	66	91	73	13	94	44
50	97	9	96	42	87	3	66	44	9	90	26	10	80	63	60
51	29	18	47	37	54	18	44	87	93	56	20	54	10	91	69
52	88	66	46	78	36	81	3	55	89	36	4	23	64	89	38
53	47	29	37	42	70	17	99	59	51	25	91	68	30	76	36
54	40	66	19	61	20	81	70	30	89	92	87	18	56	10	78
55	29	62	33	92	54	39	92	33	75	33	47	46	23	85	11
56	9	5	19	95	28	88	70	94	1	11	87	87	7	99	20
57	29	25	1	92	77	48	44	83	80	91	63	24	5	82	69
58	29	62	20	75	84	58	61	65	89	17	26	46	1	93	62
59	81	12	20	82	98	39	61	42	3	9	33	94	67	82	54
60	30	14	1	51	97	35	62	78	49	4	79	91	15	98	64
61	88	19	19	61	28	54	84	72	32	36	9	18	64	91	91
62	70	37	19	32	36	73	84	64	91	82	24	94	15	17	64
63	4	52	40	82	70	67	92	8	37	56	26	70	52	69	82

APPENDIX K

Performance Data for Students on the Programmed Instruction

Performance Data for Students
on the Programmed Instruction

OBS	PI Time	Posttest Time	Pretest Score	Posttest Score
1	22	8	0	16
2	23	12	1	18
3	24	8	0	19
4	25	14	0	12
5	26	3	0	9
6	28	6	0	18
7	30	7	0	14
8	33	5	0	9
9	35	6	0	19
10	36	4	0	8
11	37	10	0	12
12	37	5	0	16
13	42	9	0	13
14	18	5	0	10
15	26	9	0	18
16	30	8	0	10
17	28	5	2	3
18	20	19	0	19
19	36	6	1	18
20	24	3	0	11
21	15	14	0	18
22	26	6	0	8
23	29	9	0	13
24	38	7	1	10
25	28	7	1	19
26	34	6	4	15
27	40	15	0	16
28	25	5	0	15
29	36	5	0	15
30	27	5	1	9
31	28	8	1	14
32	25	4	1	19
33	44	4	0	11
34	25	5	0	9
35	32	9	0	9
36	22	12	0	9
37	27	10	0	2
38	37	20	0	19
39	41	13	0	17
40	35	10	0	19
41	36	10	0	18

Performance Data for Students
on the Programmed Instruction,
continued

OBS	PI Time	Posttest Time	Pretest Score	Posttest Score
42	25	10	0	19
43	24	13	0	18
44	37	18	0	13
45	46	9	0	9
46	38	7	0	18
47	42	13	0	15
48	33	9	2	17
49	45	10	0	19
50	27	8	0	19
51	26	22	0	15
52	51	8	0	9
53	30	5	0	18
54	22	15	0	16
55	37	9	0	17
56	36	8	0	17
57	37	3	0	5
58	23	14	0	18
59	25	2	0	18
60	37	2	2	5
61	23	15	0	18
62	32	5	0	9
63	40	9	0	18

APPENDIX L

Data on Student Information Sheets

Data on Student Information Sheets

OBS	Sex	GPA	Class	Math
1	1	3.23	4	3
2	2	3.45	3	4
3	2	3.50	3	0
4	2	0	3	4
5	1	3.50	4	0
6	2	3.75	3	4
7	2	3.10	4	3
8	2	3.35	2	0
9	2	0	4	4
10	2	4.00	4	0
11	2	3.20	4	12
12	2	3.83	3	0
13	2	3.05	2	0
14	2	3.11	4	0
15	2	3.40	4	4
16	2	2.90	2	0
17	2	3.33	2	0
18	2	3.40	4	0
19	2	2.10	3	4
20	2	0	4	0
21	2	3.98	2	4
22	2	2.80	4	5
23	2	3.40	2	4
24	2	3.10	4	0
25	1	2.88	4	4
26	1	0	4	9
27	1	2.92	4	12
28	1	2.40	4	10
29	2	3.70	4	8
30	2	2.90	4	3
31	2	2.90	4	2
32	2	3.20	3	5
33	2	3.00	4	0
34	1	3.30	4	0
35	1	3.50	4	12
36	2	0	4	8
37	2	0	4	0
38	2	3.89	3	8
39	1	3.68	4	0
40	2	3.75	4	0
41	2	3.80	3	4
42	2	3.58	2	0

Data on Student Information Sheets, continued

OBS	Sex	GPA	Class	Math
43	2	3.50	3	0
44	1	2.80	4	32
45	2	3.75	4	0
46	2	2.58	2	3
47	2	3.50	4	0
48	2	3.75	2	4
49	2	3.20	3	7
50	2	3.50	3	0
51	1	2.75	4	6
52	2	2.50	4	3
53	2	3.02	4	40
54	2	2.10	2	8
55	1	2.50	4	4
56	2	3.65	4	0
57	1	2.70	4	3
58	1	2.90	4	4
59	1	3.70	3	9
60	2	0	4	3
61	2	3.61	4	3
62	2	0	4	6
63	1	3.05	4	3

Sex: 1 = Males 2 = Females
GPA: 0 = Missing data
Class: 2 = Jr. 3 = Sr. 4 = Gr.

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