A STUDY OF THE INTERACTIONS AMONG THE LEARNING STYLES OF COLLEGE STUDENTS, INSTRUCTIONAL STYLES AND ACADEMIC FIELDS RELATED TO ACHIEVEMENT

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CHAPTER I

THE RESEARCH PROBLEM

Introduction

The emphasis of education is changing from a role as a screening service for industry to one of developing human resources (Tyler, 1972). As an agency for development, many of the usual techniques for assigning students to a curriculum--e.g., I.Q. scores, SAT, and achievement tests--are not satisfactory. They all emphasize a narrow band of abilities rather than uncovering or clarifying the variety of ways through which students learn. The reason Tyler assigns to the increasing interest in individual differences is that knowledge of a student's general intelligence does not specify what and how to teach that student.

The critical content of any learning experience is the method or process through which the learning occurs. Postman and Weingartner (1969) list four major components in a learning experience: the teacher, the students, the problems, and the strategies for solving problems. They claim that attitudes of the teacher are at the center of the learning atmosphere. The beliefs, feelings, and assumptions of teachers determine the quality of life within a learning environment.

Brenton (1970) presents the problem very emphatically. He considers that schools are doing a better job of educating than they ever did. But what troubles Brenton is that, in spite of the curriculum reform and innovation inspired by Sputnik, the problems highlighted in educational literature of the 1960's are the same as those in the 1950's, 1940's, and further back. He refers to the 1968 Report from the National Academy of Sciences, as an example, that the teaching profession needs people who can teach mathematics in grade school in a way that will not create a permanent psychological block against mathematics. Those who learn math learn it well, but as an area of resource development it has been blocked to many through the attitudes of grade school teachers.

The solution to the problems facing education is one of individualizing instruction (Cronbach, 1967; Messick, 1969; Rhetts, 1970; Lesser, 1971; Sperry, 1972; and Brophy and Good, 1974). What is needed, Lesser (1971, p. 530) says, is an "expanded range of instructional alternatives to fit particular children." When individualized instruction is mentioned, methods such as discovery learning, modular scheduling, homogeneous grouping, ungraded schools, teaching machines, and programmed instruction are brought to mind. But most of the reports of current innovations in education present findings that are often negligible, sometimes non-existent (Stephens, 1967).

Cronbach (1966) appears to find the heart of the problem when he questions the validity of research methods which investigate if one method of instruction is better than another. He points out that the theories focusing on individual differences infer that there is not likely to be one best way to learn for all students. Carrying his thoughts further, he suggests that random sampling techniques may level the information which could be acquired about individual preferences in learning. He proposes that research should cease trying to determine which method is better than which; rather, research should be concerned with determining which method is better for whom and for what.

The major problem that this study addresses is that not enough is known about the interaction of student variations in learning with instructor variations and subject matter requirements to provide the information necessary to determine what methods of teaching are better for which students and in what subject area.

Nature of the Problem

That research on individual differences did not present a clear pattern for interpretation is a gross understatement. Brophy and Good (1974, pp. 267-268) consider two possible theoretical principles to interpret the data. The most straightforward hypothesis drew upon the principle of "like attracts like," or, in other words, similarity-attraction is the rule for describing a match between

student and instructor. The other hypothesis presented is that "opposites attract." After reviewing a number of studies, Brophy and Good arrive at the conclusion that "matching based on the similarity-attraction hypothesis has generally been unsuccessful." But the other hypothesis, that opposites attract, is not too tenable either. They state that, "though there are a few data to support the 'opposites attract' hypothesis, the majority of studies favor the similarity hypothesis."

The present study proposes that the concept of matching might not be a simple linear relationship. Guilford (1965, p. 315) states:

> Although very few nonlinear regressions have been found in the correlation of measures of ability with one another, there are probably many more such relationships in psychology and education than have been realized.

It is hypothesized that, in a given situation, certain variable factors of an individual's learning style would require support by matching with instruction emphasizing similarity; at the same time, other factors would require challenge with instruction that emphasized alternative learning style factors. Furthermore, strengths in some factors of a learning style would compensate for weakness in other factors. At present, which factors come under which categories is not known.

Statement of the Problem

The major problem germane to this study is that there is not sufficient information that there could be an effective and efficient interaction between a student's learning style (a preference for using one group of characteristics over another to learn), subject matter structure, and instructional style that may govern the rate of achievement of the student.

Bruner(1956), Guilford (1971), Klein (1970), Kagan, Moss, and Sigel (1963) have demonstrated sufficiently the extent of the variations that exist in students with regard to the process of learning. There are different demands placed on a learner by different subjects. For example, studying literature is seen as requiring less structure than studying mathematics. The variations in instructors are readily apparent through a teacher's choice of lecture, discussion, or independent study. The variations are more subtle when considering the instructor's choice of words during instruction. The meaning intended is often not the meaning extracted (Greene, 1973).

Due to the nature of the variables involved, the present study is primarily a predictive study. An endeavor is made to determine what learning style variables would best account for the variation in students' achievement as measured by letter grades and to what extent an instructional style or subject area mediates the relations between a student's learning style and a student's grade. Due to the limitations

of the study, not all possible learning style variables are included. Therefore, the use of the term "learning style variables" is restricted to those variables considered in the present study.

The research of Goldman and Warren (1973), Klein (1970), Guilford and Hoepfner (1971), and Witkin (1973) has provided evidence that four areas of learning style must be considered for purposes of matching student instruction, namely, specific intelligence abilities, cognitive style, affective state, and study strategies.

The area of specific intelligence abilities are represented by three cells from Guilford's Structure-of-Intellect Model (1971). The cells are listed in order of operation, content, and product. The intelligence abilities considered in this study are evaluation-semantic-relations (EMR), divergent production-symbolic-relations (DSR), and convergent production-semantic-systems (NMS). The tests which reach these three abilities are in order: Verbal Analogies III, Alternative Additions, Ordering I. These three tests appropriately measure the abilities named (Guilford, personal communication).

The area of cognitive style is tapped by use of the factors Field Independence-Dependence and Tolerance of Ambiguity. Field Independence-Dependence considers a person's ability to draw out a single element from a complex pattern. The Hidden Figures Test is used as a measure of this factor (Barrett, Cabe, and Thornton, 1968). Tolerance of Ambiguity

is defined as a tendency to cling to the familiar, rigidly adhering to rules, norms, and stereotyped patterns. A person who has low tolerance for ambiguity seeks closure in his thinking when confronting unfamiliar or ambiguous situations (Luchins, 1959). The test Tolerance-Intolerance of Cognitive Ambiguity is used to measure this variable (Hampton, 1970).

The Affective State considers the type of emotional response a person makes to stimuli perceived. This variable is seen as having considerable effect upon the learning process. Several aspects of the Affective State are seen as directly contributing to learning. The four aspects considered in this study are dimensional. A person would be measured on a scale between extraversion and introversion; sensing and intuition; thinking and feeling; judgment and perception. Ross (1962) sees the Myers-Briggs Type Indicator as a test which appropriately measures these dimensions.

The research of Holtzman and Brown (1968) and Goldman and Hudson (1973) has demonstrated the importance of considering study habits and strategies when accounting for variations in achievement. The way a student organizes his time in preparation for class directly influences his level of achievement. The instrument seen as appropriate for measuring variations in study strategies is the Study Strategies Questionnaire (see Appendix I for a definition of the scales of the Study Strategies Questionnaire) developed by Goldman and Warren (1973).

Purpose of the Study

The purpose of the study is fourfold: (1) to identify learning style variables that relate to achievement without reference to instructor or subject matter variables, (2) to identify variables that relate to achievement for specific subject areas or for specific instructors, (3) to ascertain whether or not knowledge of an instructional style could contribute information about the relationship between a student's learning style and his/her grade, and (4) to determine if the variables related to achievement are linear or curvilinear.

Research Questions

The major question is: Can empirical evidence be provided that supports the theoretical solution that a design for optimal learning requires knowledge of the interactions among a student's learning style, the instructor's learning style, and subject matter requirements?

The specific questions asked in this study are:

Question One: Are there learning style variables whose relationship to achievement could be described as non-linear?

Question Two: Do specific learning style variables relate to achievement without reference to instructor variations or subject matter area?

Question Three: Do specific learning style variables relate to achievement for specific subject matter areas without reference to instructor variations?

Question Four: Do specific learning style variables relate to achievement for specific instructors?

Question Five: Does instructional style mediate the relation between the student's learning style and the student's achievement?

Question Six: Are there differences in learning style variables and achievement between the students who were tested over all variables and those who were not?

Definition of Terms

For the purpose of this investigation, the following terms and definitions will be employed:

1. Learning Style: The individualized way a person acquires, maintains, and applies concepts to cope with changes in the environment. Variables within the areas of intelligence abilities, cognitive style, affective state, and study strategies comprise a learning style.
2. Instructional Style: The methods employed in the classroom, as well as the form of language chosen by the teacher to communicate concepts, typically define the

instructional style. It is assumed to be directly related to the instructor's learning style. The variations of measures of the instructor's learning style will be considered indicative of differences in instructional style.

3. Intelligence Abilities: Specific types of abilities determined by the mental operations used, the content dealt with, and the product or class of material considered. The intelligence abilities investigated in the present study are FMR, DSR, and NMS.
4. Cognitive Style: The processes a person uses to acquire, maintain, and apply concepts without reference to ability level or mood. The factors of cognitive style considered in the present study are Field Independence-Dependence and Intolerance for Ambiguity.
5. Affective State: A relatively stable orientation within the individual that governs the types of emotional responses to stimuli; specifically, in the present study, orientation toward introversion or extraversion, sensing or intuiting, thinking or feeling, judging or perceiving.
6. Evaluation-Semantic-Relations (EMR): A specific intelligence ability educed from Guilford's Structure-of-Intellect Model (Guilford and Hoepfner, 1971). The evaluation (E) term includes a comparison of items of information in terms of variables and making judgments concerning criterion satisfaction. The semantic (M) term pertains to information in the form of conceptions

or mental constructs to which words are often applied. Relations (R) refers to connections between items of information based upon variables or point of contact that apply to them.

7. Convergent Production-Semantic-System (NMS): A specific intelligence ability educed from Guilford's Structure-of-Intellect Model. The convergent production (N) element implies a generation of logical conclusions from given information where emphasis is upon achieving unique or conventionally-best outcomes. The semantic (M) term pertains to information in the form of conceptions or mental construents to which words are often applied. Systems (S) refers to organization or structuring of groups of items of information.
8. Divergent Production-Symbolic-Relations (DSR): A specific intelligence ability educed from Guilford's Structure-of-Intellect Model. The divergent production (D) element implies a generation of logical alternatives from given information. The symbolic (S) pertains to information in the form of denotative signs having no significance in and of themselves such as letters and numbers. Relations (R) refers to connections between items of information based upon variables or points of contact that apply to them.
9. Field Independence-Dependence: A cognitive style variable that is concerned with the level of processing information that requires selecting a single element or

a few elements from a complex pattern. Field Independence refers to an analytical way of perceiving a tendency to extract elements from their context; Field Dependence refers to an inclination to perceive and respond to a situation globally.

10. Intolerance for Ambiguity: A cognitive style variable that describes an individual's need for structuring an ambiguous situation or task. The level of closure required by a person.
11. Study Strategies: The types of behavior an individual instigates before, during, and after a learning situation. Some examples of study strategies are preference for note taking, planning before a learning session, and methods of attacking assignments.

Assumptions Underlying the Study

The first assumption underlying this study was that a limited number of basic instruments would suffice to identify the variables tested. Horst (1941) believes, for reasons of parsimony, the number of fundamental measures used in the process should be as small as possible and that each measure should be significantly related to only a few criteria. In view of this, only one measure for each learning style variable was used.

An assumption was not made that the subjects selected would be similar to preceding and subsequent students. The assumption was that the learning style of an individual

would be relatively stable over time (Witkin, Goodenough, and Karp, 1967). Furthermore, if two students had the same learning style pattern, then they would respond in the same manner when placed with the same instructor and subject matter.

An assumption was made that responses of students to items on the instruments of the learning style variables were accurate; there were no overt conditions to imply a different case. Finally, it was assumed that the responses of the students were representative of their actual ways of interacting with the environment.

Limitations of the Study

The dimensions of this study are delimited as follows:

1. The number of learning style variables were selected on the basis of: (a) the support of these variables in the literature, (b) a logical organization of the variables to complement each other without a high degree of intercorrelation, and (c) the availability of reliable and easily-administered measuring instruments for each variable.

2. The procedure for acquiring the data distinctly defines two groups from the original population. This places restrictions upon the ability to generalize the findings of this study.

3. The findings of this study for all variables would be generalizable only to students who would voluntarily submit to the testing for the purpose of obtaining a learning style profile.

4. The ability to generalize the findings to other populations of students would be further restricted to the extent that the populations have learning styles similar to the sample tested and the instructors have learning styles similar to the sample of instructors in this study.

5. Any conclusions drawn from this study would be applicable to the specific subject areas denoted in this study.

6. Finally, the interpretations of the results on this study with respect to an individual must be made at a counseling level with great attention given to the standard error of measurement.

Organization of the Study

Chapter I has presented an introduction to the problem, the nature of the problem, a statement of the problem, the purpose of the study, the research questions, definitions, assumptions underlying the study, and the limitations of the study.

Chapter II is a review of the related literature. Attention is given to research considering the relations between aptitude and treatment as well as research that lends support for including the specific learning style variables in this study.

Chapter III describes the sample included in the study, the procedures and instruments used in data collection, and the methods of statistical analysis.

Chapter IV presents an analysis of the data. The format of the chapter will follow the sequence of the research questions.

Chapter V contains a summary of the findings, discusses the conclusions that may be derived from the study, and some recommendations for further study.

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

Chapter II presents a selected review of the literature. A brief overview of the research investigating interaction between learner variables and treatment variables is followed by sections discussing research of each of the specific learning style variables selected for this study.

Aptitude-Treatment Interaction

The concept of individual differences in education is not unique to this decade. Educators such as Dewey (1939, p. 675) have been exhorting teachers to be concerned with the problem of teaching pupils who are different:

> . . . it is a cardinal precept of the newer school of education that the beginning of instruction shall be made with the experience the learners already have . . .

But the variables that have been investigated over the years have changed. Stephens (1967) reviewed a representative sample of research in education as far back as 1933. Some of the variables investigated were school attendance, amount of time spent in study, homogeneous ability groupings,

and television vs. live instructor. The overall conclusion made by Stephens about these studies with respect to academic achievement is that there are basically no differences. Since the basic purpose of the earlier research was to find the best method for all students or the single factor that would predict academic achievement, a result of "no difference" did not discourage the researchers from repeating the study without investigating other variables.

The experimental method was accepted as the proper technique for educational research and error variance was a nuisance. In the last eight years, however, research interest has focused on the interactions between the learner and the environment. The general title given this work is Aptitude x Treatment Interaction (ATI) (Cronbach and Snow, 1969; Lesser, 1970; Bracht, 1970; and Glaser, 1972). This research is aimed not at finding the best treatment for all students but the best treatment for specific types of students. Though a few instances have pointed toward specific concepts of learning style that may be relevant as a basis of assigning students to specific treatments, e.g., matching on the basis of conceptual level as depicted by Hunt (1966), "the progress toward the goal of identifying and understanding ATI has been slight"(Cronbach and Snow, 1969, p. 193).

In a study of Belgian secondary school students, Meuris (1970) investigated the relation of primary mental abilities to academic specialization. A test battery including

measures for verbal, numerical, spatial, and reasoning abilities was administered to 3,943 subjects ranging in age from 12 to 18. The sample contained 2,000 boys and 1,943 girls. The academic program was clearly defined as science orientated or language orientated. Hoteling's iterative method of factoring (Harmon, 1960; Holzinger and Harmon, 1941) was applied to a correlation matrix derived from the test battery to obtain the principle factor solution. A comparison was made of the primary factor intercorrelations and second order loadings from factor analyses of separate 12- and 17-year-old student groups segregated from the total sample. The conclusions drawn from the analysis by the investigator are: (a) there is a progressive differentiation of mental abilities with age, (b) the importance of a general intellectual factor appears to diminish with age; and (c) the progressive differentiation of abilities might be attributable not only to a developmental or maturational factor but also to the influence of intensive study of increasingly differentiated subject matter areas that occur at later grade levels.

In a review of Instructional Psychology, McKeachie (1974) analyzed the research in terms of learner variables, teaching methods, and objective and content. He discussed only one study of ATI done by Koran, Snow, and McDonald (1971).

In the experiment designed to investigate individual differences in acquiring a teaching skill from written and

video-mediated modeling procedures, Koran, Snow, and McDonald (1971) gave 120 teacher interns a set of aptitude tests representing verbal and perceptual abilities. Analysis of variance results showed that video modeling produced significantly higher performance frequencies than written modeling. Both modeling treatments were significantly better than a control. There were a number of aptitude x treatment interactions. But of special interest to the present study was a disordinal interaction between the Hidden Figures Test (French, Ekstrom, and Price, 1963) and frequency, variety, and quality of analytic questioning on classroom performance measures. Scores on Hidden Figures were positively related to written modeling performance but negatively related to video modeling performance. The conclusion implied is that subjects with relatively high scores on Hidden Figures, Part 1, would be expected to benefit more from the written modeling treatment than from video modeling while those with relatively low scores on Hidden Figures, Part 1, would probably benefit more from video modeling than from written modeling. However, the study reported was not as clear-cut as the conclusions implied. Because video modeling was generally superior, there was a lack of clear treatment differences at both ends of the aptitude continua. Koran, Snow, and McDonald did not regard this as critical at this stage of aptitude treatment interaction research.

A systematic analysis of 90 research studies was made by Bracht (1970). This analysis was designed to permit a test of

Aptitude x Treatment Interaction (ATI). The studies selected had to include a comparison of two or more alternative treatments for attaining a common set of objectives and one or more learning style variables so the comparison between alternative treatments could be made for different levels of the learning style variable. The empirical results of each study were classified according to the type of interaction effect between the alternate treatments and the learning style variable. Bracht modified Lubin's (1961) method of determining when interactions imply differentiation of treatments to students by specifying that an interaction effect is operationally defined as disordinal only when the differences between alternative treatments at two levels of a learning style variable are both significantly non-zero and different in algebraic sign. From the 90 studies, Bracht found 108 ATI combinations to analyze. From the 108 combinations, he found only five disordinal interactions which implied a requirement of differential treatment to students to obtain optimal learning payoff from instruction.

The studies were classified as controlled or uncontrolled based on the degree the variables were controlled by the experimenter. Bracht had hypothesized that to obtain a disordinal interaction would require control of the variables and, indeed, the five disordinal interactions were found in controlled treatments. But, as the data were presented, in 85 of the 108 combinations the treatment tasks

were classified as controlled. The ratio of controlled studies to uncontrolled studies certainly biased the data in the direction of Bracht's hypothesis.

The measures used as learning style variables were basically I.Q. scores and similar measures of general ability. Most of the studies did an analysis of interaction as an afterthought. It was not planned into the design.

Cronbach and Snow (1969) also evaluated previous research that was related to ATI. The conclusions were that: (a) previous research was inadequate because of weak methodology, inappropriate hypotheses, and lack of replication; (b) learning rate is a false issue; (c) general ability is related to learning of conceptual tasks; and (d) rote and meaningful instruction may serve different kinds of students. The final conclusion of the investigation was that the principles governing the matching of learner to individualized instructional environment are not yet known and the thinking on personality variables as they relate to instruction is in a primitive state.

Aptitude x Treatment Interaction has as its main goal the investigation of individual differences in students as they interact with various treatments. The brief review of the literature in the ATI tradition demonstrates the need for continued research for the support of the main ATI hypothesis: individual differentiation implies that students be assigned differentially to treatments (courses).

Specific Intelligence Abilities and Achievement

Research in the area of preference for types of mental operations has produced some useful information. Several studies dealing with the preference or tendency to be convergent versus divergent in one's thinking are reported below. Persons favoring convergent thinking are oriented toward organized, deductive problem solving leading to convergence upon a single "correct" solution to a problem. In contrast, divergent thinkers are interested in and good at generating alternative strategies or solutions to problems (Brophy and Good, 1974). These two abilities were not mutually exclusive or even negatively correlated, but some individuals strongly preferred and/or excelled at one as opposed to the other.

Joyce and Hudson (1968) studied the interaction between personalities and intellectual styles of medical students taking statistics courses with those of their teachers. Four teachers were each studied over three successive classes. Investigation of final exam scores from these courses showed that students with high divergent scores did better when taught by the most divergent teacher and that, in general, convergent students did better when taught by convergent teachers.

Zussman and Pascal (1973) studied the effects of divergence and convergence in twenty teachers teaching 450 high school students. The Cropley version of the Wallach-

Kogan (1965) test was chosen as a test of divergence. The Raven Progressive Matrices were chosen as the convergent measure. The Omnibus Personality Inventory (OPI) was used to measure the personality variables of the teachers, but results were not reported for the OPI.

The investigators found that combined divergent-convergent scores best predicted success in biology, chemistry, physics, English composition, and English literature. With regard to comparing the teachers' cognitive bias to the students, a rating scale was used as the dependent variable. Teachers stated that divergent students participated more in class and made more original statements. In contrast, the convergent students were not named as better than divergent students on any traits. Most noteworthy is that teachers stated that students whose convergent-divergent bias was the same as their own needed more attention from them, had a greater need for achievement, and achieved at a higher level than students with the opposite bias.

In a study similar to the Zussman and Pascal study, Ycas and Pascal (1973) found that convergent college students expressed preference for methods such as lecture courses with a precise, well-organized instructor. The divergent college students preferred such structures as student-dominated seminars with relaxed, easy-going instructors and independent courses set up to match the interest of the student.

Guilford (1971) has listed five levels of operations: cognition, memory, convergent production, divergent production, and evaluation. His investigations have shown that these levels can be used as predictors of academic achievement and "creativity."

Field Independence-Dependence and Achievement

The term Field Independence-Dependence (FID) is applied to a cognitive style which appears to govern specific aspects of thinking. Field Independent people have an analytical way of perceiving, a tendency to extract elements from their context. Field Dependent people tend to respond globally to their environment. Witkin (1973) presented a summary of relations found in college students to the FID concept. Field Independent students were oriented toward the sciences rather than arts or humanities. They preferred lecture to discussion. They were realistic and specific in their career choices. Field Dependent students wanted direction from persons in authority, placed great importance on interpersonal relations, preferred socially-oriented fields of study, and were more likely to be undecided about their career. These same relations were found by Warren (1974). Warren administered a 200-item questionnaire to 6,500 college students. The conclusions drawn were that Field Dependent students were student-centered and Field Independent students were teacher-

centered. The classification of students as Field Independent or Field Dependent was logically deduced from items in the questionnaire which were based on Witkin's work (1973).

However, Mayo and Bell (1972) tested 147 college students matched for age, education, and social class. The investigators used a shortened version of Witkin's Embedded Figures Test (EFT) (Jackson, 1965). Their analysis led to the conclusion that FID is related to ability in art. Mayo and Bell also compared FID to the extraversion-introversion scale of the Eysenck Personality Inventory (Form A) with correlations of .05 for men and -.05 for women. Neither of the two coefficients is significant.

In terms of achievement, Davis and Klausmeier (1970) found that high analytic students performed better on a concept identification task than did low analytic students. The measure used for FID in the study was the Hidden Figures Test (HFT) (French, Ekstrom, and Price, 1963).

The Hidden Figures Test contributed information in a study by Farr (1968) to investigate the relationships between Field Independence-Dependence, sex-role identification, and problem difficulty and problem-solving performance.

The subjects were 298 students (219 females and 79 males) between the ages of 18 and 24 enrolled in undergraduate education courses.

The criteria measures were anagram problems for verbal performance and match-stick problems for non-verbal performance. Each type of problem was presented in organized

and disorganized forms, with easy and difficult problems in each form.

When math aptitude--as measured by the SAT--was held constant, Field Independent subjects generally received significantly higher scores than Field Dependent subjects on non-verbal but not on verbal problems, regardless of problem organization or difficulty.

In a correlational study to investigate the relation of several learning style variables--achievement need, time perspective, affiliation need, and field articulation--to academic performance, Acker (1967) thought that nAch would be a better predictor of academic performance than nAffil and that field articulation would tend to vary directly with nAch but inversely with nAffil.

The tests used to measure the variables were: (1) achievement need - TAT adaptation and achievement subscale of Jackson's Personality Research Form (PRF) A, (2) affiliation need - Affiliation subscale of PRF A, (3) time perspective - Time Competence subscale of Shostrom's Personal Orientation Inventory, and (4) field articulation - Figure Drawings technique and Hidden Figures Test, CF 1, from Educational Testing Service.

The subjects were 255 high school seniors from two schools. Criterion data were taken from school cumulative records.

Multiple correlations between predictor battery and GPA and total achievement test score, taken separately as

criteria, were significant at .001 level. Sex differences on all personality measures were small and insignificant.

Ranked in terms of effectiveness as predictors of academic achievement, the best single personality variable was field articulation as measured by the Hidden Figures Test. This was contrary to what Acker expected.

Tolerance of Ambiguity and Achievement

Some people seem to adapt readily to new situations and ideas; other people cannot change their direction no matter what new evidence is presented. These are opposing directions on a continuum of tolerance of ambiguity (TOA) (Luchins and Luchins, 1959).

Budner (1963) found that TOA was related to career specialty of medical students. Contrary to what the investigator expected, those medical students who perceived their field of specialty as structured measured significantly more tolerant than those who perceived their field of specialty as unstructured.

In a study of types of feedback, West, Stallings, and Watts (1973) found that those students categorized as intolerant of ambiguity were less affected by types of feedback (correct, false, none) than those categorized as tolerant.

Hampton (1967) found that tolerance of ambiguity was related to age, sex, and ethnicity. In a study of counselor effectiveness, Jeffrey (1973) was not able to establish a

relationship between tolerance of ambiguity and counselor effectiveness.

In an investigation of the relationships between "causal" orientation to the environment and tolerance of ambiguity, Muuss (1960) observed that sixth grade children who were high "causally oriented" were more tolerant of ambiguity than low "causally oriented" children as measured by the Decision Location Test.

The studies reported imply that the concept of tolerance of ambiguity is tied to maturational and cultural processes. Furthermore, the level of tolerance for ambiguity influences the judgments a person makes about his environment and the actions he will take.

Affective State and Achievement

Praise is generally considered a reward which shapes behavior (Gladstone, 1972). Yet, not everyone responds to praise in the same way. There are substantial variations in behavior which imply individual differences based on other variables. Ginott (1965) has substantiated cases where violent negative behavior has followed the use of praise as a reward.

The question was: What aspects of the affective state would be related to achievement? Worrell (1959) was able to predict college achievement on the basis of scholastic aptitude and grade-point average with an r of .43. By including a measure of level of aspiration, the predictive strength increased to an r of .85.

One of the important ingredients in a classroom setting is communication between teacher and students. Three studies have been previously discussed that imply that matching teachers and students along the convergent-divergent dimension relates to achievement.

In a study of the effects of counselor-client similarity, Mendelsohn and Geller (1963) observed that the number of times a client freely returned to therapy was a function of the closeness of similarity between client and counselor on the four scales of the Myers-Briggs Type Indicator.

Madill (1972) studied the effects of motivational modes and personality types upon academic performance. The personality instruments were the Sixteen Personality Factor Questionnaire (16 PF) and Harvey's Conceptual Levels Test (CLT). Two main motivational modes were used, defined as: external motivation (EM), which included tangible or intangible rewards originating from outside the student, and internal motivation (IM), which included any device by which a need-to-know attitude was created in the student. The students were categorized as abstract or concrete from the personality instruments. Abstract individuals responded significantly to the use of the IM mode.

The dimensions of the affective state investigated in the present study are: extraversion-introversion, sensing-intuition, thinking-feeling, and judging-perceiving, measured by the Myers-Briggs Type Indicator.

Study Strategies and Achievement

A given task could be performed through the use of different operations (strategies), and success on the task would, in part, be determined by the particular choice of a strategy. Different major fields present different types of problems to the student. There is little surface resemblance between the solution of mathematical equations and most forms of modern art (Bruner, Goodnow, and Austin, 1956).

Goldman and Hudson (1973) investigated this hypothesis. A sample of 256 college freshmen was administered a battery of tests including specific ability measures and the Study Strategies Questionnaire (SSQ), designed to measure study strategies along seven dimensions (Goldman and Warren, 1973). Grade-point average and major field were included as dependent variables. The results imply that there were significant main effects between major field and study strategies, between sex and major field, and between sex and study strategies as well.

Goldman and Warren (1973) found differences in study strategies with respect to students who have high grade-point averages compared to students with low grade-point averages.

A correlation of .49 was established by Holtzman and Brown (1968) between study habits and grade-point averages for 590 high school students. Study habits were measured

by the Survey of Study Habits and Attitude Questionnaire (SSHA) developed by Holtzman.

Haslan and Brown (1968) were able to improve academic performance in high school students through a course for study effectiveness. Scores on the SSHA corresponded significantly to students' grades.

Summary

The literature tends to support the position that testing for differences between treatments without reference to individual preferences for learning results in the analysis producing no significant differences. Furthermore, when studies investigated different aptitudes with respect to treatment, few aptitudes appeared to require differential treatment. One reason presented for this result was that the studies reviewed were not principally designed to explore this kind of relationship. A second reason was that the aptitudes examined were basically of the general intelligence type such as I.Q. scores. A third reason was that none of the studies reviewed considered the position of the instructor's learning style when they investigated aptitude treatment interactions.

Each of the learning style variables included in this study is supported by the literature as requiring consideration when investigating student achievement in terms of preferences for different ways of learning.

CHAPTER III

METHODS AND PROCEDURES

Introduction

The matching of appropriate instructor learning style variables with student learning style variables is considered an important step for designing an optimal learning environment. Not enough is known about the learning style variables to determine which ones are most influential for learning. The relationships that exist between the learning style variables and achievement have not been clearly established.

It is the purpose of the present investigation to identify the learning style variables that relate to achievement in different ways. It is expected some variables would be related to achievement for students in all four subject areas while other variables would have a relationship to achievement for specific subject matter areas. Some variables would have a significant relationship to achievement for specific instructors. Knowing the relationships of learning style variables to achievement, it would be possible for instructors to prepare material to meet the needs of the students. Teaching could then come one step closer to the goal of accommodating individual differences to

arrive at creating an optimal learning environment for each student.

Selection of the Subjects

The subjects selected attend a state university located in Oklahoma. Though the university draws its students internationally, ninety percent of the subjects indicated on a biographical data sheet that they attend the university as residents of Oklahoma. The subjects ages range from 17 years to 56 years with the mean at 19.2 years. The number of subjects in the study is 940 with 493 males and 447 females.

The subjects were enrolled in one or more of four courses by means of the regular registration procedures. Each course represented a subject matter area. The subject matter areas were: Economics, represented by ECON 1113 The Economics of Social Issues; English, represented by ENGL 1113 Freshman Composition; History, represented by HIST 2493 American History From 1865 to the Present; and Psychology, represented by PSYCH 1113 Introductory Psychology. The Oklahoma State University catalog for 1974-75 describes the courses as follows:

> ECON 1113: An examination of the economic aspects of contemporary social issues with emphasis on how economists approach such issues.
>
> ENGL 1113: For students who have an English ACT score of 17 or above or have successfully completed 0103. Practice of the fundamentals of expository writing with emphasis on structure and development.

HIST 2493: May be taken independently of HIST 2483. Development of the United States including the growth of industry and its impact on society and foreign affairs.

PSYCH 1113: Intelligence, personality, motivation and application of psychology in various fields.

Subjects enrolled in more than one course involved in the study were treated as independent subjects for each subject area because they would have a separate criterion measure for each subject area. There were 40 subjects enrolled in more than one course with only 2 enrolled in more than two courses.

The instructors in the study were selected on the basis of their assignment by the department head to teach the level of course in the study and by their desire to cooperate in the study. The instructors were provided with information concerning the nature of the study by means of an abstract (see Appendix A) of the problem under investigation. There were eleven instructors covering nineteen classes in the study (see Table I).

Due to the procedures for acquiring the data, the subjects are separated into two groups for purposes of analysis based on whether they had completed all tests (Group II) or just the first set (Group I)(see Table I).

Procedures

The battery of tests was divided into two parts. The first set of tests consisting, in order, of Verbal Analogies III, Ordering I, and Alternate Additions, was administered

TABLE I

NUMBER OF SUBJECTS AND CLASSES IN EACH GROUP FOR EACH INSTRUCTOR AND SUBJECT MATTER AREA

Subject Area and Instructor	Group I Partial Testing	Group II Complete Testing	Total	Number of Classes
ECON	160	68	228	3
Inst. A	84	8	92	1
Inst. B	34	50	84	1
Inst. C	42	10	52	1
ENGL	111	37	148	6
Inst. D	55	22	77	3
Inst. E	56	15	71	3
HIST	207	134	341	7
Inst. F	96	61	157	3
Inst. G	53	39	92	2
Inst. H	58	34	92	2
PSYCH	96	127	223	3
Inst. I	38	34	72	1
Inst. J	28	47	75	1
Inst. K	30	46	76	1

to the subjects in their assigned classrooms. The instructors took the first set of tests at that time. Prior to the testing, reasons for the study were presented to the subjects. The test administrator read the information directly from the instruction sheet (see Appendix B) to control for effects arising from variations in knowledge about the study. The subjects completed a biographical data sheet (see Appendix C) which would establish a computer file for each subject. After the test session, part two of the instruction sheet was read to the subjects. It explained that there were more tests to be completed. A form was distributed with a number of testing times; the subjects were requested to write their name under the time most convenient to them.

The first set of tests was administered to all 19 classes during the first three weeks in the Fall semester of the 1974-75 school year. All classes met between 7:30 a.m. and 4:30 p.m. Testing sessions were well distributed among the days of the week except for Monday (see Table II).

The second set of tests was administered at the residence halls on Tuesday and Friday afternoons at 2:00, on Thursday and Saturday mornings at 9:30, and on Monday, Tuesday, and Thursday evenings at 7:00. These sessions were held from the second week through the sixth week of school.

The order of testing for the second session was Hidden Figures Test, Intolerance-Tolerance for Cognitive Ambiguity, Study Strategies Questionnaire, and the Myers-Briggs Type

Indicator. The range of time for completion was from 70 minutes to 135 minutes with the mean near 90 minutes. Two instructors attended the second testing session to complete the battery; the other nine instructors were tested in their offices at a time convenient to them.

TABLE II

FIRST TESTING BY SUBJECT MATTER AREA
BY DAY OF THE WEEK

	Mon	Tue	Wed	Thur	Fri	Total Per Subject Area
Economics	1		1	1		3
English			2	3	1	6
History		2		2	3	7
Psychology		3				3
Total Per Day of Week	1	5	3	6	4	19

The criterion measure was the final grade assigned to each subject by the instructor. This was obtained from the instructor at the end of the semester.

Instrumentation

Verbal Analogies III

The test Verbal Analogies III (VA) was developed as a measure of evaluation:operation; semantic:content; relations:product (EMR) (Guilford and Hoepfner, 1974). Analogies tests have been found suitable in connection with relation in other operation categories, so a special form of analogies test was designed for evaluation of relations. The test VA presents three terms, and the subject is asked to select a fourth term from a list of four possible alternatives to complete the analogy. The first two words of each item are quite easy to recognize. Each of the alternative answers from which to select the fourth word of the analogy bears a well-recognized relation to the third word, but one comes nearest to being the same as between the first two words. The subject must evaluate which would be the best from a list of good choices (Guilford and Hoepfner, 1974, p. 207); e.g.,

Given words: TRAFFIC:SIGNAL as RIVER:_____

A. bank B. dam C. canel D. sand bags

Answer: B (a dam regulates the flow of a river as a signal regulates the flow of traffic)

The VA had the highest loading of the set of tests developed for EMR, .58.

The reliability reported for this test in the bulletin of tests selected to represent Structure-of-Intellect

abilities is .60 (Sheridan, Inc., 1974). According to the bulletin, the more nearly the square of the loading approaches the reliability, the more nearly universal the test is for measuring its salient ability. The square of the factor loading for VA is approximately .34. It is listed as the most salient test for the EMR ability.

Ordering I

The test Ordering I (OR) was developed as a measure of convergent production:operation; semantic:content, and systems:product (Guilford and Hoepfner, 1974). The OR presents several statements as one item with the instruction to put the list of events into the most reasonable time order. For example, sample events: A. Casey swung mightily but missed. B. There was no joy in the home town after the game. C. The home town stands roared as he came to bat. The correct order would be CAB. The organization of events in relation to time is seen as requiring thinking at the level of systems. Although the OR shares factor loadings with some tests that represent convergent production: operation; symbolic:content; and classes, systems, and transformations:product, for the purpose of this study to tap convergent production:operation it is seen as appropriate. It was recommended by Guilford (May, 1974, personal communication) over Word Matrices, another test for the same factor. The factor loading is .51.

The reliability reported for this test (Sheridan, Inc., 1974) is .48. The square of the factor loading is an index of validity of the test to measure the NMS ability. It is .26.

Alternate Additions

The test Alternate Additions (AA) was developed as a measure of divergent production:operation; symbolic:content; and relations:product (DSR) (Guilford and Hoepfner, 1971). The AA presents several simple numbers with the instruction to combine them, by addition only, in different ways to achieve a specified sum. For example, the digits 1, 2, 3, and 4 can be summed in different ways to equal the total of 7. By means of factor analysis the AA test as part of a battery representing DSR was clearly separated from five figural and five symbolic factors of the same operation category. The AA had the highest loading, .60, of the tests developed for DSR. This test is seen as appropriate to use as a measure of DSR (Guilford, May, 1974, personal commication).

The reliability reported for this test is .71 (Sheridan, Inc., 1974). The square of the factor loading is approximately .31. This is an index of the validity of the test to measure the DSR ability.

Hidden Figures Test

The Hidden Figures Test (HFT) is related to the variable Field Independence-Dependence. Barrett and Cabe (1968)

studied the relation of the HFT to the Rod and Frame Test (RFT) which was one of the original measures to operationally define the concept (Witkin, 1950). The investigators gave the HFT to 37 subjects six months after they had taken the RFT. The conclusion of the investigators is that the relation is not a simple linear one. However, the HFT is closely akin to one of the group forms of the Embedded Figures Test (EFT) used by Jackson, Messick, and Myers (1964) to evaluate group forms of the EFT to the original individual form developed by Witkin (1950). The description of Forms III and IV for EFT is identical to the HFT. The conclusion of the study by Jackson et al. was that Forms III and IV of the EFT correlated highly enough to be used in place of the original EFT; r's of .62 and .68 respectively.

The HFT contains instructions to attempt to locate one of five simple figures, which appear at the top of each page, in each of 32 complex patterns. The complex patterns each contain only one of the simple figures always in the upright position, but the subject does not know which of the five he is searching for. The 32 patterns are separated into two timed parts of 16 each. The subject has 10 minutes for each part.

The test-retest reliability of Form CF-1, which will be used in this study, is reported as .63 for 105 college freshmen after 10 weeks by Boersma (1968). He found that

experience resulted in better performance but that sex differences were negligible.

The relationship of the HFT to achievement and performance in problem solving as criterion validity is reported in Chapter II.

Tolerance-Intolerance of Cognitive Ambiguity

The Tolerance-Intolerance of Cognitive Ambiguity test (TICA) is a modification (Hampton, 1967) of Siegel's (1954) TICA test. It consists of sixteen pictures of adult males and females taken at random from various popular magazines dated 1962-1965 and sixteen statements taken at random from different popular magazines. The pictures are printed on one sheet and the statements on another. Subjects are requested to match those pictures they feel represent people who had made specific statements. The subjects are informed that they can make as many picture statement matches as they wish, or none if they so wish. On a separate sheet, the subjects are requested to indicate their degree of certainty of each match on a seven-point Likert-type scale. High scores are accepted as indicative of ambiguity intolerance.

The reliability of the TICA is reported by Hampton (1970) in a study of 322 students in three age categories, ages 10-12, 15-17, and 20-22. The Coefficient Alpha (Cronbach, 1951) for each of the three groups is reported as .44, .90, and .92, respectively.

The only validity for the TICA at the time of this study is construct validity. The test was designed on the Gestalt concept of need for closure. The task is ambiguous. The amount of closure a person seeks implies the degree of intolerance he has for an uncertain situation. Intolerance for ambiguity is frequently described as resulting in rigid conceptualization or behavior (Luchins and Luchins, 1959). In a study of flexibility of thinking, Frick, Guilford, Christensen, and Merrifield (1959) comment that there is no unitary general trait of rigidity that applies to all kinds of operations--sensory, perceptual, thinking, psychomotor, and attitudinal. The TICA is believed to tap the operation of thinking. It is seen as a tendency at premature closure; a need to mentally structure the environment (Hampton, 1970).

Myers-Briggs Type Indicator

The Myers-Briggs Type Indicator (MBTI) is a self-report inventory of 166 forced choice items which is intended to measure variables stemming from the Jungian personality typology. It consists of four scales: Extraversion-Introversion (EI), Sensation-Intuition (SN), Thinking-Feeling (TF), and Judging-Perceiving (JP). The EI scale is presumed to measure interest in things and people or concepts and ideas; the SN scale, tendencies to perceive through the usual sensory processes or indirectly, via the unconscious; the TF scale, tendencies to judge (or evaluate)

phenomena rationally and impersonally or subjectively and personally; the JP scale, tendencies to reach conclusions about phenomena or to become aware of them (Myers, 1962).

The internal-consistency reliability of continuous scores was estimated by coefficient Alpha (Cronbach, 1951), which was computed from item statistics. These reliability coefficients were generally in the .70's and low .80's (Stricker and Ross, 1963).

The TF scale consistently had lower reliability than the other scales; its reliability ranged from .64 to .74.

The intercorrelational results for both type categories and continuous scores, and for all groups (12th graders: 393 boys and 614 girls; college freshmen: 300 male and 184 female), consistently indicate that the EI, SN, and TF scales are independent of each other but that the JP scale is moderately related to the SN and TF scales (Myers, 1962; Stricker and Ross, 1963).

Test-retest reliability is reported by Mendelsohn (1965) as .73 for EI, .69 for SN, .69 for JP, and .48 for TF for 41 college students after 14 months.

The type scores relate meaningfully, to establish concurrent validity, to a wide range of variables including personality, ability, interest, value, aptitude and performance measures, academic choice, and behavior ratings (Myers, 1962).

Study Strategies Questionnaire

The Study Strategies Questionnaire (SSQ) was developed from a list of answers to the question, "What study strategies do you use," obtained from over 100 students. Of approximately 150 original statements, 80 were extracted for use in a pilot study. Out of the pilot study, 64 items were administered to 538 upper-division college students (Goldman and Warren, 1973). The data werefactor analyzed, and seven categories (see Appendix I for a description of each scale) were used to describe the loadings. The seven categories are: clerical diligence (CD), academic "savvy" (AS), mnemonics (MN), planfulness (PL), formal thinking (FT), note taking (NT), and transformation and application (TR). The subjects answered each item by responding to a five-point Likert-type scale.

The SSQ was used in a study by Goldman and Hudson (1973) to investigate the relation of study strategies for successful and unsuccessful college students in different major fields to establish construct validity. The study uncovered relationship to achievement based on sex, field of study, and study strategies.

Statistical Treatments

The primary purpose of the present study was to serve as a basis for deciding on the importance of various learning style variables with relation to student achievement. As such, educators and administrators will have to make

decisions as to the number of variables they would include in a program that attempts to match students with an optimal learning environment. These decisions are frequently limited by resources such as time, money, and faculty. Therefore, correlation coefficients will be presented with their exact probability of occurrence rather than flagging only coefficients that have probabilities less than or equal to the conventional .05 or .01 levels.

Research Question One

Research Question One, "Are there learning style variables whose relationships to achievement could be described as non-linear?" was answered by applying the statistical techniques of product-moment correlation (see Appendix K for reference to computer programs) and correlation ratio to grouped data. The product-moment correlation statistic is designed to compute a coefficient based on the assumption that the two variables are rectilinear (Guilford, 1965). "The correlation ratio is a very general index of correlation particularly adapted to data in which there is a curved regression" (Guilford, 1965, p. 285). The correlation ratio does not make any assumptions about the shape of the regression line.

The use of these statistics was seen as appropriate in that the measuring instruments Verbal Analogies III, Ordering I, Alternate Additions, Hidden Figures, Tolerance-Intolerance of Cognitive Ambiguity, Study Strategies

Questionnaire, and the Myers-Briggs Type Indicator produced scores which the test constructors have treated as interval measurements.

The F test of linearity (see Appendix M for reference to statistical formulae) was applied to the coefficients produced by the two statistics to determine if there were relationships between the learning style variables and achievement which were non-linear.

Research Questions Two, Three, and Four

Research Question Two, "Do specific learning style variables relate to achievement without reference to instructor variations or subject matter area?", Research Question Three, "Do specific learning style variables relate to achievement for specific subject matter areas without reference to instructor variations?", and Research Question Four, "Do specific learning style variables relate to achievement for specific instructors?", were answered by applying the statistical techniques of product-moment correlation and multiple regression to the raw data.

The multiple regression technique produced a coefficient of multiple correlation which indicated the strength of the relationship between achievement and one or more of the learning style variables combined with optimal weights (Guilford and Fruchter, 1973).

The stepwise procedure was used to choose the first best predictor variable and then the next best when combined with the first variable and so on.

The use of the multiple regression statistic with the stepwise procedure was appropriate for the present study in that it extracted the most powerful predictor variable and the combination of variables that accounted noticeably for the amount of variance in achievement with adjustment for the intercorrelations of the variables.

The product-moment correlation statistic provided a matrix of correlation coefficients so that the exact relationship of each learning style variable to achievement and to each other variable could be observed.

The Fisher's z transformation (see Appendix M) statistic was used to test if two correlation coefficients were equivalent (Guilford and Fruchter, 1973, p. 145).

Research Question Five

To answer Research Question Five, "Does the instructional style mediate the relation between the student's learning style and the student's achievement?", an index of distance for the learning style variables of each student from his/her instructor was computed. A z score was computed for each raw score based on the means and standard deviations of the entire sample. The z score was considered an appropriate index for comparing scores between tests (Anastasi, 1968). The formula for the distance index was derived from the formula for the distance between points (Georges, 1955).

$$d = \sqrt{(V_{1_s} - V_{1_I})^2 + (V_{2_s} - V_{2_I})^2 + \ldots + (V_{n_s} - V_{n_I})^2}$$

V_{1_s} - the z score for a student for the first variable

V_{1_I} - the z score for the instructor for the first variable

The statistical technique of one-way classification analysis of variance (see Appendix K) was applied to the d index and grade. This statistic was considered robust and efficient even when complete randomness could not be assured (Steel and Torrie, 1960).

Research Question Six

Research Question Six, "Were there differences between the students who were tested for all variables and those who were not?", was answered by applying the statistical technique of the t test (see Appendix M). This statistic was appropriate for testing whether two sample means come from the same population (Spence, Underwood, Duncan, and Cotton, 1968).

CHAPTER IV

ANALYSIS OF THE DATA

Introduction

The purpose of this chapter is to present the results of the statistical analysis for the six research questions formulated in the present study. The focus of the study is to explore the relationship of learning style variables to instructional style, academic fields and achievement. The results from the analysis of the data for each question provides the information required to draw conclusions about the usefulness of approaching the question of achievement by considering both a student's learning style and the relationship between a student's style and the instructor's style. Chapter IV is divided into six parts; each part begins with the reiteration of one of the research questions.

Research Question One

Are there learning style variables whose relationship to achievement could be described as non-linear?

The correlation ratio (eta) and the product-moment correlation techniques were applied to Group II (complete testing) data at the subject matter level. The results are summarized in Table III. An F test of linearity was

calculated to determine if the differences between the r and η were large enough to exclude chance differences at the .05 probability level.

The data in Table III are computed for each subject area. The column headings are from left to right: Variables, Product-Moment Correlation Coefficient (r), Correlation Ratio Coefficient (η), Degrees of Freedom, and F Value. A characteristic of the correlation ratio is the absence of a directional sign. This is not necessarily a weakness in the technique since the correlation ratio is designed for relationships that are curvilinear. To avoid confusion about the size of the difference between the r and the η, the sign for the r has been applied to the η (Guilford, 1965).

Three variables in the table were derived from the data of the original variables discussed in the previous chapters. The variable "Wrong" is the sum of the incorrect responses from the Verbal Analogies, Ordering, and Alternate Additions. RI-1 is the sum of the items left blank for Verbal Analogies and Ordering. RI-2 represents the items left blank for the Hidden Figures Test.

An examination of the results revealed only three instances where the difference between the coefficients was significant at less than or equal to the .05 probability level. The variable "Clerical Diligence" had an F value of 2.4605 and 3.868 for History students and Psychology students, respectively. "Academic Savvy" had an F value of 2.1702 for Psychology students. The number of differences less than or

TABLE III

F TEST OF LINEARITY BETWEEN PRODUCT-MOMENT COEFFICIENTS AND CORRELATION RATIO COEFFICIENTS FOR GROUP II DATA FOR THE FOUR SUBJECT MATTER AREAS

VARIABLE	ECONOMICS (n=64)					ENGLISH (n=36)					HISTORY (n=133)					PSYCHOLOGY (n=125)				
	r	η	δf		F	r	η	δf		F	r	η	δf		F	r	η	δf		F
VERBAL ANALOGIES	.546	.541	5,	55	.0845	.223	.471	5,	29	1.2828	.206	.303	6,	125	1.1326	.225	.288	7,	100	.5034
ORDERING	.312	.367	5,	55	.4747	.298	.340	4,	30	.2272	.142	.217	7,	100	.4036	.303	.308	5,	100	.0675
ALTERNATE ADDITIONS	.206	.344	9,	50	.4783	.287	.582	10,	24	.9304	.069	.4	10,	100	1.8481	.156	.354	9,	100	1.2827
WRONG	-.403	-.482	10,	50	.4553	.269	-.562	8,	26	1.157	-.234	-.298	10	100	.3737	-.2	-.279	9,	100	.0456
RI-1	-.229	-.495	11,	50	1.1595	-.036	-.516	9,	25	1.0031	-.046	-.429	12	100	.8580	-.146	-.3	12,	100	.6290
HIDDEN FIGURES	.191	.356	8,	50	.6460	.2	.529	9,	25	1.1656	.012	288	9,	100	1.0032	.141	.286	9,	100	.7492
RI-2	-.076	-.255	7,	55	.4979	.025	445	8,	26	.8000	.01	.179	8,	100	.4125	.037	.224	8,	100	.6423
CLERICAL DILIGENCE	.020	.330	8,	55	.8371	-.034	-.283	5,	29	.4976	-.187	-.410	8,	123	2.4605	-.11	-.459	8,	123	3.868
ACADEMIC SAVVY	.055	.305	7,	55	.7797	.062	.468	7,	27	1.0628	-.161	-.283	7,	24	1.0431	-.098	-.321	6,	125	2.1702
MNEMONICS	.012	.397	7,	55	1.4687	-.204	-.383	7,	27	.4750	-.218	-.298	8,	123	.6965	-.13	-.358	8,	123	1.9621
PLANFULNESS	.01	.369	7,	55	1.2376	-.336	-.502	7,	27	.7173	-.363	-.429	8	123	.9849	-.26	.319	7,	124	737
FORMAL THINKING	-.211	-.369	8	55	.7293	-.313	-.444	8	26	.4014	005	241	8,	123	.9476	.01	.217	8,	123	.7633
NOTE TAKING	.08	442	7,	55	1.8452	-.024	-.534	7	27	1.5355	-.090	-.221	7,	124	.7588	-.054	-.234	7,	124	.9715
TRANSFORMATION	.005	.184	8,	50	.2188	-.044	- 41	8,	26	.6686	-.037	-.226	8,	100	.6548	-.113	-.264	8,	100	.7649
EXTRAVERSION-INTROVERSION	.143	.371	6,	55	1.2457	.070	.386	6,	28	.7902	.09	.239	6,	125	1.0831	.089	.2	6,	100	.5569
SENSING-INTUITION	.391	.569	7,	55	1.9854	.037	.576	7,	27	1.9072	-.143	.214	7,	100	.3795	.111	.182	7	100	.3074
THINKING-FEELING	-.162	-.319	7,	55	6606	-.124	-.332	7,	27	.4112	.115	.340	7,	100	1.6659	.030	.297	7,	100	1.3679
JUDGING-PERCEIVING	.138	.303	6,	55	.7344	-.126	-.335	5,	29	.6295	-.227	-.290	6,	125	.7409	-.101	-.249	6,	100	.9204
TOLERANCE OF AMBIGUITY	.033	.365	7,	55	1.1979	-.141	-.438	6,	28	.9930	-.083	-.158	7	100	.2648	-.115	-.264	7,	100	.8672

equal to the .05 probability level was fewer than would be expected by chance for the 76 values tested. On the basis of the techniques used, there was no firm evidence to imply that any of the learning style variables had a non-linear relationship to achievement.

Research Question Two

Do specific learning style variables relate to achievement without reference to instructor variations or subject matter area?

The descriptive statistics of mean and standard deviation of Group I data (partial testing) and Group II data (complete testing) are summarized in Tables IV, V, VI, and VII. The data in Tables IV and V describe the mean and standard deviation of either "all students tested" (Group I students, partial testing; and Group II students, complete testing) or Group II students as comparable to the subclass of "all students with ACT scores" or Group II students with ACT scores."

In Tables VI and VII the distribution of scores for Group I students and Group II students were examined for sex differences. The t statistic was applied to consider differences between the mean scores for male students and female students.

TABLE IV

DESCRIPTIVE STATISTICS OF MEAN AND STANDARD DEVIATION FOR THOSE VARIABLES MEASURED FOR ALL STUDENTS AND THE SUBCLASS OF ALL STUDENTS WITH ACT SCORES

	All Students (Total) n = 889		All Students (w/ACT) n = 750	
	$\bar{X}$	SD	$\bar{X}$	SD
ASSIGNED GRADE	2.97	1.01	3.00	0.99
VERBAL ANALOGIES	10.98	2.82	11.09	2.74
ORDERING	7.59	2.58	7.60	2.58
ALTERNATE ADDITIONS	23.34	4.86	23.49	4.80
WRONG	17.26	5.15	17.09	5.09
RI-1	6.02	3.19	6.04	3.18
ACTE			19.74	4.41
ACTM			21.07	6.14

TABLE V

DESCRIPTIVE STATISTICS OF MEAN AND STANDARD DEVIATION FOR ALL THE VARIABLES MEASURED FOR GROUP II STUDENTS AND THE SUBCLASS OF GROUP II STUDENTS WITH ACT SCORES

	Group II Total n = 358		Group II w/ACT n = 303	
	$\bar{X}$	SD	$\bar{X}$	SD
ASSIGNED GRADE	3.24	0.89	3.27	0.88
VERBAL ANALOGIES	11.08	2.83	11.09	2.84
ORDERING	7.74	2.57	7.75	2.56
ALTERNATE ADDITIONS	23.63	4.69	23.64	4.78
WRONG	16.93	4.64	16.81	4.68
RI-1	5.94	3.16	6.05	3.15
HIDDEN FIGURES	10.04	5.31	9.90	5.16
RI-2	16.99	6.40	17.06	6.42
CLERICAL DILIGENCE	3.22	0.55	3.20	0.56
ACADEMIC SAVVY	1.82	0.42	1.82	0.43
MNEMONICS	2.34	0.60	2.34	0.61
PLANFULNESS	2.50	0.62	2.49	0.63
FORMAL THINKING	2.72	0.61	2.69	0.60
NOTE TAKING	2.45	0.80	2.48	0.81
TRANSFORMATION	2.69	0.53	2.68	0.54
EXTRAVERSION-INTROVERSION	98.70	26.45	98.14	26.49
SENSING-INTUITION	89.03	26.17	90.24	25.72
THINKING-FEELING	114.42	19.16	114.49	19.05
JUDGING-PERCEIVING	97.70	26.75	97.21	26.63
TOLERANCE OF AMBIGUITY	61.30	24.06	61.40	23.62
ACTE			20.31	4.29
ACTM			21.59	6.56

TABLE VI

DESCRIPTIVE STATISTICS OF MEAN AND STANDARD DEVIATION FOR VARIABLES MEASURED FOR GROUP I STUDENTS AND THE SUBCLASSES OF MALE STUDENTS AND FEMALE STUDENTS WITH T TESTS FOR THE VARIABLES FOR MALE STUDENTS AND FEMALE STUDENTS

	Group I (Total) n = 531		Group I (Males) n = 303		Group I (Females) n = 228		T
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	
GRADE	2.78	1.05	2.76	1.05	2.80	1.05	.434
VERBAL ANALOGIES	10.92	2.80	11.07	2.96	10.72	2.57	1.424
ORDERING	7.48	2.59	7.44	2.62	7.54	2.56	.439
ALTERNATE ADDITIONS	23.14	4.96	23.45	5.25	22.72	4.52	1.679
WRONG	17.49	5.46	17.27	5.40	17.78	5.54	1.063
RI-1	6.07	3.21	6.21	3.28	5.90	3.12	1.099

$t_{.05,\ 500} = 1.965$

$t_{.01,\ 500} = 2.506$ (Guilford and Fruchter, 1973, p. 516)

TABLE VII

DESCRIPTIVE STATISTICS OF MEAN AND STANDARD DEVIATION FOR VARIABLES MEASURED FOR GROUP II STUDENTS AND THE SUBCLASSES OF MALE STUDENTS AND FEMALE STUDENTS WITH T TESTS FOR THE VARIABLES FOR MALE STUDENTS AND FEMALE STUDENTS

	Group II (Total) n = 358		Group II (Males) n = 164		Group II (Females) n = 194		T
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	
GRADE	3.24	0.89	3.19	0.94	3.29	0.84	1.059
VERBAL ANALOGIES	11.08	2.83	11.42	2.91	10.79	2.74	2.101*
ORDERING	7.74	2.57	7.64	2.52	7.83	2.61	0.695
ALTERNATE ADDITIONS	23.63	4.69	24.36	4.68	23.02	4.63	2.707**
WRONG	16.93	4.64	16.35	4.52	17.42	4.7	2.177*
RI-1	5.94	3.16	6.31	3.19	5.62	3.10	2.065*
HIDDEN FIGURES	10.04	5.31	10.04	5.54	10.05	5.12	.018
RI-2	17	6.4	16.93	6.78	17.05	6.07	.176
CLERICAL DILIGENCE	3.22	0.55	3.24	0.56	3.2	0.54	.685
ACADEMIC SAVVY	1.82	0.42	1.92	0.40	1.73	0.42	4.346**
MNEMONICS	2.34	0.6	2.38	0.59	2.31	0.61	1.095
PLANFULNESS	2.50	0.62	2.57	0.62	2.44	0.61	1.988*
FORMAL THINKING	2.72	0.61	2.63	0.52	2.79	0.66	2.507**
NOTE TAKING	2.45	0.80	2.64	0.86	2.3	0.71	4.086**
TRANSFORMATION	2.69	0.53	2.66	0.53	2.71	0.54	.878
EXTRAVERSION-INTROVERSION	98.7	26.45	99.66	25.34	97.89	27.40	.628
SENSING-INTUITION	89.03	26.17	87.18	25.16	90.59	26.96	1.226
THINKING-FEELING	114.42	19.16	108.45	19.24	119.46	17.62	5.131**
JUDGING-PERCEIVING	97.7	26.75	96.34	27.62	98.85	26.02	.882
TOLERANCE OF AMBIGUITY	61.3	24.06	56.94	26.25	64.98	21.43	3.181**

$t_{.05,\ 350} = 1.967$ $t_{.01,\ 350} = 2.590$ (Guilford and Fruchter, 1973, p. 516).

For Group I students, Table VI, no significant differences were found between the means of the variables with significance defined as $p \leq .05$.

For Group II students, Table VII, ten variables (noted with an asterisk) had a significant difference between means for male students and female students with significance less than or equal to the .05 level. "Verbal Analogies" was designed to measure an intelligence ability for evaluating relations expressed semantically; male students obtained a larger mean score. The test "Alternate Additions" was constructed to measure the intelligence ability used to produce a variety of answers of relationships that were presented in a numerical context; male students obtained a larger mean score. The label "Wrong" represented the sum of incorrect responses on all three tests of intelligence abilities, "Verbal Analogies," "Ordering," and "Alternate Additions;" male students obtained a lower mean score. The label "RI-1" represented the sum of items left blank on "Verbal Analogies" and "Ordering;" male students left more items blank.

On the Study Strategies Questionnaire containing seven sub-scales to measure variations in a student's preference for methods of studying, male students obtained a different mean score from female students on four of the sub-scales. The response scale was designed so that the smaller the number the higher the agreement of importance for that variable.

On the sub-scale labeled "Academic Savvy," male students felt it was less important to know the system than female students.

For "Planfulness," male students felt it was less important to plan ahead than female students.

For the sub-scale "Formal Thinking," male students obtained a lower mean score than female students, which implied that male students considered formal thinking more important.

For "Note Taking," which represented a preference for writing while studying, male students felt this was less important.

The dimension "Thinking-Feeling" was measured by the Myers-Briggs Type Indicator. The lower the score on this dimension, the greater the preference for using logical processes aimed at an impersonal finding. The higher the score on "Thinking-Feeling," the greater the preference for using a process of appreciation and bestowing on things a personal, subjective value. Male students obtained a lower mean score on "Thinking-Feeling" than female students.

The "Tolerance-Intolerance for Cognitive Ambiguity" instrument was constructed so that a lower score implied a greater tolerance for ambiguous situations or concepts. Male students obtained a lower mean score than female students.

Despite these observed differences in mean score on ten of the 19 variables, there was no significant difference for grade between male students and female students. The distribution of students by sex for subject matter areas and instructors is summarized in Table VIII.

TABLE VIII

DISTRIBUTION OF GROUP I STUDENTS AND GROUP II STUDENTS BY SEX FOR SUBJECT MATTER AREAS AND INSTRUCTORS

	GROUP II		GROUP I	
	M	F	M	F
ECON.	30	34	84	63
A	2	5	49	28
B	24	24	18	14
C	4	5	17	21
ENGLISH	18	18	69	34
D	11	11	31	18
E	7	7	38	16
HISTORY	71	62	112	85
F	35	25	55	38
G	17	22	32	18
H	19	15	25	29
PSYCH.	45	80	38	46
I	8	25	11	25
J	21	25	13	11
K	16	30	14	10

Product-moment correlation coefficients were computed for all the learning style variables to achievement. The results are summarized in Tables IX and X. The exact probability is stated so that decisions about the relative importance of the contribution of a variable can be made more easily based on the specific needs of the educator and

TABLE IX

PRODUCT-MOMENT CORRELATION COEFFICIENTS AND PROBABILITY LEVELS FOR LEARNING STYLE VARIABLES TO ACHIEVEMENT FOR GROUP I AND GROUP II STUDENTS

		All Students (n = 889)	All Students w/ACT (n = 750)	Group I (n = 531)	Group II (n = 358)	Group II w/ACT (n = 303)	Group I Males (n = 303)	Group II Males (n = 164)	Group I Females (n = 228)	Group II Females (n = 194)
VERBAL ANALOGIES	r	.32	.29	.37	.24	.24	.43	.3	0.29	.2
	p	.000	.000	.000	.000	.000	.000	.000	.000	.006
ORDERING	r	.28	.28	.32	.21	.21	.38	.22	.23	.20
	p	.000	.000	.000	.000	.000	.000	.006	.000	.005
ALTERNATE ADDITIONS	r	.18	.18	.23	.09	.08	.26	.18	.19	.02
	p	.000	.000	.000	.084	.143	.000	.019	.005	.763
WRONG	r	-.30	-.28	-.32	-.25	-.24	-.35	-.36	-.29	-.16
	p	.000	.000	.000	.000	.000	.000	.000	.000	.024
RI-1	r	-.1	-.11	-.10	-.08	-.09	-.17	-.06	-.01	-.08
	p	.005	.004	.019	.134	.097	.004	.570	.928	.249
ACTE	r		.39			.41				
	p		.000			.000				
ACTM	r		.34			.32				
	p		.000			.000				

TABLE X

PRODUCT-MOMENT CORRELATION COEFFICIENTS AND PROBABILITY LEVELS FOR LEARNING STYLE VARIABLES (SPECIFIC FOR GROUP II STUDENTS) TO ACHIEVEMENT

		Group II (n=358)	Group II w/ACT (n=303)	Group II Males (n=164)	Group II Females (n=194)
HIDDEN FIGURES	r	.10	.09	.10	.11
	p	.051	.114	.221	.127
RI-2	r	.03	.02	.03	.03
	p	.561	.727	.686	.685
CLERICAL DILIGENCE	r	-.11	-.08	-.12	-.09
	p	.039	.157	.131	.188
ACADEMIC SAVVY	r	-.10	-.12	-.13	-.04
	p	.063	.036	.084	.544
MNEMONICS	r	-.15	-.169	-.15	-.14
	p	.005	.004	.05	.044
PLANFULNESS	r	-.27	-.30	-.27	-.26
	p	.000	.000	.001	.001
FORMAL THINKING	r	-.04	-.07	-.08	-.03
	p	.607	.223	.280	.667
NOTE TAKING	r	-.04	-.04	-.08	.03
	p	.563	.525	.304	.708
TRANSFORMATION	r	-.04	-.09	-.05	-.04
	p	.594	.133	.521	.548
EXTRAVERSION-INTROVERSION	r	.05	.04	.13	.00
	p	.262	.501	.01	.953
SENSING-INTUITION	r	.05	.08	.01	.09
	p	.267	.16	.868	.193
THINKING-FEELING	r	-.00	.01	.04	-.08
	p	.966	.898	.59	.246
JUDGING-PERCEIVING	r	-.11	-.10	-.14	-.09
	p	.032	.083	.074	.202
TOLERANCE OF AMBIGUITY	r	-.05	-.05	-.02	-.11
	p	.658	.604	.829	.115

the resources available. The relative contributions of the variables as a group, taking into account intercorrelations, are summarized in Table XV. The Fisher's z transformation statistic was used to compare differences in coefficients between groups (see Table XI).

From Table IX, it can be seen that "Verbal Analogies" had a range of coefficients from .43 for Group I male students to .2 for Group II female students with an average of .298. The difference between these coefficients was significant at the .05 level. This difference between Group I male students and Group II female students accounted for the observed difference between the coefficients of Group I students and Group II students. All the coefficients had a $p \leq .006$.

The size of the coefficients for "Ordering" were generally smaller than for "Verbal Analogies" with a range of .38 to .20 and an average of .259. The difference between Group I male students and Group II female students was significant at the .05 level. All the coefficients for "Ordering" had a $p \leq .006$.

"Alternate Additions" showed much more variation between groups, with a range of .02 to .26 and an average of .157. The difference between Group I students and Group II students was once again due to the difference between Group I male students and Group II female students.

There was an inverse relationship between "Wrong" (sum of incorrect responses for "Verbal Analogies," "Ordering," and "Alternate Additions") and achievement. The range of

TABLE XI

APPROXIMATION OF THE DIFFERENCE BETWEEN TWO COEFFICIENTS REQUIRED TO REACH A SIGNIFICANCE LEVEL OF .05 FOR CORRELATIONS OF LEARNING STYLE VARIABLES TO ACHIEVEMENT FOR GROUP I AND GROUP II STUDENTS

	A n=889	B n=750	C n=531	D n=358	E n=303	F n=303	G n=164	H n=228	I n=194
ALL STUDENTS	.093	.097	.108	.123	.131	.131	.168	.146	.156
ALL STUDENTS WITH ACT SCORES		.101	.111	.126	.134	.134	.170	.149	159
GROUP I			.121	.134	.142	.142	.176	.156	.165
GROUP II				.147	.154	.154	.186	.167	.176
GROUP II WITH ACT SCORES					.160	.160	.191	.173	.181
GROUP I (MALES)						.160	.191	.173	.181
GROUP II (MALES)							.218	.202	.21
GROUP I (FEMALES)								.185	.193
GROUP II (FEMALES)									.200

coefficients for "Wrong" was from -.16 to - 36 with an average of -.283. The coefficient for Group II female students was smaller than both Group I male students and Group II male students at the .05 level of confidence.

The relationship "RI-1" (sum of blanks for Verbal Analogies II and Ordering I) to achievement was also inverse. The range was from -.01 to -.17 with an average of -.089. The difference between Group I male students and Group I female students was significant at the .05 level.

The learning style variables presented in Table X were the variables completed by Group II students. An inspection of the table revealed that the size of the coefficients was generally smaller than those for the intelligence abilities variables. The size of these coefficients was more likely due to chance with some notable exceptions.

Of the seven subscales for Study Strategies Questionnaire (SSQ), "Clerical Diligence," "Academic Savvy," "Mnemonics," and "Planfulness" provided useful information. The scale for the SSQ was constructed so that a lower score represented higher agreement as to the importance of the variable. This resulted in negative coefficient signifying a positive relationship. "Clerical Diligence" had a small coefficient (r = -.11) for Group II students with a probability due to chance of .039. The relationship implied that students who perceived themselves as "spending more

time studying than most people" tended to have higher grades. "Academic Savvy" reflected a sensitivity to the academic "game." There was a small positive relationship between students who tried to figure out what the instructor wanted and grade. This relationship was more likely true for male students than for female students. The use of memorization as a strategy of study had a positive relationship to grade for both male and female students. The variable "Planfulness" was especially important with relation to grade for both male and female students. The coefficient of -.27, $p \leq .001$, implied that the greater the emphasis on foreplanning, the higher the grade.

The variable "Extraversion-Introversion" has a small positive correlation to achievement for male students and a zero correlation for female students. A positive correlation implied that the stronger a student's preference was towards introversion, the higher the grade.

The variable "Judging-Perceiving" had a small negative correlation for male students with a $p \leq .074$. This implied that the stronger the preference a student had towards dealing with material in a critical fashion as opposed to dealing with material in an open accepting fashion, the higher the grade.

A correlation matrix was constructed for "all students," Group I and Group II to provide information as to the intercorrelations of the variables. The results are presented in Tables XII, XIII, and XIV, respectively.

TABLE XII

PRODUCT-MOMENT CORRELATION MATRIX OF LEARNING STYLE VARIABLES FOR ALL STUDENTS

	VERB ANAL	ORD	ALT ADD	WRONG	R-I 1	GRADE
VERBAL ANALOGIES	1.00	.32 .000	.2 .000	-.65 .000	-.17 .000	.32 .000
ORDERING		1.00	.28 .000	-.41 .000	-.50 .000	.28 .000
ALTERNATE ADDITIONS			1.00	-.16 .000	-.33 .000	.18 .000
WRONG				1.00	-.27 .000	-.30 .000
RI-1					1.00	-.1 .005
GRADE						1.00

TABLE XIII

PRODUCT-MOMENT CORRELATION MATRIX OF LEARNING STYLE VARIABLES FOR GROUP I STUDENTS

	VERB ANAL	ORD	ALT ADD	WRONG	R-I 1	GRADE
VERBAL ANALOGIES	1.00	.36 .000	.21 .000	-.62 .000	-.21 .000	.37 .000
ORDERING			.26 .000	-.45 .000	-.45 .000	.32 .000
ALTERNATE ADDITIONS			1.00	-.15 .001	-.32 .000	.23 .000
WRONG				1.00	-.27 .000	-.32 .000
RI-1					1.00	-.10 .019
GRADE						1.00

TABLE XIV

PRODUCT-MOMENT CORRELATION MATRIX OF LEARNING STYLE VARIABLES FOR GROUP II STUDENTS

	VERB ANAL	ORD	ALT ADD	WRONG	R-I 1	HFT	R-I 2	CLR DIL	ACD SVY	MNEM	PLNG	FWD THK	NOTE TAKG	TRANS	EI	SN	THKG FLG	JUDG PERC	TOL AMB	GRADE
VERBAL ANALOGIES	1.00	.26 .000	.18 .001	-.71 .000	-.11 .036	.27 .000	-.01 .854	.06 .284	-.04 .515	-.05 .618	-.11 .041	-.19 .001	0.17 .002	-.01 .855	.17 .002	.17 .001	-.09 .083	0.01 .796	-.00 .954	.24 .000
ORDERING		1.00	.31 .000	-.35 .000	-.58 .000	.22 .000	-.09 .076	.01 .836	-.02 .74	-.04 51	-.08 .15	-.14 .007	.13 .011	-.07 .217	.02 .718	.17 .001	.00 .957	.12 .021	-.03 .632	.21 .000
ALTERNATE ADDITIONS			1.00	-.18 .001	-.34 .000	.17 .002	-.10 .048	-.04 .586	.12 .025	-.06 .284	.04 .574	-.13 .014	.04 .583	-.01 .815	.05 .664	-.02 .695	.00 .993	-.01 .921	-.07 .172	.09 084
WRONG				1.00	-.27 .000	-.23 .000	-.06 .272	0.01 .824	0.04 .516	.09 .095	.12 .017	.21 .000	-.09 .01	.06 .23	-.13 .014	-.18 .001	0.05 .632	.01 .897	.08 .129	-.25 .000
RI-1					1.00	-.13 .012	.19 .001	-.01 .819	-.00 .929	.00 .963	.01 .905	.00 .981	-.04 .505	-.01 .828	.01 .818	-.05 .313	.02 .726	-.12 .026	-.08 .124	-.08 134
HIDDEN FIGURES						1.00	-.53 .000	.1 .064	-.06 .225	-.02 .742	-.06 .23	-.22 .000	.07 .159	-.05 .62	.05 .608	.18 .001	-.05 .627	.11 .040	.05 .633	10 051
RI-2							1.00	-.02 .745	-.08 .126	-.2 .	.02 .	.09 .099	-.06 .242	-.01 .855	.00 .989	-.12 .018	.07 .156	-.05 .646	-.14 .01	.03 .561
CLERICAL DILIGENCE								1.00	.19 .001	.22 .000	.33 .000	.08 .136	.42 .000	.35 .000	.02 .717	.07 .215	-.03 .641	.32 .000	-.04 .541	-.11 .039
ACADEMIC SAVVY									1.00	.32 .000	.28 .000	.18 .001	.25 .000	.43 .000	.1 .056	-.14 .007	.02 .764	-.03 .619	-.1 .059	-.1 .063
MNEMONICS										1.00	.19 .001	.29 .000	0.19 .001	0.15 .005	.08 .125	-.02 .713	-.07 .196	.06 .272	-.03 .553	-.15 .005
PLANFULNESS											1.00	.18 .001	.18 .001	.28 .000	.16 .003	.06 .259	.01 .916	.21 .000	-.08 .114	-.27 .000
FORMAL THINKING												1.00	.00 .964	.35 .000	-.01 .828	-.26 .000	.21 .000	-.03 .57	.02 .654	-.05 .607
NOTE TAKING													1.00	.21 .000	.12 .02	-.00 943	-.11 .037	.07 .161	-.02 .66	-.04 563
TRANSFORMATION														1.00	.11 .038	.2 .000	.12 .023	.02 .681	-.00 .977	-.04 .595
EXTRAVERSION-INTROVERSION															1.00	-.10 .049	-.05 .644	-.12 022	.02 .652	.06 .262
SENSING-INTUITION																1.00	.08 .144	.42 .000	-.03 .525	.06 .267
THINKING-FEELING																	1.00	.11 .037	.09 .081	-.00 .966
JUDGING-PERCEIVING																		1.00	-.04 .581	-.11 .032
TOLERANCE OF AMBUIGUITY																			1.00	-.05 .658
GRADE																				1.00

The multiple correlation technique was applied to the data for each group to determine the overall value of the contributions of the variables combined. The results are summarized in Table XV. The learning style variables accounted for the least amount of variance for Group I female students and Group II female students with 13.1 and 12.3 percent, respectively. Group II students with ACT scores had the largest known variance. For both groups with ACT scores, learning style variables contributed to the amount of known variance with a significance level of .10.

The inclusion of information about "Planfulness," "Formal Thinking," and "Mnemonics" increased the amount of accounted variance from knowledge about ACT scores alone by 7.3 percent for Group II students.

Research Question Three

Do specific learning style variables relate to achievement for specific subject matter areas without reference to instructor variations?

The descriptive statistics of mean and standard deviation were summarized for the subject matter areas. The results of Group I students are presented in Table XVI and the results for Group II students are presented in Table XVII. A t value was computed for "Grade," the achievement variable, to test for differences between the mean scores for the subject matter areas. From Table XVIII

TABLE XV

MULTIPLE CORRELATION OF LEARNING STYLE VARIABLES TO ACHIEVEMENT FOR GROUP I AND GROUP II STUDENTS[1]

CATEGORY	VARIANCE	VARIABLES IN MODEL
ALL STUDENTS	.103	Verbal Analogies
(n=889)	.138	Verbal Analogies, Ordering
	.145	Verbal Analogies, Ordering, Alternate Additions
	.151	Verbal Analogies, Ordering, Alternate Additions, RI-1
ALL STUDENTS	.152	ACTE
WITH ACT	.188	ACTE, ACTM
(n=750)	.199	ACTE, ACTM, Ordering
	.203	ACTE, ACTM, Ordering, Verbal Analogies
GROUP I	.140	Verbal Analogies
(n=531)	.177	Verbal Analogies, Ordering
	.191	Verbal Analogies, Ordering, Alternate Additions
	.199	Verbal Analogies, Ordering, Alternate Additions, RI-1
GROUP I MALES	.189	Verbal Analogies
(n=303)	.240	Verbal Analogies, Ordering
	.252	Verbal Analogies, Ordering, Alternate Additions
GROUP I FEMALES	.086	Wrong
(n=228)	.117	Wrong, Alternate Additions
	.131	Wrong, Alternate Additions, Verbal Analogies
GROUP II	.071	Planfulness
(n=358)	.117	Planfulness, Wrong
	.137	Planfulness, Wrong, RI-1
	.144	Planfulness, Wrong, RI-1 Mnemonics

TABLE XV (CONTINUED)

CATEGORY	VARIANCE	VARIABLES IN MODEL
GROUP II WITH ACT (n=303)	.169	ACTE
	.216	ACTE, Planfulness
	.238	ACTE, Planfulness, ACTM
	.252	ACTE, Planfulness, ACTM, Formal Thinking
	.264	ACTE, Planfulness, ACTM, Formal Thinking, Mnemonics
GROUP II MALES (n=164)	.13	Wrong
	.179	Wrong, Planfulness
	.211	Wrong, Planfulness, RI-1
	.227	Wrong, Planfulness, RI-1, Extraversion-Introversion
GROUP II FEMALES (n=194)	.066	Planfulness
	.096	Planfulness, Ordering
	.110	Planfulness, Ordering, Tolerance of Ambiguity
	.123	Planfulness, Ordering, Tolerance of Ambiguity, Verbal Analogies

[1]The variables in the model are listed in the order of their contribution. The total known variance is listed with the addition of each variable. Variables were tested at the .10 level of significance for inclusion into the model.

TABLE XVI

DESCRIPTIVE STATISTICS OF MEAN AND STANDARD DEVIATION FOR GROUP I STUDENTS AT THE SUBJECT MATTER LEVEL

VARIABLES	ECONOMICS (n = 147) $\bar{X}$	SD	ENGLISH (n = 103) $\bar{X}$	SD	HISTORY (n = 197) $\bar{X}$	SD	PSYCHOLOGY (n = 84) $\bar{X}$	SD
GRADE	2.59	0.93	2.62	1.05	3.08	1.02	2.61	1.16
VERBAL ANALOGIES	11.02	2.61	10.61	3.06	11.01	2.79	10.90	2.86
ORDERING	7.72	2.59	6.92	2.69	7.73	2.56	7.15	2.47
ALTERNATE ADDITIONS	23.40	4.86	23.59	5.08	22.84	5.04	22.81	4.81
WRONG	17.3	5.19	18.41	5.35	17.4	5.36	16.92	6.2
RI-1	5.97	2.90	5.95	3.39	5.82	2.97	7.02	3.9

TABLE XVII

DESCRIPTIVE STATISTICS OF MEAN AND STANDARD DEVIATION FOR GROUP II STUDENTS AT THE SUBJECT MATTER LEVEL

VARIABLES	ECONOMICS (n = 64) $\bar{X}$	SD	ENGLISH (n = 36) $\bar{X}$	SD	HISTORY (n = 133) $\bar{X}$	SD	PSYCHOLOGY (n = 125) $\bar{X}$	SD
GRADE	2.64	.80	3.00	0.86	3.44	0.82	3.41	0.85
VERBAL ANALOGIES	11.42	2.77	10.78	2.83	11.05	2.78	11.02	2.94
ORDERING	8.05	2.66	7.56	2.34	7.89	2.69	7.48	2.45
ALTERNATE ADDITIONS	24.63	4.06	24.25	4.50	23.33	5.25	23.26	4.38
WRONG	17.28	4.29	16.83	4.19	16.84	4.72	16.87	4.90
RI-1	5,38	2.97	6.00	2.8	5.87	3.12	6.27	3.37
HIDDEN FIGURES	10,17	5.36	9,56	5,30	10.41	5.41	9.74	5.2
RI-2	17.20	6.59	16,97	6.69	16.58	6.79	17.34	5.82
CLERICAL DILIGENCE	3.27	0.52	3.08	0.41	3.22	0.55	3.22	0.59
ACADEMIC SAVVY	1.86	0.43	1.95	0.47	1.84	0.38	1.74	0.43
MNEMONICS	2,4	0,45	2,25	0,6	2,32	0,59	2,36	0,68
PLANFULNESS	2.55	0,56	2.60	0,7	2,50	0,63	2,45	0,61
FORMAL THINKING	2.71	0.61	2.58	0.6	2.69	0.58	2.8	0.63
NOTE TAKING	2.47	0,81	2,5	0.84	2.47	0.72	2.42	0.87
TRANSFORMATION	2,63	0,53	2,75	0,54	2,68	0,51	2.71	0,56
EXTRAVERSION-INTROVERSION	104.38	28.28	96.67	26.50	96.1	25.84	99.14	25.96
SENSING-INTUITION	89.59	30.79	93.33	25.20	87.8	23.67	88.8	26.59
THINKING-FEELING	116.25	18.68	113.78	20.26	112.02	19.98	116.22	18.10
JUDGING-PERCEIVING	99.06	28.84	99.33	25.85	96.73	28.16	97.56	24.54
TOLERANCE OF AMBIGUITY	59.14	26.44	56.97	25.65	60.51	24.47	64.48	21.67

TABLE XVIII

T TESTS FOR MEAN SCORES FOR ACHIEVEMENT BETWEEN SUBJECT MATTER AREAS FOR GROUP I STUDENTS AND GROUP II STUDENTS

SUBJECT AREA	$\bar{X}$	SD	N	ECONOMICS	ENGLISH	HISTORY	PSYCHOLOGY
ECONOMICS							
Group I	2.59	.93	147	-	.237	4.56**	.143
Group II	2.64	.80	64	-	2.08*	6.43**	5.98**
ENGLISH							
Group I	2.62	1.05	103	-	-	3.66**	.061
Group II	3.00	.86	36	-	-	2.81**	2.53*
HISTORY							
Group I	3.08	1.02	197	-	-	-	3.38**
Group II	3.44	.82	133	-	-	-	.287
PSYCHOLOGY							
Group I	2.61	1.16	84	-	-	-	-
Group II	3.41	.85	125	-	-	-	-

*$t_{.05,\ 100} = 1.984$

**$t_{.01,\ 100} = 2.626$ (Guilford and Fruchter, 1973, p. 516)

differences between mean scores for the subject matter areas can be observed for both Group I students and Group II students. Economic students, English students and Psychology students had a lower mean grade than History students, but not each other for students in Group I. However, for Group II students, History students and Psychology students both had higher mean scores than English students and Economic students. English students had a higher mean score than students in Economics.

Product-moment correlation coefficients were computed for the learning style variables to achievement. The results are summarized in Table XIX for Group I students and Table XX for Group II students. The Fisher's z transformation statistic was used to compare differences in coefficients between subject areas (see Tables XXI and XXII).

The range of coefficients for Group I students for "Verbal Analogies" was from .28 to .55 with an average of .395. The difference between the coefficients for English students and History students was significant at the .05 level. There were no other coefficients for Group I students students that differed with a $p \leq .05$. The probability that the relationships for "Verbal Analogies," "Ordering," "Alternate Additions," occurred by chance was very small ($p \leq .003$) except for "Ordering" and "Alternate Additions" for Economic students which had probabilities of .021 and .133, respectively. For the variable "RI-1" only English

TABLE XIX

PRODUCT-MOMENT CORRELATION COEFFICIENTS AND PROBABILITY LEVELS FOR LEARNING STYLE VARIABLES TO ACHIEVEMENT FOR GROUP I STUDENTS FOR THE SUBJECT MATTER AREAS

VARIABLES	ECONOMICS (n=147)	ENGLISH (n=103)	HISTORY (n=197)	PSYCHOLOGY (n=84)
VERBAL ANALOGIES				
r	.41	.55	.28	.34
p	.000	.000	.000	.002
ORDERING				
r	.19	.41	.29	.41
p	.021	.000	.000	.000
ALTERNATE ADDITIONS				
r	.12	.29	.24	.37
p	.133	.003	.001	.001
WRONG				
r	-.35	-.40	-.25	-.37
p	.000	.000	.001	.001
RI^{-1}				
r	.02	-.22	-.11	-.05
p	.771	.024	.121	.633

TABLE XX

PRODUCT-MOMENT CORRELATION COEFFICIENTS AND PROBABILITY LEVELS FOR LEARNING STYLE VARIABLES TO ACHIEVEMENT FOR GROUP II STUDENTS FOR THE SUBJECT MATTER AREAS

VARIABLES	ECONOMICS (n=64)	ENGLISH (n=36)	HISTORY (n=133)	PSYCHOLOGY (n=125)
VERBAL ANALOGIES				
r	.55	.22	.21	.22
p	.000	.189	.017	.012
ORDERING				
r	.31	.3	.14	.30
p	.012	.074	.1	.001
ALTERNATE ADDITIONS				
r	.21	.29	.07	.16
p	.099	.086	.568	.078
WRONG				
r	-.40	-.27	-.23	-.2
p	.001	.109	.007	.024
RI-1				
r	-.23	-.04	-.05	-.15
p	.066	.831	.608	.101
HIDDEN FIGURES				
r	.19	.2	.01	.14
p	.126	.241	.886	.113
RI-2				
r	-.08	.02	.1	.04
p	.558	.881	.255	.684
CLERICAL DILIGENCE				
r	.02	-.03	-.19	-.11
p	.867	.838	.029	.221
ACADEMIC SAVVY				
r	.05	.06	-.16	-.1
p	.671	.722	.061	.274
MNEMONICS				
r	.01	-.20	-.22	-.13
p	.922	.231	.011	.145
PLANFULNESS				
r	.01	-.34	-.36	-.26
p	.936	.043	.000	.004

TABLE XX (CONTINUED)

VARIABLES	ECONOMICS (n=64)	ENGLISH (n=36)	HISTORY (n=133)	PSYCHOLOGY (n=125)
FORMAL THINKING				
r	-.21	-.31	.01	.01
p	.090	.06	.949	911
NOTE TAKING				
r	.08	-.02	-.09	-.05
p	.539	.886	.303	.56
TRANSFORMATION				
r	.01	-.04	-.04	-.11
p	.966	.795	.675	.206
EXTRAVERSION-INTROVERSION				
r	.14	.07	.09	.09
p	.257	.687	.305	.676
SENSING-INTUITION				
r	.39	.04	-.14	.11
p	.002	.826	.096	.216
THINKING-FEELING				
r	-.16	-.12	.12	.03
p	.198	.523	.183	.737
JUDGING-PERCEIVING				
r	.14	-.13	-.23	-.10
p	.277	.528	.009	.261
TOLERANCE OF AMBIGUITY				
r	.03	-.14	-.08	-.12
p	.791	.583	.659	.197

TABLE XXI

APPROXIMATION OF THE DIFFERENCE BETWEEN TWO COEFFICIENTS REQUIRED TO REACH A SIGNIFICANCE LEVEL OF .05 FOR CORRELATIONS OF LEARNING STYLE VARIABLES TO ACHIEVEMENT FOR GROUP I STUDENTS FOR THE SUBJECT MATTER AREAS

GROUP I	ECONOMICS (n=147)	ENGLISH (n=103)	HISTORY (n=197)	PSYCHOLOGY (n=84)
Economics	.231	.255	.216	.272
English		.277	.241	.293
History			.199	.259
Psychology				.308

TABLE XXII

APPROXIMATION OF THE DIFFERENCE BETWEEN TWO COEFFICIENTS REQUIRED TO REACH A SIGNIFICANCE LEVEL OF .05 FOR CORRELATIONS OF LEARNING STYLE VARIABLES TO ACHIEVEMENT FOR GROUP II STUDENTS FOR THE SUBJECT MATTER AREAS

GROUP II	ECONOMICS (n=64)	ENGLISH (n=36)	HISTORY (n=133)	PSYCHOLOGY (n=125)
Economics	.355	.423	.304	.307
English		.482	.382	.384
History			.243	.247
Psychology				.251

students had a probability that was small enough (p=.024) to imply a useful relationship.

The coefficients of the variables for Group II students were generally smaller in size with larger probabilities of occurring by chance than those for Group I students. The coefficients for the intelligence abilities, "Verbal Analogies," "Ordering," and "Alternate Additions" for Group II students were basically consistent with results for Group I students. "Verbal Analogies" for Economic students was different from History students and Psychology students at the .05 level.

At the group level, "Clerical Diligence," "Academic Savvy," "Mnemonics," and "Planfulness" provided useful information. However, when the relations are examined at the subject matter level, there are great differences both in the size of the coefficients and the probability that they were due to chance. The correlation for "Clerical Diligence" for History students had the lowest probability of chance occurrence at .029. The correlation for Economics students and English students showed basically no relationship to grade. History students had a clear positive relationship for "Academic Savvy." For "Mnemonics" both English students and History students had practically the same size coefficients but greatly differed in probability levels due to the difference in sample size: $r = -.20$, $p = .231$, and $r = -.22, p = .011$, respectively. The variable

"Planfulness" stood out as demonstrating the strongest relationship to grade for English, History and Psychology students. Economics students had near zero relationship for all of these variables.

The variable "Formal Thinking," reflecting logical and mathematical thinking had a near zero relationship to grade at the group level but had an r of -.21 and -.31 for Economic students and English students, respectively. Students who preferred to use logical processes for thinking tended to achieve higher grades for both of these subject areas.

With respect to the variables representing the affective domain, there were several differences between subject areas. For the variable "Sensing-Intuition," students in Economics who preferred using intuition were more likely to receive the higher grade ($r = .39$, $p = .002$). In the subject area of History, however, the students preferring sensing were more likely to receive the higher grade ($r = -.14$, $p = .096$). The differences between these two subject matter areas was significant at the .05 level. For "Judging-Perceiving," History students who preferred examining material in a critical fashion tended to have higher grades.

The multiple correlation technique was applied to the data for each group at the subject matter level to determine the overall value of the contribution of the variables

combined. The results are summarized in Table XXIII. For Group I students, "Verbal Analogies" was the most important variable for Economic students and English students. The variable "Ordering" was the most important variable for History and Psychology students. The range of known variance was from .143 to .334 with an average of .239. When data were available on the complete set of learning style variables, Group II students, the range of known variance was .183 to .557 with an average of .332. The variable "Verbal Analogies" was the first variable in the multiple correlation model for Economics. "Ordering" was the first variable for Psychology students. "Planfulness" was the first variable for both English and History students.

Each subject area had a different set of variables for the multiple correlation model. Economic students in Group I had only one variable in the model. English students in Group II had seven variables in the model. The contribution of each variable was significant at the .10 level.

Research Question Four

Do specific learning style variables relate to achievement for specific instructors?

The descriptive statistics of mean and standard deviation on the instructor level are summarized for Group I students in Table XXIV and for Group II students in Table XXV.

TABLE XXIII

MULTIPLE CORRELATION OF LEARNING STYLE VARIABLES TO ACHIEVEMENT FOR GROUP I AND GROUP II STUDENTS FOR SUBJECT MATTER AREAS[1]

CATEGORY	VARIANCE	VARIABLES IN MODEL
GROUP I		
Economics	.169	Verbal Analogies
English	.303	Verbal Analogies
	.334	Verbal Analogies, Ordering
History	.086	Ordering
	.122	Ordering, Verbal Analogies
	.143	Ordering, Verbal Analogies Alternate Additions
Psychology	.169	Ordering
	.237	Ordering, Alternate Additions
	.309	Ordering, Alternate Additions, Wrong
GROUP II		
Economics	.299	Verbal Analogies
	.370	Verbal Analogies, Sensing-Intuition
English	.113	Planfulness
	.210	Planfulness, Ordering
	.312	Planfulness, Ordering, Extraversion-Introversion
	.379	Planfulness, Ordering, Extraversion-Introversion, Formal Thinking
	.448	Planfulness, Ordering, Extraversion-Introversion, Formal Thinking, Wrong
	.509	Planfulness, Ordering, Extraversion-Introversion, Formal Thinking, Wrong, Tolerance of Ambiguity

TABLE XXIII (CONTINUED)

CATEGORY	VARIANCE	VARIABLES IN MODEL
	.557	Planfulness, Ordering, Extraversion-Introversion, Formal Thinking, Wrong, Tolerance of Ambiguity, Judging-Perceiving
History	.132	Planfulness
	.166	Planfulness, Wrong
	.192	Planfulness, Wrong, Sensing-Intuition
	.217	Planfulness, Wrong, Sensing-Intuition, Thinking-Feeling
Psychology	.092	Ordering
	.138	Ordering, Planfulness
	.164	Ordering, Planfulness, Extraversion-Introversion
	.183	Ordering, Planfulness, Extraversion-Introversion, Tolerance of Ambiguity

[1]The variables in the model are listed in the order of their contribution. The total known variance is listed with the addition of each variable. Variables were tested at the .10 level of significance for inclusion into the model.

TABLE XXIV

DESCRIPTIVE STATISTICS OF MEAN AND STANDARD DEVIATION FOR GROUP I STUDENTS FOR EACH INSTRUCTOR

	ECONOMICS						ENGLISH				HISTORY						PSYCHOLOGY					
	A		B		C		D		E		F		G		H		I		J		K	
	(n = 77)		(n = 32)		(n = 38)		(n = 49)		(n = 54)		(n = 93)		(n = 50)		(n = 54)		(n = 36)		(n = 24)		(n = 24)	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
GRADE	2.62	.95	2.34	.79	2.74	.98	2.61	.98	2.63	1.12	3.4	.9	3.04	1.07	2.56	.8	2.47	1.11	2.63	1.31	2.79	1.10
VERBAL ANALOGIES	11.23	2.64	10.81	2.24	10.76	2.85	10.9	2.79	10.35	3.28	10.85	2.75	11.54	2.76	10.8	2.88	10.92	2.87	10.58	3.3	11.21	2.45
ORDERING	7.55	2.3	8.06	2.64	7.79	3.09	7.12	2.36	6.74	2.96	7.78	2.34	8.08	2.73	7.31	2.75	7.33	2.23	7.00	3.09	7.04	2.2
ALTERNATE ADDITIONS	24.04	4.99	23.22	4.79	22.26	4.54	23.39	4.43	23.78	5.65	23.28	4.98	23.36	4.36	21.61	5.58	21.86	4.57	23.83	5.54	23.21	4.29
WRONG	17.14	4.64	16.97	4.00	17.89	6.94	18.55	5.24	18.28	5.49	17.96	5.38	15.56	4.18	18.13	5.1	15.69	4.8	17.79	8.45	17.88	5.30
RI-I	5.73	2.90	6.13	2.59	6.34	3.16	5.55	3.19	6.31	3.55	5.44	2.57	6.36	3.48	5.96	3.07	7.[illegible]	3.64	6.96	5.01	6.46	2.98

TABLE XXV

DESCRIPTIVE STATISTICS OF MEAN AND STANDARD DEVIATION FOR GROUP II STUDENTS FOR EACH INSTRUCTOR

ECONOMICS					ENGLISH				HISTORY						PSYCHOLOGY					
)	B		C		D		E		F		G		H		I		J		K	
SD	$\bar{X}$ (n = 48)	SD	$\bar{X}$ (n = 9)	SD	$\bar{X}$ (n = 22)	SD	$\bar{X}$ (n = 14)	SD	$\bar{X}$ (n = 60)	SD	$\bar{X}$ (n = 39)	SD	$\bar{X}$ (n = 34)	SD	$\bar{X}$ (n = 33)	SD	$\bar{X}$ (n = 46)	SD	$\bar{X}$ (n = 46)	SD
	.260	.76	2.67	1.00	2.95	.95	3.07	.73	3.73	.48	3.46	.91	2.91	.93	3.45	.71	3.39	.83	3.39	.98
	11.60	2.44	11.11	2.42	10.91	2.49	10.57	3.39	11.37	2.9	11.38	2.45	10.12	2.79	10.48	3.22	10.91	2.98	11.50	2.66
	8.06	2.78	8.44	1.67	7.36	1.94	7.86	2.91	7.73	2.71	7.87	2.45	8.21	2.95	6.48	2.27	7.65	2.5	8.02	2.36
	24.9	3.75	23.33	5.52	24.50	4.82	23.86	4.09	23.50	4.73	23.15	5.59	23.24	5.83	23.18	4.38	23.15	4.72	23.43	4.12
	17.23	4.04	18.33	4.82	16.95	4.12	16.64	4.43	16.75	5.00	16.00	4.14	17.97	4.74	17.85	5.02	16.59	5.41	16.46	4.24
	5.4	2.90	4.67	3.54	5.86	2.68	6.21	3.07	5.88	2.79	6.41	2.94	5.24	3.79	7.12	3.46	6.39	3.65	5.54	2.89
	9.83	5.47	10.89	4.08	10.23	5.74	8.50	4.54	9.95	5.68	10.87	5.42	10.68	5.01	8.88	4.12	9.61	5.12	10.48	5.92
	17.92	6.02	12.11	7.74	14.77	6.63	20.43	5.33	16.60	6.82	16.54	5.97	16.59	7.75	16.97	5.99	18.07	5.63	16.87	5.94
	3.31	0.56	3.14	.38	3.08	.38	3.07	0.47	3.20	.49	3.24	.51	3.24	.7	3.14	.64	3.24	.61	3.25	.53
	1.84	0.44	2.06	.40	2.02	.57	1.84	.24	1.83	.39	1.89	.39	1.79	.36	1.69	.41	1.78	.41	1.73	.46
	2.37	.42	2.58	.56	2.26	.67	2.25	.48	2.37	.52	2.28	.64	2.26	.65	2.36	.61	2.40	.8	2.33	.59
	2.49	.55	2.82	.41	2.78	.75	2.32	.51	2.46	.60	2.52	.65	2.56	.66	2.28	.53	2.48	.69	2.53	.58
	2.67	.63	2.80	.48	2.47	.61	2.76	.53	2.68	.65	2.68	.52	2.71	.54	2.86	.69	2.7	.57	2.85	.63
	2.54	.82	2.47	.79	2.37	.82	2.70	.85	2.4	.68	2.52	.69	2.53	.81	2.31	.82	2.57	1.	2.35	.77
	2.65	.54	2.73	.44	2.73	.51	2.78	.61	2.61	.49	2.86	.56	2.6	.44	2.67	.5	2.71	.54	2.74	.62
	105.50	28.47	101.44	23.85	97.55	26.46	95.29	27.51	104.07	26.11	91.72	24.22	87.06	23.55	96.82	26.16	100.65	25.95	99.30	26.27
	91.00	29.68	77.67	35.79	94.36	25.16	91.71	26.13	88.30	25.39	83.36	21.81	92.00	22.32	88.88	22.74	87.00	25.83	90.57	30.10
	117.29	18.72	108.11	18.5	112.18	17.9	116.29	24.02	112.40	21.20	111.46	19.73	112.00	18.54	120.64	16.68	113.22	19.01	116.04	17.9
	98.63	28.64	105.22	33.62	99.64	20.59	98.86	33.37	94.17	28.13	96.18	26.20	101.88	30.46	90.21	22.36	103.17	25.29	97.22	24.34
	59.08	26.8	64.11	24.28	61.14	22.07	50.43	30.15	64.20	22.40	60.85	24.37	53.62	27.2	67.55	15.51	63.48	27.68	63.28	18.65

The variations observed in mean scores for grades could not be accounted for by variations in mean scores on the learning style variables.

Product-moment correlation coefficients were computed for the learning style variables to achievement. The results are summarized in Table XXVI for Group I students and Table XXVII for Group II students. The Fisher's z transformation statistic was used to compare differences in coefficients between instructors (see Tables XXVIII and XXIX).

Although the exact probabilities of the correlation coefficients are presented in Tables XXVI and XXVII, the .05 probability level has been chosen as a standard for making comparisons about differences between the groups.

For Group I students, nine of the eleven instructor groups had coefficients with probabilities less than or equal to .05 for "Verbal Analogies." One group in English had a coefficient of .71 which differed from seven of the remaining ten groups at the .05 level. For "Ordering" five of the eleven groups, E, G, H, J, K, had coefficients with probabilities less than or equal to .05. The coefficient for instructor E was larger than groups A, D, F, and I, significant at the .05 level. The coefficient for group J was larger than groups A, D, and F. The same five groups that had small probabilities for "Ordering" had probabilities less than or equal to .05 for "Alternate Additions."

TABLE XXVI

PRODUCT-MOMENT CORRELATION COEFFICIENTS AND PROBABILITY LEVELS FOR LEARNING STYLE VARIABLES TO ACHIEVEMENT FOR GROUP I STUDENTS FOR EACH INSTRUCTOR

	ECONOMICS			ENGLISH		HISTORY			PSYCHOLOGY		
	A	B	C	D	E	F	G	H	I	J	K
VERBAL ANALOGIES											
r	.40	.37	.47	.32	.71	.27	.24	.41	.17	.47	.40
p	.001	.036	.003	.023	.000	.009	.097	.002	.310	.018	.048
ORDERING											
r	.19	.21	.22	.18	.56	.19	.29	.42	.20	.61	.45
p	.100	.255	.177	.203	.000	.071	.037	.002	.24	.002	.025
ALTERNATE ADDITIONS											
r	.08	.133	.24	.08	.42	.07	.30	.32	.10	.46	.63
p	.510	.527	.141	.574	.002	.515	.030	.017	.554	.023	.001
WRONG											
r	-.25	-.324	-.53	-.11	-.63	-.18	-.16	-.51	-.17	-.69	-.21
p	.028	.067	.001	.534	.000	.083	.265	.000	.664	.000	.319
RI-1											
r	.06	-.053	-.01	-.22	-.23	.02	-.23	-.08	-.11	.10	-.21
p	.594	.769	.975	.129	.096	.828	.112	.57	.53	.636	.669

TABLE XXVII

PRODUCT-MOMENT CORRELATION COEFFICIENTS AND PROBABILITY LEVELS FOR LEARNING STYLE VARIABLES TO ACHIEVEMENT FOR GROUP II STUDENTS FOR EACH INSTRUCTOR

	ECONOMICS			ENGLISH		HISTORY			PSYCHOLOGY		
	A	B	C	D	E	F	G	H	I	J	K
VERBAL ANALOGIES											
r		.5	.74	.22	.26	-.01	.05	.42	.47	.14	.17
p		.001	.022	.327	.632	.914	.769	.01	.006	.644	.256
ORDERING											
r		.22	.78	.29	.33	.18	.22	.19	.34	.27	.36
p		.125	.014	.182	.246	.169	.185	.272	.047	.065	.013
ALTERNATE ADDITIONS											
r		.126	.27	.3	.29	-.04	.01	.22	.03	.20	.19
p		.603	.515	.178	.321	.735	.968	.206	.850	.18	.207
WRONG											
r		-.293	-.65	-.26	-.30	.02	-.2	-.49	-.16	-.19	-.27
p		.041	.057	.249	.297	.868	.232	.003	.608	.214	.067
RI-1											
r		-.18	-.07	.02	-.14	-.17	.06	-.17	-.39	-.09	-.08
p		.226	.850	.941	.626	.178	.697	.674	.023	.566	.582
HIDDEN FIGURES											
r		.10	.36	.28	.03	-.11	.24	-.05	.09	.09	.20
p		.502	.346	.202	.902	.593	.136	.769	.609	.539	.176

TABLE XXVII (CONTINUED)

	ECONOMICS			ENGLISH		HISTORY			PSYCHOLOGY		
	A	B	C	D	E	F	G	H	I	J	K
RI-2											
r		-.19	.46	.04	-.13	.13	-.06	.25	-.20	-.08	.26
p		.199	.214	.841	.668	.664	.733	.15	.258	.617	.08
CLERICAL DILIGENCE											
r		-.03	-.11	-.21	.26	-.04	-.18	-.32	-.19	.07	-.23
p		.840	.777	.640	.6289	.758	.267	.063	.299	.663	.112
ACADEMIC SAVVY											
r		.08	-.08	.12	-.11	-.01	-.26	-.34	-.04	-.04	-.17
p		.606	.837	.613	.706	.909	.105	.047	.81	.796	.268
MNEMONICS											
r		.042	-.28	-.27	.00	.09	-.46	-.35	.15	.01	-.45
p		.772	.529	.216	1.00	.507	.004	.04	.58	.953	.002
PLANFULNESS											
r		.11	-.28	-.42	-.06	.02	-.55	-.54	-.13	-.39	-.20
p		.544	.530	.049	.822	.865	.001	.001	.522	.008	.178
FORMAL THINKING											
r		-.16	-.26	-.24	-.59	.11	.05	-.12	.24	-.23	.05
p		.265	.503	.283	.025	.600	.781	.509	.167	.129	.737
NOTE TAKING											
r		.21	-.48	.08	-.28	-.02	-.3	.11	.26	-.18	-.09
p		.157	.193	.713	.325	.897	.065	.544	.137	.225	.58
TRANSFORMATION											
r		.13	-.37	-.09	.02	-.01	.05	-.24	-.3	.12	-.21
p		.605	.334	.706	.951	.915	.773	.175	.091	.569	.163

TABLE XXVII (CONTINUED)

	ECONOMICS			ENGLISH		HISTORY			PSYCHOLOGY		
	A	B	C	D	E	F	G	H	I	J	K
EXTRAVERSION-INTROVERSION											
r		-.01	.29	.13	-.03	.13	-.05	-.14	.36	-.04	.06
p		.965	.546	.582	.911	.669	.776	.575	.035	.793	.69
SENSING-INTUITION											
r		.31	.84	-.15	.43	-.08	-.23	-.10	.05	.15	.11
p		.033	.005	.504	.12	.555	.165	.579	.779	.670	.521
THINKING-FEELING											
r		-.11	-.36	-.18	-.07	.15	.16	.07	.10	-.15	.14
p		.527	.349	.576	.814	.252	.322	.689	.571	.667	.658
JUDGING-PERCEIVING											
r		.08	.4	-.49	.34	-.12	-.28	-.21	-.35	.15	-.2
p		.602	.291	.018	.240	.643	.078	.226	.046	.67	.188
TOLERANCE OF AMBIGUITY											
r		.05	-.28	-.10	-.19	-.1	-.2	-.22	-.12	-.13	-.12
p		.748	.523	.656	.529	.525	.226	.214	.504	.597	.556

TABLE XXVIII

APPROXIMATION OF THE DIFFERENCE BETWEEN TWO COEFFICIENTS REQUIRED TO REACH A SIGNIFICANCE LEVEL OF .05 FOR CORRELATIONS OF LEARNING STYLE VARIABLES TO ACHIEVEMENT FOR GROUP I STUDENTS FOR EACH INSTRUCTOR

INSTRUCTOR	A	B	C	D	E	F	G	H	I	J	K
A (n=77)	.322	.429	.402	.368	.357	.308	.366	.357	.410	.485	.485
B (n=32)		.515	.492	.465	.456	.419	.463	.456	.5	.562	.562
C (n=38)			.469	.44	.430	.390	.438	.430	.476	.541	.541
D (n=49)				.409	.399	.355	.407	.399	.447	.516	.516
E (n=54)					.388	.344	.396	.388	.438	.508	.508
F (n=93)						.292	.353	.344	.399	.475	.475
G (n=50)							.398	.396	.445	.514	.514
H (n=54)								.388	.438	.508	.508
I (n=36)									.483	.547	.547
J (n=24)										.605	.605
K (n=24)											.605

TABLE XXIX

APPROXIMATION OF THE DIFFERENCE BETWEEN TWO COEFFICIENTS REQUIRED TO REACH A SIGNIFICANCE LEVEL OF .05 FOR CORRELATIONS OF LEARNING STYLE VARIABLES TO ACHIEVEMENT FOR GROUP II STUDENTS FOR EACH INSTRUCTOR

INSTRUCTOR	B	C	D	E	F	G	H	I	J	K
B (n=48)	.413	.852	.536	.659	.391	.438	.457	.462	.418	.418
C (n=9)		1.316	.918	.995	.841	.864	.874	.876	.854	.854
D (n=22)			.636	.742	.519	.556	.571	.575	.54	.54
E (n=14)				.836	.64	.675	.688	.691	.662	.662
F (n=60)					.367	.417	.437	.442	.396	.396
G (n=39)						.462	.480	.484	.443	.443
H (n=34)							.498	.502	.462	.462
I (n=33)								.506	.466	.466
J (n=46)									.423	.423
K (n=46)										.423

Group K had a coefficient that was larger than A, B, C, D, F, and I. Group E was larger than A and F. For the variable represented by "Wrong", five groups, A, C, E, H, J, had coefficients with probabilities less than or equal to .05. Groups E and J had coefficients greater than A, D, F, G, I, and K. The variable represented by "RI-1" had no coefficients with probabilities less than or equal to .05.

The variables that had coefficients of correlation to grade for Group II students at the instructor level with a probability level of .05 or less differed greatly from Group I students. The analysis was made on ten groups of students because the sample size for instructor A in Economics was too small to provide meaningful results. The groups B and C in Economics had coefficients for "Verbal Analogies" and "Sensing-Intuition" with $p \leq .05$. Group B also had a coefficient for "Wrong" and C had a coefficient for "Ordering" with $p \leq .05$. The coefficients for "Planfulness" and "Judging-Perceiving" had $p \leq .05$ for group D in English. Group E in English had a coefficient for "Formal Thinking" with a $p \leq .05$. Group F in History had no coefficients with $p \leq .05$. The two other groups in History, G and H, had coefficients for "Mnemonics" and "Planfulness" with $p \leq .05$. Group H also had a $p \leq .05$ for "Verbal Analogies," "Wrong," and "Academic Savvy." The three groups in Psychology did not have coefficients with $p \leq .05$ in common for any variable. The group of students for instructor I had coefficients with $p \leq .05$ for "Verbal Analogies,"

"Ordering," "RI-1", "Extraversion-Introversion," and "Judging-Perceiving." Group J had "Planfulness." Group K had "Ordering" and "Mnemonics."

The multiple correlation technique was applied to the data for each instructor to determine the overall value of the contributions of the variables combined. The results are summarized in Table XXX.

For Group I students, "Verbal Analogies" was the most important variable in five of the eleven cases: for two groups of students, A and B, in Economics, both groups of students in English, and one group of students, F, in History. The variable represented by "Alternate Additions" was the most important variable for one group of students, G, in History and one group, K, in Psychology. The variable represented by "Wrong" was most important for one group of students, C, in Economics, one group, H, in History, and one group, J, in Psychology. The range of known variance was from .04 to .502 with an average of .263.

For the students in Group II, the variable represented by "Verbal Analogies" was first in the multiple correlation model for one group of students, B, in Economics and one group, I, in Psychology. "Sensing-Intuition" was first for one group, C, in Economics. "Judging-Perceiving" was first for one group of students, D, in English. "Formal Thinking" was first for the other group in English. "Mnemonics" was first for one group, K, in Psychology. The variable represented by "Planfulness" was first for two groups of

TABLE XXX

MULTIPLE CORRELATION OF LEARNING STYLE VARIABLES TO ACHIEVEMENT FOR GROUP I AND GROUP II STUDENTS FOR EACH INSTRUCTOR[1]

CATEGORY	VARIANCE	VARIABLES IN MODEL
GROUP I		
Economics		
Instructor A	.159	Verbal Analogies
Instructor B	.135	Verbal Analogies
Instructor C	.285	Wrong
English		
Instructor D	.145	Verbal Analogies
Instructor E	.502	Verbal Analogies
History		
Instructor F	.073	Verbal Analogies
Instructor G	.092	Alternate Additions
	.149	Alternate Additions, Verbal Analogies
Instructor H	.259	Wrong
	.323	Wrong, Alternate Additions
Psychology		
Instructor I	.040	Ordering
Instructor J	.469	Wrong
	.599	Wrong, Alternate Additions
Instructor K	.402	Alternate Additions
	.484	Alternate Additions, Ordering
GROUP II		
Economics		
Instructor A	--	No data; insufficient sample size
Instructor B	.246	Verbal Analogies
	.304	Verbal Analogies, Sensing-Intuition

TABLE XXX (CONTINUED)

CATEGORY	VARIANCE	VARIABLES IN MODEL
Instructor C	.702	Sensing-Intuition
English		
Instructor D	.245	Judging-Perceiving
	.549	Judging-Perceiving
Instructor E	.349	Formal Thinking
History		
Instructor F	.032	Ordering
Instructor G	.306	Planfulness
	.382	Planfulness, Sensing-Intuition
Instructor H	.288	Planfulness
	.380	Planfulness, Wrong
	.484	Planfulness, Wrong, RI-2
	.606	Planfulness, Wrong, RI-2, RI-1
Psychology		
Instructor I	.22	Verbal Analogies
	.405	Verbal Analogies, RI-1
	.491	Verbal Analogies, RI-1, Formal Thinking
	.592	Verbal Analogies, RI-1, Formal Thinking, Transformation
	.669	Verbal Analogies, RI-1, Formal Thinking, Transformation, Note Taking
	.735	Verbal Analogies, RI-1, Formal Thinking, Transformation, Note Taking, Extraversion-Introversion
	.764	Verbal Analogies, RI-1, Formal Thinking, Transformation, Note Taking, Extraversion-Introversion, Sensing-Intuition
	.802	Verbal Analogies, RI-1, Formal Thinking, Transformation, Note Taking, Extraversion-Introversion, Sensing-Intuition, Thinking-Feeling

TABLE XXX (CONTINUED)

CATEGORY	VARIANCE	VARIABLES IN MODEL
	.833	Verbal Analogies, RI-1, Formal Thinking, Transformation, Note Taking, Extraversion-Introversion, Sensing-Intuition, Thinking-Feeling, RI-2
	.864	Verbal Analogies, RI-1, Formal Thinking, Transformation, Note Taking, Extraversion-Introversion, Sensing-Intuition, Thinking-Feeling, RI-2, Wrong
Instructor J	.148	Planfulness
	.238	Planfulness, Transformation
Instructor K	.198	Mnemonics
	.328	Mnemonics, Ordering
	.4	Mnemonics, Ordering, Formal Thinking

[1]The variables in the model are listed in the order of their contribution. The total known variance is listed with the addition of each variable. Variables were tested at the .10 level of significance for inclusion into the model.

students, G and H, and one group of students, J, in Psychology. The range of known variance was from .032 to .864 with an average of .442.

Research Question Five

Do instructional styles mediate the relation between the student's learning style and the student's achievement?

An index of distance between a student's learning style profile and the instructional style as measured by the instructor's learning style was computed for each student. The analysis of variance technique was used to determine differences in grade level. The results are summarized in Tables XXXI and XXXII. The label D1 is the distance between student and instructor for the intelligence abilities; D2 is the distance for cognitive style, affective style, and study strategies; D3 is the distance for all the learning style variables. The d-index numbers are not additive.

The results for "all students," observed in Table XXXI, implied that the closer a student's learning style was to the instructor's style, the higher the grade. The results were significant at the .003 level of confidence. The results were generally in the direction of smaller distances between student and teacher receiving higher grades, with the exception of History students; there was a different pattern for both Group I students and Group II students. The pattern for History students was similar for the Group I and Group II students with the smallest distance in the center of the grade range.

TABLE XXXI

F-TESTS OF THE DISTANCE BETWEEN STUDENTS AND INSTRUCTORS FOR LEARNING STYLE VARIABLES MEASURED FOR ALL STUDENTS (D1) AND ACHIEVEMENT FOR ALL STUDENTS, GROUP I STUDENTS, AND GROUP I STUDENTS FOR SUBJECT MATTER AREAS

	F TEST		GRADE A	B	C	D	F
All Students Group I and Group II							
F	4.130	D_1	2.963	3.066	3.137	3.487	3.866
p	.0029	N	332	285	200	54	18
All Students First Test Only							
F	4.063	D_1	2.967	3.020	3.074	3.487	4.156
p	.0033	N	161	163	150	43	14
Economics							
F	4.826	D_1	2.043	2.414	2.838	3.478	4.374
p	.0014	N	30	41	63	12	1
English							
F	1.221	D_1	3.034	3.679	3.593	3.906	3.818
p	.306	N	25	29	38	7	4
History							
F	1.490	D_1	3.413	3.208	2.913	3.331	3.826
p	.2055	N	85	63	33	11	5
Psychology							
F	3.718	D_1	2.401	2.817	3.108	3.400	4.85
p	.0082	N	21	30	16	13	4

TABLE XXXII

F-TESTS OF THE DISTANCE BETWEEN STUDENTS AND INSTRUCTORS FOR ALL LEARNING STYLE VARIABLES MEASURED FOR ALL STUDENTS (D1), VARIABLES MEASURED FOR GROUP II STUDENTS ONLY (D2), AND ALL VARIABLES COMBINED (D3) AND ACHIEVEMENT FOR GROUP II STUDENTS, AND GROUP II STUDENTS FOR SUBJECT MATTER AREAS

	F TEST		GRADE A	B	C	D	F
All Students (n=358)							
F	1.359						
p	.246	D_1	2.96	3.128	3.324	3.49	2.85
F	.730						
p	.574	D_2	5.833	5.897	5.969	5.783	6.775
F	.802						
p	.526	D_3	6.614	6.752	6.911	6.884	7.362
		N^3	171	122	50	11	4
Economics (n=64)							
F	1.227						
p	.307	D_1	2.77	3.231	3.534	3.607	
F	.544						
p	.658	D_2	6.211	6.01	5.894	6.642	
F	.378						
p	.772	D_3	6.829	6.869	6.951	7.593	
		N^3	9	27	24	4	
English (n=36)							
F	.187						
p	.904	D_1	3.669	3.302	3.600		3.651
F	.51						
p	.682	D_2	5.867	6.206	6.492		7.672
F	.338						
p	.801	D_3	6.992	7.116	7.542		8.496
		N^3	10	18	7		1
History (n=133)							
F	.678						
p	.611	D_1	3.257	3.259	2.683	3.540	2.274
F	.759						
p	.556	D_2	6.038	5.913	5.762	5.153	7.075
F	.414						
p	.801	D_3	6.93	6.833	6.393	6.458	7.432
		N^3	80	38	10	4	1

TABLE XXXII (CONTINUED)

	F TEST		A	B	GRADE C	D	F
Psychology (n=125)							
F	1.389						
p	.241	D_1	2.554	2.85	2.262	3.265	2.746
F	.648						
p	.633	D_2	5.554	5.663	5.989	5.478	6.177
F	1.266						
p	.286	D_3	6.185	6.423	6.888	6.506	6.76
		N	72	39	9	3	2

The distances between instructors were computed. The results are summarized in Table XXXIII. The same data are presented graphically in Figure 1. From Figure 1 it can be observed that instructor F is closer to the two other History instructors than to any other instructor. Likewise the two other History instructors were closer to each other than to any other instructor.

Research Question Six

Are there differences between the students who were tested for all variables and those who were not?

To answer this question, the t statistic was calculated for the difference in mean scores of Group I students (partial testing) and Group II students (complete testing) for the variables labeled "Grade," "Verbal Analogies," "Ordering," "Alternate Additions," "Wrong" (sum of incorrect responses on "Verbal Analogies," "Ordering," and "Alternate Additions"), and "RI-1" (sum of blanks on "Verbal Analogies" and "Ordering"). The results are summarized in Table XXXIV. The differences between mean scores was significant at the .01 level for the variable "Grade." The difference between mean scores was not significant at either the .01 or .05 levels for the other variables. The percent distribution of grades is summarized in Table XXXV for the two groups.

TABLE XXXIII

DISTANCES BETWEEN INSTRUCTORS USING ALL LEARNING STYLE VARIABLES

INSTRUCTORS	A (n=01)	B (n=02)	C (n=03)	D (n=06)	E (n=04)	F (n=10)	G (n=11)	H (n=14)	I (n=17)	J (n=18)	K (n=19)
A	0.0	6.503	4.553	4.879	4.628	8.357	6.349	6.411	6.546	7.061	5.261
B		0.0	4.749	8.306	6.950	10.132	6.762	6.117	5.244	4.493	5.551
C			0.0	6.725	4.217	8.858	6.145	5.505	4.17	4.173	4.50
D				0.0	4.936	9.944	8.100	8.344	8.901	8.036	7.917
E					0.0	8.679	6.114	6.761	6.129	5.270	5.724
F						0.0	7.409	6.815	9.03	8.607	8.304
G							0.0	5.042	6.058	5.798	6.492
H								0.0	6.712	5.849	5.835
I									0.0	4.703	4.444
J										0.0	5.659
K											0.0

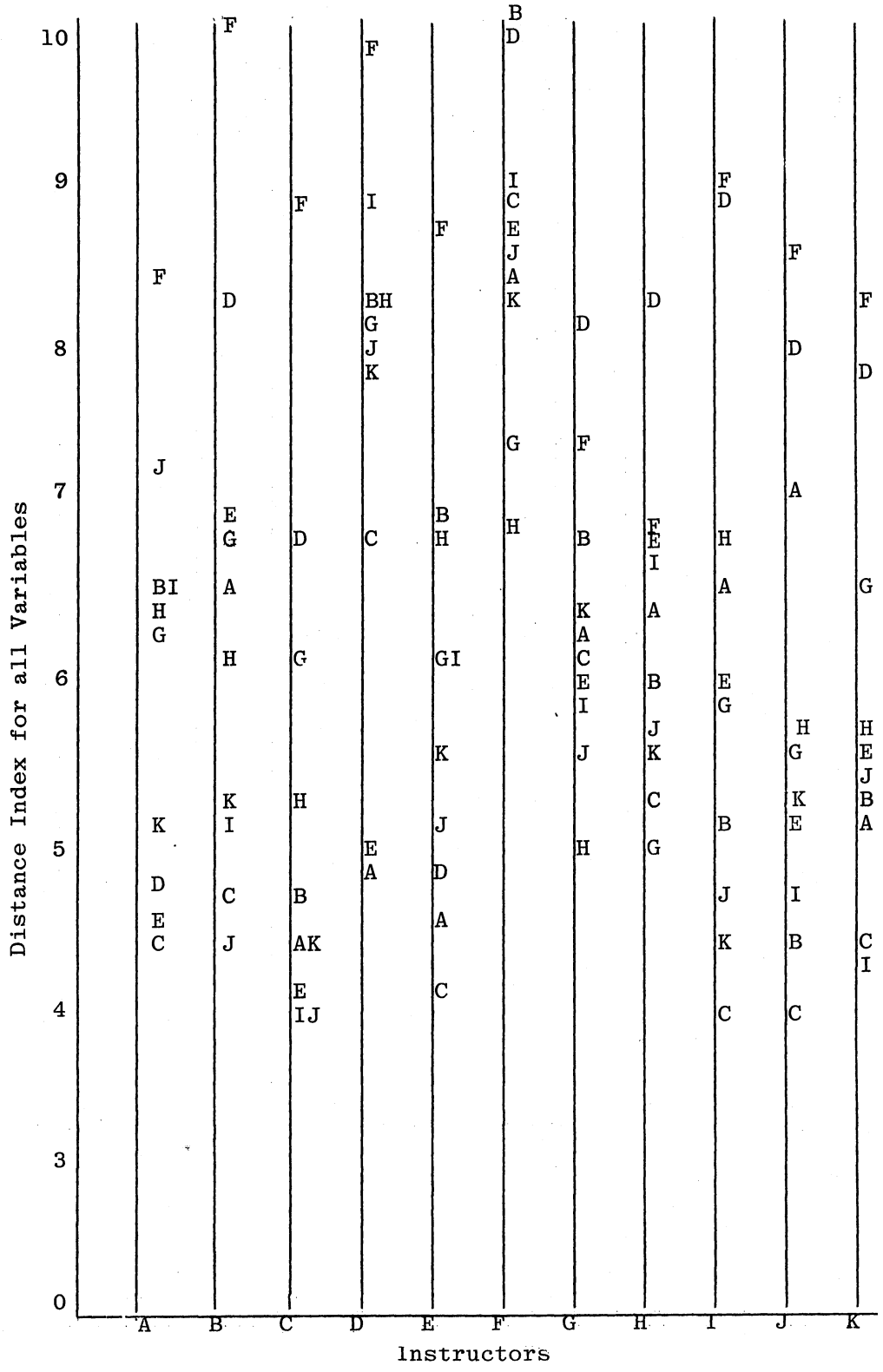

Figure 1. Distance of Instructors from Each Instructor

TABLE XXXIV

DESCRIPTIVE STATISTICS OF MEAN AND STANDARD DEVIATION AND T TESTS OF LEARNING STYLE VARIABLES FOR GROUP I AND GROUP II STUDENTS

	GROUP I (n=531)		GROUP II (n=358)		
	X	SD	X	SD	t
GRADE	2.78	1.044	3.24	.885	6.78**
VERBAL ANALOGIES	10.92	2.803	11.08	2.834	1.39
ORDERING	7.48	2.594	7.74	2.567	1.47
ALTERNATE ADDITIONS	23.14	4.959	23.63	4.695	1.47
WRONG	17.49	5.44	16.93	4.643	1.59
RI-1	6.08	3.214	5.94	3.158	.64

*$t_{.05,\ 500} = 1.965$

**$t_{.01,\ 500} = 2.586$ (Guilford and Fruchter, 1973, p. 516)

TABLE XXXV

DISTRIBUTION OF GRADES FOR GROUP I AND GROUP II STUDENTS

	GROUP I (n = 574)		GROUP II (n = 366)	
	N	%	N	%
A	161	28.0	171	46.7
B	163	28.4	122	33.3
C	150	26.1	50	13.7
D	43	7.5	11	3.0
F	14	2.4	4	1.1
Incomplete or Withdrew	43	7.5	8	2.2

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

General Review of the Study

The problem addressed by the present study was lack of knowledge of relationships between learning style variables and achievement. With the current trend in education that of individualizing instruction, it was necessary to ascertain the characteristics in a student for which instruction must be individualized.

To add to the present level of knowledge of individual differences and their relation to achievement, a number of characteristics were selected for study. These characteristics, called learning style variables, were selected to represent four general categories: intelligence abilities, cognitive style factors, affective factors, and study skills.

The types of intelligence abilities considered were: evaluation of relations presented in a semantic context, production of different possible ways of arriving at a solution of relations presented in a symbolic context, and the production of a specific solution for a system presented in a semantic context.

The cognitive style factors investigated were "Field Independence-Dependence," the process of dealing with conceptual parts as they relate to a whole, and "Tolerance for Ambiguity," the type of response made to an uncertain or ambiguous situation or concept.

The affective factors examined were: (a) "Extraversion-Introversion," the preference for responding to things and people or to ideas and concepts; (b) "Sensing-Intuition," the preference to perceive directly through the senses or indirectly by way of contributions of ideas and associations supplied by the unconscious; (c) "Thinking-Feeling," the preference to make conclusions through an analytical impersonal process or through a process of appreciation bestowing on things a personal, subjective value; (d) "Judging-Perceiving," the preference to examine things and ideas in a critical judging fashion or in an open, accepting fashion.

For the area of study skills, the following seven factors were studied: (a) "Clerical Diligence," the degree of effort a student expended in preparation for class; (b) "Academic Savvy," the importance of following the rules of the academic "game"; (c) "Mnemonics," the reliance on memory and memory tricks for success; (d) "Planfulness," the concern about keeping up with assignments and being prepared ahead of time for tests; (e) "Formal Thinking," a preference for analyzing material in an orderly manner; (f) "Note Taking," the level of

importance a student places on getting things down in writing; (g) "Transformation and Application," the importance placed on actively integrating information.

An examination of the relationships of these learning style variables to achievement was made by obtaining data to answer the six research questions formulated.

The research questions were:

One: Are there learning style variables whose relationships to achievement could be described as non-linear?

Two: Do specific learning style variables relate to achievement without reference to instructor variations or subject matter area?

Three: Do specific learning style variables relate to achievement for specific subject matter areas without reference to instructor variables?

Four: Do specific learning style variables relate to achievement for specific instructors?

Five: Do the instructional style mediate the relation between the student's learning style and the student's achievement?

Six: Are there differences between the students who were tested over all variables and those who were not?

Data were obtained from 940 students at two levels; 574 students were tested on intelligence abilities only, and 366 students were tested for all variables. The

students were enrolled in one or more subject matter areas: Economics, English, History, and Psychology. Data were collected for the instructors (n = 11) of the students in those subject matter areas.

Product-Moment, multiple correlation, correlation and analysis of variance procedures were used to process the data for analysis.

Conclusions

Within the limits and findings of the present study the following conclusions are suggested:

Q 1. There was no evidence that specific learning style variables that had a non-linear relationship to achievement.

Q 2. There are specific learning style variables which can provide information about achievement in general. This is a qualified affirmative in that highly technical and natural science type subject areas were not represented in the present study. With this limitation in mind, the results of the study show that when lumping subject matter areas together the two most important areas to consider for learning styles are intelligence abilities and study strategies.

Q 3. There are specific learning style variables which provide useful information about achievement for specific subject matter areas. The importance of the relationship of "Sensing-Intuition" to achievement for the area of Economics was hidden when the data were

analyzed for all students without considering subject matter requirements.

Q 4. There are specific learning style variables which provide useful information about achievement for specific instructors. The importance of specific learning style variables for specific instructors was frequently hidden when considering relationships at the subject matter level. The amount of variance in achievement that could be accounted for increased radically as the data were analyzed at lower and lower levels. The known variance for all students in Group II was .144. An average variance of .33 was accounted for at the subject matter level and an average of .442 at the instructor level. Caution must be exercised in generalizing the results on the instructor level to a different course taught by the same instructor. There may be differences in course demands as there were at the subject matter level.

Q 5. There was evidence that the instructor's style entered into the relationship between a student's learning style and his/her level of achievement. Generally, the closer the student's learning style was to the instructor's style, the higher the grade. The evidence was not univocal and decisions based on these results must be made with caution.

Q 6. There was an important difference between the two groups of students in the present study. The students, who on their own time came to complete the tests, received

significantly higher grades. The difference was larger than could be accounted for by any incentives provided. A clear distinction must be made between the students who said they would come and those who actually did come. To use the findings of this difference in student achievement, some action on the part of the student must be required.

Several general conclusions can be drawn from the present study:

1. Knowledge of factors in the four general areas of learning style provide information, not presently available to educators, that can be used to predict achievement. The results of the multiple correlations for research questions three and four demonstrate that different combinations of the learning style variables have a relationship to achievement for different subject areas and different instructors. Knowledge of the appropriate combination of variables is the key element for predicting the level of achievement for specific subject areas and specific instructors.

2. Prediction about the chances of a student's level of achievement increases greatly when knowledge about subject matter demands and instructor differences are available and can be compared to the student's learning style profile. This conclusion is based on the fact that the amount of variance accounted for in achievement by the variables generally increased as the data were analyzed by subject area and instructor.

3. Presently there are individual differences which are not predictive of achievement. If instruction is to meet individual needs and strengths, then techniques of instruction and evaluation must be developed so that those non-represented variables which may be considered important can have an influence on achievement. For example, "Clerical Diligence" which represents the cultural value of the work ethic had only one correlation coefficient to achievement with a $p < .10$ for the ten instructor level groups.

Recommendations

The present study has provided evidence that specific learning style variables relate to achievement. However, a word of caution is required to emphasize that the present study investigated relationships. It has not established causes and effects.

The study has supported the notion that differences between subject areas exist as well as differences between instructors. These differences offer a means of predicting what kind of student is likely to succeed under specific conditions.

Some steps that are suggested: (a) the need for replication to obtain more evidence of the specific variables that are important for the subject areas and instructors; (b) the test battery be improved by item analysis to produce finer discrimination between the variables; (c) other learning style variables be included to broaden the

scope of the learning style profile; (d) the method of computing the distance between student and instructor be refined.

Some questions raised by the results of the present study are:

1. Can a student's learning style be changed?
2. Would a student's learning style change towards the demands of a subject area after experience with that subject area?
3. Would it be useful to try to change a student's learning style to fit the demands of the subject area prior to entry?
4. Could a subject area be presented to students in such a way that it fits the students' learning style?

The answers to these questions have a great bearing on the decisions that have to be made as to the direction of education in the future.

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APPENDIX A

INFORMATION OF RESEARCH PRESENTED TO INSTRUCTORS

A STUDY OF THE INTERACTIONS AMONG THE LEARNING STYLES OF COLLEGE STUDENTS, INSTRUCTIONAL STYLES AND ACADEMIC FIELDS RELATED TO ACHIEVEMENT

By

Alphonsus Niec
Oklahoma State University

Statement of the Problem

Postsecondary educational opportunities require the learner to adapt to the structure and processes of the instructional system. Often the learner experiences dissatisfaction and even frustration when he is required to adapt to two existing curricula, overt and covert. The covert curriculum demands that the learner adjust to the ever-changing styles of instructors. Limitations of a learner's ranges of adjustment often create appreciable levels of frustration. This frustration is expressed in a variety of ways from classroom cheating to overt demands for relevance. We are quite familiar with the relationship of student drop-out rates to these frustrations.

Student dissatisfaction and frustration occur because of the innumerable failures in communication the student experiences as he struggles through the system. Attempts have been made to increase communication by offering varied

forms of instruction; however, variation is based primarily on the preference of the instructor. The instructional system is not sensitive enough to accommodate the often contrary learning styles of students placed in the same class. Communication depends on the individual's style of perceiving material and organizing concepts. This style can be called the preferred learning pattern (PLP) which psychologists have identified as governing input, storage, and output of human behavior. It has been hypothesized frequently that if the teacher's PLP does not to some degree resemble that of the learner, communication is not effected; when communication does not occur, learning does not take place.

In terms of the diversity in PLP of ethnic groups and social classes, whose students attend postsecondary education, it is not surprising to know that students ask, "What does my teacher mean by that?" Studies have demonstrated different PLPs though they have been researched as learning styles, cognitive styles, and personality variables. At present, teachers are not often aware of the need to recognize or even relate to students with PLPs different from their own. In addition, it must be recognized that teacher training programs do not train for this important variable in student-teacher interaction. Because of the multifactored requirements of contemporary education, today's teacher would find it difficult to accommodate several different PLPs in the same classroom.

As with different instructional modes, various subject matter disciplines demand somewhat different learning patterns. The thrust of the present effort is to emphasize the teacher as the intermediary between subject matter demands and students' PLPs. If the teacher has only vague notions about the various skills which the subject demands in terms of learning styles and no knowledge of the PLP of the student, then he cannot mediate effectively. A combination of these vague notions and a lack of knowledge forces the teacher to adopt a "shotgun" approach to instruction, a wasteful practice of using many teaching techniques with the hope that some are appropriate for each student. To improve this stiuation the faculty must be deployed on a different basis.

Objective

The primary objective of the present effort is to investigate the factors of a PLP which best predict achievement and satisfaction in specific fields when taught by instructors with specific instructional styles.

Procedure

1. A profile of each student's PLP will be constructed.
2. A profile of the instructor's PLP will be constructed.
3. The relationship of students' PLPs to achievement and satisfaction mediated by the instructor's PLP will be statistically analyzed.

Results

The results of the analysis will be presented in terms of factors which have a significant relation to specific subject areas. Regression equations and nomographs will be developed for predicting success in a specific course when taught by an instructor with a specific PLP. For example, can a student who has a global way of perceiving and conceiving (Field-Dependence) achieve success in a course taught by an instructor who is highly analytical in thinking (Field-Independence)?

Conditions

1. One class period for testing
2. Willingness on the part of the students to take the test and spend an additional two hours outside of class for additional testing
3. Cooperation of the instructor to permit testing and to take the test himself (herself) and to provide scores on the final exam and final grades.
4. All materials will be supplied by the examiner
5. Students and instructors participating in the research will be provided feedback of both general results and specific results in the form of a profile.

APPENDIX B

INTRODUCTION OF THE RESEARCH TO SUBJECTS

Instructions for Testing

(Note: to be read slowly and clearly)

Until recently, students were labeled good or bad; bright or dumb. Currently, questions have been raised against this type of labeling. Could it be that students are neither good nor bad; neither bright nor dumb? Present knowledge about the subtleties of communication indicate that how a student achieves in a course may be related to the subject matter of the course and the teacher's style of communication.

The purpose of this research is to explore the relations between a student's style of learning and an instructor's style of communication. To obtain evidence of this relation, I am requesting the cooperation of both the instructor and his (her) students to take a series of written activities and questionnaires, investigating ways in which thinking occurs. The material covered in the questionnaires is not highly personal and does not attempt to pry into your private lives.

Many people find these activities an interesting challenge. Furthermore, at the conclusion of the research, profiles of your individual learning style will be made available to you along with an explanation of how you can use this knowledge as an aid in your continuing education.

The goal of the project is to determine what factors are influential for matching students and teachers to provide a student with the best learning opportunities.

I am going to ask you to complete a biographical data sheet to supply necessary information for making statistical analyses, then you will be given three short activities dealing with different ways of thinking. Different people feel they do better on different activities. You may not be able to finish all the activities in the time alloted.

Any Questions?

(Note: read this and pass out the proper sheets after the three tests)

There are a number of other types of activities and some questionnaires. But in order to preserve class time, arrangements have been made to continue the program at the residence halls. It will require about two hours to complete; cokes will be provided for the thirsty.

I am passing out a list showing a schedule of the times available; please write your name on the sheet under the time that will be most convenient for you.

Thank you for your cooperation.

APPENDIX C

BIOGRAPHICAL DATA SHEET

PLEASE PRINT REQUESTED INFORMATION

IN THE SPACES PROVIDED

1. STUDENT I. D. NUMBER _ _ _ _ _ _ _

2. NAME _____
LAST FIRST MIDDLE

3. AGE (Years/Months) _____/_____

4. SEX (M or F) _____

5. HOME STATE _____

6. MAJOR _____

7. CLASS (circle one)

(a) Freshman (b) Sophomore (c) Junior (d) Senior

(e) Other

8. HOME TOWN POPULATION (Circle One)

(a) Below 10,000 (b) 10,000-50,000 (c) 50,000-100,000

(d) Over 100,000

9. APPROXIMATE HIGH SCHOOL GRADE AVERAGE
(circle the number most representative)

A B C D

1 2 3 4 5 6 7

10. COURSE _____ _____ _____

APPENDIX D

THE VERBAL ANALOGIES III TEST

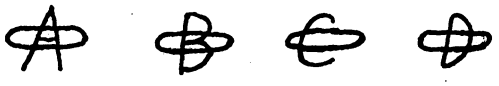
VERBAL ANALOGIES III

This is a test of your ability to judge relations between words. In each item you will be given a first pair of words which are related in the same way. You are to complete a second pair by choosing one of four given words. The second pair should have a relation similar to that of the first pair. Now look at the example.

Example:

TRAFFIC : SIGNAL as RIVER : ___?___

A. bank
B. dam
C. canal
D. sand bags



Although all four alternatives are related to river, the alternative B, dam, best fits the blank to complete the second pair. Signal controls traffic as dam controls river. The space under B has been blackened to show that "B" is the right answer.

In the test, select the alternative word which best fits the blank in each item.

This test has 2 pages with 10 items on each page. You will be given 3 minutes to work on each page and will be told when 1 minute remains for each page.

If you have questions, ask them now.

STOP HERE.

WAIT FOR FURTHER INSTRUCTIONS.

APPENDIX E

THE ORDERING I TEST

ORDERING I

DO NOT MARK ON THIS TEST BOOKLET

Each item in this test consists of three numbered statements, which are not in a sensible order. Look at the example.

1. Casey swung mightily but missed.
2. There was no joy in the hometown after the game.
3. The hometown stands roared as he came to bat.

A	B	C	D	E
1	2	2	3	3
3	1	3	1	2
2	3	1	2	1

Which of the orders indicated in the boxes above is the best order of the sentences in the example? On your answer card you would mark the space under "B" for such a test item since the sentence order in box "B" makes the most sense.

The two parts of this test each consists of 10 items similar to the one above. Your task is to select the proper order of each group of sentences by choosing from the orders given in the boxes at the top of each page. Note the letter label of the order and mark your answer under the same letter on your answer card. You will have 3 minutes for each part.

When you come to the end of a part, you may go back over the items in that part until time is called. Do not start a new part until told to do so.

If you have questions ask them now.

STOP HERE. WAIT FOR FURTHER INSTRUCTIONS.

APPENDIX F

THE ALTERNATE ADDITIONS TEST

ALTERNATE ADDITIONS -

Name _____ I. D. number _____

In this test you are to think of different ways to add numbers to get the same total. You will be told which numbers to work with. Look at the sample item:

SAMPLE ITEM:

Add only					Get	
1	2	3	4		7	
3	+	4		=	7	
1	+	2	+ 4	=	7	
3	+	3	+ 1	=	7	X Not acceptable
2	+	5		=	7	X Not acceptable

Two acceptable ways of getting 7 by adding some of the given numbers are shown. The sum 3 + 3 + 1 is not acceptable because you are given just one number 3 to use. The sum 2 + 5 is not acceptable because the number 5 is not given.

Here are the rules to remember:

A. Use only addition.
B. Add only the numbers given.
C. Do not use a number twice in the same item.
D. Use a different combination of the given numbers for each sum; writing 4 + 3 = 7 in the sample item would not count, since it is the same as 3 + 4 = 7.

This test consists of 2 pages each containing 8 items. You will have 3 minutes for each page. Your score will depend upon how many different acceptable ways you write for each item.

If you have any questions, ask them now.

STOP HERE. WAIT FOR FURTHER INSTRUCTIONS.

APPENDIX G

THE HIDDEN FIGURES TEST

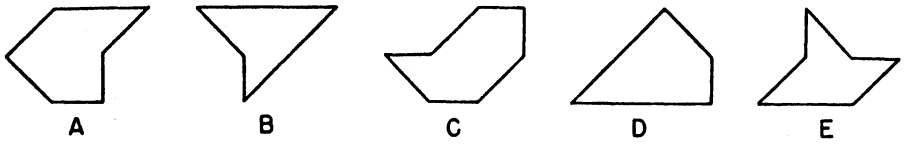
Name: _____

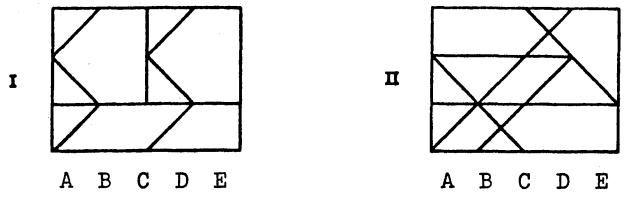
HIDDEN FIGURES TEST — Cf-1

This is a test of your ability to tell which one of five simple figures can be found in a more complex pattern. At the top of each page in this test are five simple figures lettered A, B, C, D, and E. Beneath each row of figures is a page of patterns. Each pattern has a row of letters beneath it. Indicate your answer by putting an X through the letter of the figure which you find in the pattern.

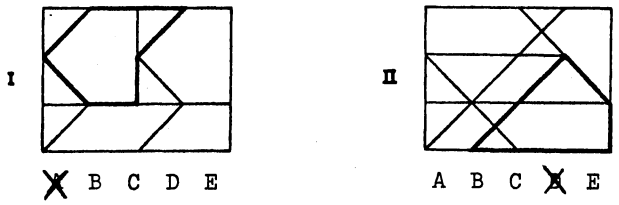
NOTE: There is only one of these figures in each pattern, and this figure will always be right side up and exactly the same size as one of the five lettered figures.

Now try these 2 examples.





The figures below show how the figures are included in the problems. Figure A is in the first problem and figure D in the second.



Your score on this test will be the number marked correctly minus a fraction of the number marked incorrectly. Therefore, it will not be to your advantage to guess unless you are able to eliminate one or more of the answer choices as wrong.

You will have 10 minutes for each of the two parts of this test. Each part has 2 pages. When you have finished Part 1, STOP. Please do not go on to Part 2 until you are asked to do so.

DO NOT TURN THIS PAGE UNTIL ASKED TO DO SO.

Developed under NIMH Contract M-4186

APPENDIX H

THE TOLERANCE-INTOLERANCE OF COGNITIVE AMBIGUITY TEST


1


2


3


4


5


6


7


8


9


10


11


12


13


14


15


16

Name _____ I.D. number _____

PICTURE - STATEMENT EVALUATION

Instructions:

You have been given a group of pictures and this sheet of statements. If you feel that any of the persons pictured on the other sheet made one of the statements on this sheet, put the number of that picture on the line provided beside that statement. If you do not associate a particular statement with a particular picture, leave that line blank.

___A. "Yesterday, you may have had a reason."

___B. "We knew that it would make news."

___C. "Most people get pretty much what they deserve."

___D. "I can't agree to any rushing of this question."

___E. "When the light is green, go."

___F. "TV is killing us--costs are rising."

___G. "Then I'm not going."

___H. "The future of the world is being shaped by machines."

___I. "Are we half through, finished or what?"

___J. "I've seen him fall asleep many times."

___K. "I am delighted to be here today."

___L. "For the first time in your life, you are wrong."

___M. "This is a strange kind of thing."

___N. "I never look backward."

___O. "The news was too good to be kept quiet for long."

___P. "I don't understand any of you."

PLEASE TURN TO THE NEXT PAGE AND CONTINUE!

Name _____ I.D. number _____

Picture-Statement Evaluation (Continued)

On the previous page you were asked to match pictures and statements; you may have many, or only a few, or no matches. On this page--only for the matches you made on the previous page--show how certain you feel that the person in the picture made the statement that you matched it with.

Please make a check mark on only those scales which are next to the matches you made. Place the check mark in the box on the scale to show how certain you are about the match you made. Remember, do only the matches you actually made. Do not mark the scale where there are no matches.

Please use the following scale as a guide.

	Very Certain	Certain	Slightly Certain	Unsure	Slightly Uncertain	Uncertain	Very Uncertain
A.							
B.							
C.							
D.							
E.							
F.							
G.							
H.							
I.							
J.							
K.							
L.							
M.							
N.							
O.							
P.							

APPENDIX I

THE STUDY STRATEGIES QUESTIONNAIRE

STUDY STRATEGIES QUESTIONNAIRE

Description of Subscales

Clerical diligence (Scale 1). Clerical diligence contains items that reflect considerable effort in preparation for classes (e.g., I spend more time studying than most people; I review my class notes before each class session; I do research at the library on class material even if it is not required).

Academic "savvy" (Scale 2). Academic savvy contains items that reflect a sensitivity to the academic "game" (e.g., I try to find out what the instructor expects and study with that in mind; I try to learn from errors on graded material; I get individual help from the professor and TAs (teaching assistant) whenever necessary).

Mnemonics (Scale 3). Mnemonics is defined by items that indicate the use of memorization as a strategy of study (e.g., I memorize specific facts for use in exams; I use mnemonic devices (memory tricks) with specific problems or terms).

Planfulness (Scale 4). Planfulness contains items that reflect concern for punctuality and foreplanning (e.g., I take especially complete notes; I attend all or nearly all class meetings; I keep up with the assigned readings week by week; I do most of the assigned reading at the end of the quarter -- in other words, I cram (scored in the reverse direction)).

Formal thinking (Scale 5). Formal thinking contains items related to logical and mathematical thinking (e.g., I enjoy mathematical reasoning; I try to find a logical reason for all information; I am good at syllogistic (logical) reasoning).

Note taking (Scale 6). Note taking is defined by items that reflect the behavior of writing while studying (e.g., I extract the important points from the assigned reading and write them down; I outline the reading and review the outlines; I take notes on the reading while doing the reading).

Transformation and application (Scale 7). Transformation and application reflect active integration of scholastic information (e.g., I read the same material from three or four different sources and then combine all specific views into one large view; I find interrelationships in the material covered as a memory aid). This scale also reflects application and relevance of scholastic material (e.g., I try to find practical application of the material I read; I try to find personal relevance in lecture and reading material so I can look at it subjectively rather than objectively). In sum this scale reflects some altering by the individual of the original input of scholastic information into a more amenable form.

STUDY STRATEGIES

QUESTIONNAIRE

The items comprising each subscale are as follows:

Clerical Diligence

5 9 24 30 32 39 40 41

Academic Savvy

17 19 20 26 27 28 33

Mnemonics

14 21 23 25

Planfulness

1 2 31 35 36 38

Formal Thinking

13 21 22 34 37

Note Taking

6 15 18 29 42

Transformation

3 4 7 8 10 11 12 16 33

Questionnaire on Study Techniques

This is a questionnaire designed to measure the study techniques people use in various college classes. It will hopefully contribute to an understanding of learning styles. Please answer as honestly and accurately as possible.

A separate answer card is provided. Indicate the degree to which you agree with the statement or the degree to which it applies to you on a five-point scale as follows:

highly agree neutral strongly disagree

1. I read the same material from three or four different sources and then combine all specific views into one large view.
2. I take especially complete notes.
3. I "debate" with the material as I study it.
4. I make up questions on underlined reading material and make sure I am able to answer them.
5. I spend more time studying than most people do.
6. I extract the important points from the assigned reading and write them down.
7. I try to find personal relevance in lecture and reading material so I can look at it subjectively rather than objectively.
8. I find interrelationships in the material covered in a class as a memory aid.
9. I review my class notes before each class session.
10. I try to discover associations between all areas of a subject in order to obtain a total view.
11. I like to spend some time just thinking about the material covered in class and in the reading.
12. I question and answer from memory all the material read.
13. I enjoy mathematical reasoning.
14. I memorize specific facts for use in exams.
15. I outline the assigned reading and review the outlines.
16. I try to find practical application for the material I read.
17. I try to find similarities between lectures and readings.
18. I underline important points made in the book.
19. I get individual help from the professor and T.A.'s whenever necessary.
20. I find that information learned in one class helps with the material of other classes sometimes.
21. I try to get an intuitive feel for new concepts.
22. I try to draw diagrams of concepts presented in class.

23. I memorize the mechanical operation of mathematical formulas.

24. I keep up with the assigned reading week by week.

25. I memorize when I find it possible.

26. My concentration is strongly influenced by how interesting the material is.

27. I try to understand examples given in class.

28. I try to find out what the instructor expects and study with that in mind.

29. I make a list of important terms and ideas as I come across them in the reading.

30. I put important information from the reading on 5" x 8" cards and study from the cards.

31. I hope the material seeps in somehow without consciously studying it.

32. I do all suggested outside reading.

33. I like to build on my own previous understanding of the material with the new information presented in class.

34. I try to find a logical reason for all information.

35. I do most of the assigned reading at the end of the semester - in other words, I "cram".

36. I just cross my fingers and hope.

37. I am good at syllogistic (logical) reasoning.

38. I often memorize material without understanding it.

39. I do research at the library on the class material even if it is not required.

40. I do the assigned reading just before the lecture that will cover that information.

41. I review notes from a class as soon after class as possible in order to consolidate the material in my mind.

42. I take notes on the reading while doing the reading.

APPENDIX J

THE MYERS-BRIGGS TYPE INDICATOR

DESCRIPTION OF THE SUBSCALES IN MYERS-BRIGGS TYPE INDICATOR

Extraversion-Introversion (EI)

Introversion in the sense given it by Jung, who formulated the term and the idea, is one of two mutually valuable orientations to life. The introvert's main interests are in the inner world of concepts and ideas, while the extravert's main interests are in the outer world of people and things. Therefore, when circumstances permit, the introvert directs both perception and judgment upon ideas, while the extravert likes to direct both upon his outside environment.

Sensing-Intuition (SN)

A basic difference in the use of perception arises from the fact that, as Jung points out, mankind is equipped with two distinct and sharply contrasting ways of perceiving. There is not only the familiar process of sensing, by which we become aware of things directly through our five senses. There is also the process of intuition, which is indirect perception by way of the unconscious, accompanied by ideas or associations which the unconscious tacks on to the perceptions coming from outside. These unconscious contributions range from the merest masculine "hunch" or "woman's intuition" to the crowning examples of creative art or scientific discovery.

Thinking-Feeling (TF)

A similar basic difference, this time in the use of judgment, arises from the existence of two distinct and sharply contrasting ways of coming to conclusions. One way is by the use of thinking, which is a logical process, aimed at an impersonal finding. The other way is by the use of feeling, which is a process of appreciation, equally reasonable in its fashion, bestowing on things a personal, subjective value.

Judging-Perceiving (JP)

The remaining preference is between perception and judgment as a way of life, a method of dealing with the surrounding world. Both must of course be used. But both cannot be used at the same time. So individuals alternate between the perceptive attitude and the judging attitude. And almost all people enjoy one attitude more than the other, find it more comfortable, feel more at home in it, and spend as much of their lives in it as possible.

For instance, if one merely follows this explanation open-mindedly, he is preferring perception. However, if he has already decided that he agrees or disagrees, he is preferring judgment.

There is a fundamental difference between the two attitudes. In the judging attitude, in order to come to a conclusion, perception must be shut off for the time being. The evidence is all in. Anything more is

incompetent, irrelevant and immaterial. One now arrives at a verdict and gets things settled. Conversely, in the perceptive atittude one shuts off judgment for the time being. The evidence is not all in. There is much more to it than this. New developments will occur. It is much too soon to do anything irrevocable.

MYERS-BRIGGS TYPE INDICATOR

Form F

READ THESE DIRECTIONS FIRST:

1. This is a test to show which sides of your personality you have developed the most.

2. The answer you choose to any question is neither "right" nor "wrong." It simply helps to point out what type of person you are, and therefore where your special strengths lie and what sort of work you will like to do.

3. For each question, choose the answer which comes **closest** to how you usually feel or act. Mark your choice on the separate answer sheet, as shown here.

Sample Question

167. Are your interests
(A) few and lasting
(B) varied

Sample Answer Sheet

	A	B
167.	⋯	▬

If your interests are varied, you would mark answer "B" as it is marked on the sample answer sheet. If they are few and lasting you would mark "A."

4. If you find a question where you cannot choose, don't mark both answers. Just skip the question and go on.

NOW TAKE YOUR ANSWER SHEET

5. Fill in all facts called for at the top of the answer sheet.

THEN START WITH QUESTION 1 AND WORK STRAIGHT THROUGH TO THE END OF THE TEST WITHOUT STOPPING

Educational Testing Service, Princeton, New Jersey

APPENDIX K

REFERENCE OF COMPUTER PROGRAMS

The product-moment correlation coefficients in this study were produced by the SAS Cor procedure (Service, 1972).

The analysis of variance technique based in this study was computed by the SAS ANOVA procedure (Service, 1972).

The correlation ratio (eta.) coefficients in this study were produced by the Statistical Program for Social Sciences (SPSS) Fast Tabs, eta.

APPENDIX L

STATISTICAL FORMULAE

Research Question One

The F-test of linearity (Guilford, 1965, p. 290):

$$F = \frac{(\eta^2 - r^2)\ (N - k)}{(1 - \eta^2)\ (k - 2)}$$

where:

r = the measure of the relation for the product-moment correlation

η = the measure of the relation for the correlation ratio

N = the number of observations

k = the number of columns

Research Questions Three, Four and Five

The formula for Fisher's z Transformation:

$$Z_1 = \tfrac{1}{2} \ln \left(\frac{1 + r_1}{1 - r_1} \right)$$

$$Z = \frac{Z_1 - Z_2}{\sqrt{\frac{1}{N_1 - 3} + \frac{1}{N_2 - 3}}}$$

where:

r_1 = the correlation coefficient of the first sample

r_2 = the correlation coefficient of the second sample

Z_1 = the computed z coefficient of the first sample

Z_2 = the computed z coefficient of the second sample

N_1 = the number of observations in the first sample

N_2 = the number of observations in the second sample

Research Questions Two, Three and Six

Formula for t-test (Spence, Underwood, Duncon and Cotton, 1968, p. 104):

$$t = \frac{\bar{X}_1 - \bar{X}_2}{S_{\bar{X}_1 - \bar{X}_2}}$$

where:

$\bar{X}_1$ = the mean of Group I

$\bar{X}_2$ = the mean of Group II

$S_{\bar{X}_1}$ = the standard error of Group I

$S_{\bar{X}_2}$ = the standard error of Group II

$$S_{\bar{X}_1 - \bar{X}_2} = \sqrt{\left(\frac{N_1 S_{\bar{X}_1}^2 - N_2 S_{\bar{X}_2}^2}{N_1 + N_2 - 2}\right)\left(\frac{1}{N_1} + \frac{1}{N_2}\right)}$$

where:

N_1 = the number of observations for Group I

N_2 = the number of observations for Group II

APPENDIX M

FEEDBACK MATERIAL FOR SUBJECTS

LEARNING STYLE RESEARCH

Description of Variables and Test Scores

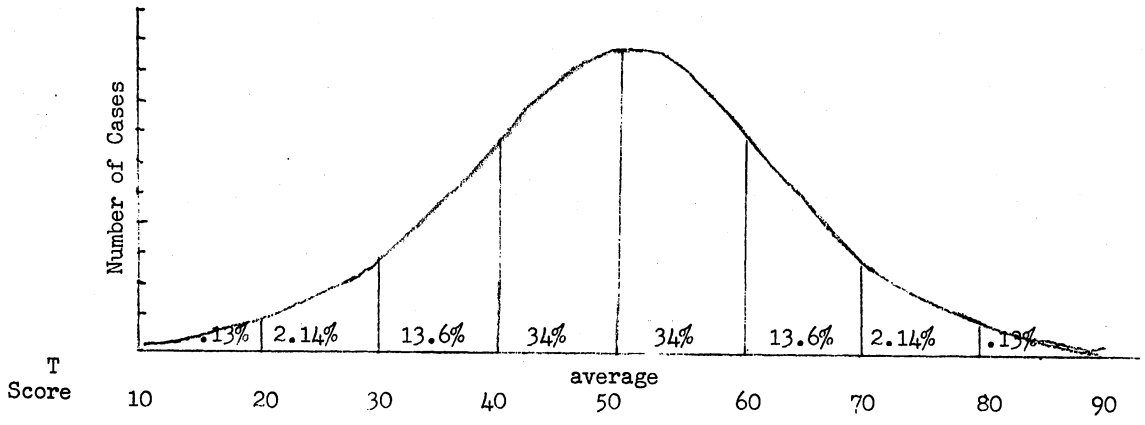
This booklet has been prepared to provide information about the tests you took early in the fall semester of 1974 as well as some indication of the meaning of your test scores. As you read through the description of a test and compare your score to the information presented you may find yourself saying "Yes, that's me!", "No, that's not me!", or "I didn't know that about myself!"

WARNING: The information in this booklet is not to be taken Internally.

The meaning of the previous message is that the results of your tests must be viewed tentatively. The value of this information comes from a comparison between the results and your knowledge of yourself. The descriptions of the tests and your scores may provide an opportunity to look at yourself in ways that you have not thought of yet. In any case you are the final judge of the value this information has for you. So let us begin by seeing how to view the score itself.

T - Score

The results of the tests are printed as T-scores. This is a standardized way of changing an actual score or raw score into a number that represents how one person compares to the whole group. This is accomplished by letting the number represent the distance from the average score for the group. At the same time it provides information as to the percent of scores above or below that score. The way this happens is by letting the average score be called 50 and by letting a fixed distance represent a given percent of the scores. The graph below shows how the scores are distributed or spread out.



An advantage of using the T-score is that different tests can be compared. For instance if you got a 40 on one test and a 60 on a second test you could not determine which was the higher score without knowing what the total possible score was. A 40 out of a possible 50 is a better score than 60 out of a possible 100. But if the numbers 40 and 60 were T-scores then by looking at the graph you could tell that on the first test you had a higher score than about 16 percent of the students who took the test. A score of 60 tells you that you had a score greater than 84 percent of the students who took the test. The percent is figured by adding the percents on the graph that are to the left of your score. The graph on the next page is provided so that you can mark off the place for your T-score for each test and quickly read the percent on the right side of the graph.

WARNING #2: The scores are not good vs bad. On some tests a low score means one direction is favored and a high score means another direction is favored. Only from the description of each test can an interpretation of the score be made.

An important point to keep in mind is that the score you received the day you took the test may not be the same score if you had taken the test on a different day. To take into account these variations in scores on the same test by the same person, a range is calculated so that one can have some degree of confidence as to where the true score would be. Under the name of each test on the graph is a number. For example the number under Verbal Analogies (VA) is 12. If you draw a line 12 units up from your score and 12 units down you will know that your "true" score will be somewhere in that band with odds of 5 out of 100 that your "true" score is not in that band.

These scores were computed on a total of 358 students from Economics 1113, English 1113, History 2493 and Psychology 1113. Information about the value of each test has not been acquired for more advanced courses in these subject areas. But if you are planning to take some of the courses listed, this information may be useful.

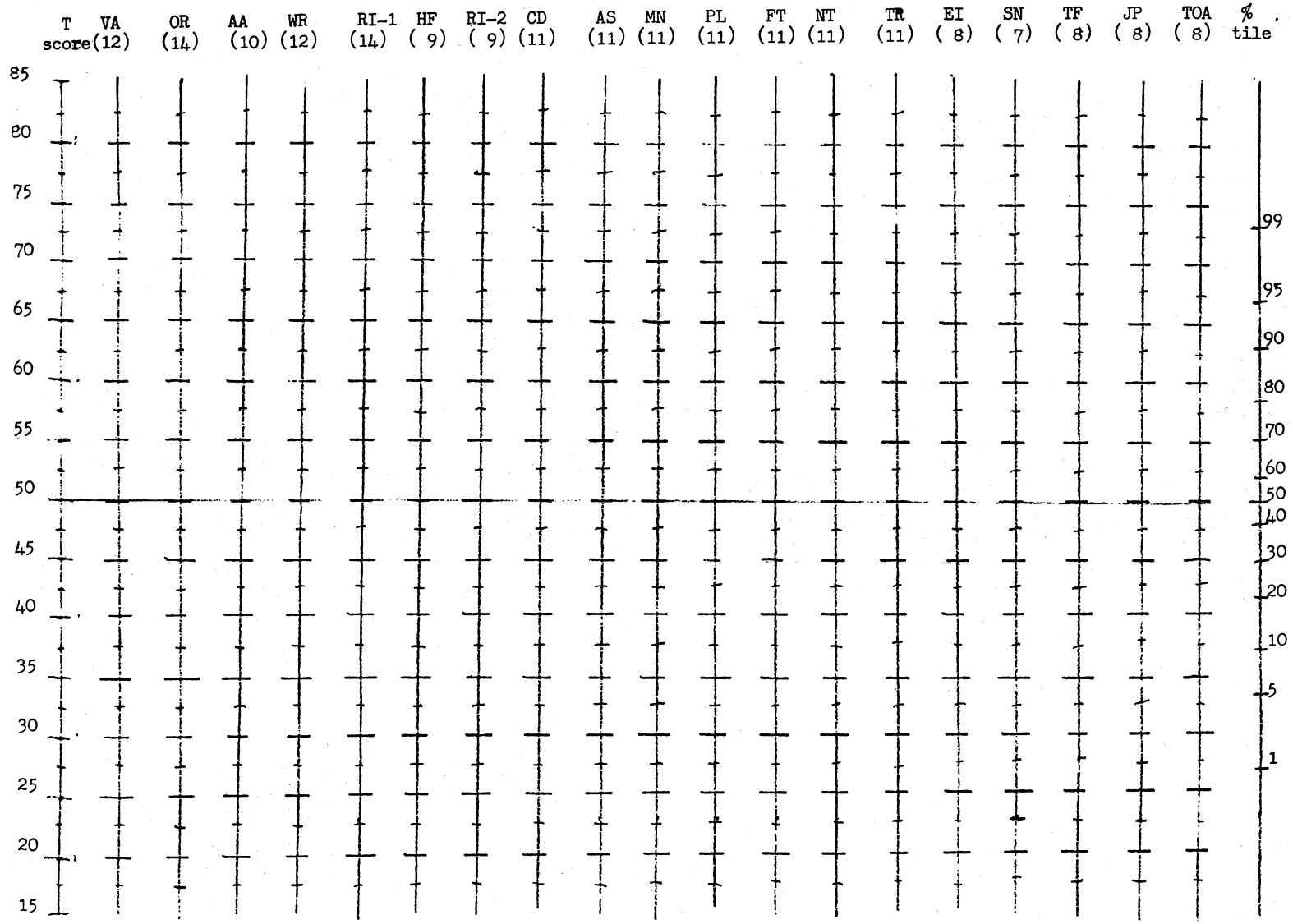
WARNING #3: No test by itself had such a strong relationship to grades that it could always predict what kind of grade would be achieved. Also there are many other factors that enter into a grade which were not looked at in the research you participated in.

Verbal Analogies

The test Verbal Analogies was designed to measure a student's ability to evaluate relations of ideas or concepts that are presented through words. A sample item is:

Traffic is to Signal as River is to _____

a) bank b) dam c) canal d) sand bags


T score
VA (12)
OR (14)
AA (10)
WR (12)
RI-1 (14)
HF (9)
RI-2 (9)
CD (11)
AS (11)
MN (11)
PL (11)
FT (11)
NT (11)
TR (11)
EI (8)
SN (7)
TF (8)
JP (8)
TOA (8)
% tile
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
99
95
90
80
70
60
50
40
30
20
10
5
1

The results of the research imply that generally students who received high scores on this test received high grades for all four subject areas. This was especially true for Economics.

Ordering (OR)

The test Ordering was designed to measure a student's ability to organize a set of ideas or concepts in a logical sequence. A sample item is:

1. Casey swung mightily but missed
2. There was no Joy in the hometown after the game
3. The home town stands roared as he came to bat

the correct order should be _____.

The relationship between Ordering and grades was strongest for Psychology but was important for the other three subject areas as well. Generally students with higher scores received higher grades.

Alternate Additions (AA)

The test Alternate Additions was designed to measure a student's ability to produce different possible answers for relationships between numbers. A sample item is:

Add only	Get
1 2 3 4	7
ans. 3 + 4	
1 + 2 + 4	

Ability with this kind of material was not very important for Economics and only slightly important for the other three subject areas. It did not matter very much whether the test score was high or low with respect to the grade.

Wrong (WR)

The label Wrong was applied to the variations in the sum of the number of incorrect responses for the three preceding tests: VA, OR, and AA.

This variable had a meaningful relationship to all four subject areas. In this case the lower the score on Wrong, the higher the grade was likely to be.

RI - 1

The label RI - 1 was applied to the variations in the sum of the number of items left blank for the tests VA and OR.

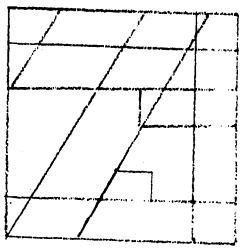
There was some relationship between the number of blanks and the grade for English. The relation was the fewer the blanks the higher the grade. For the other three subject areas the number of blanks had little relationship to the grade.

Hidden Figures (HF)

The Hidden Figures test was designed to distinguish between people who take in information of forms as whole units (low scores) and those who can locate parts that are hidden or covered up by the rest of the figure (high scores). A sample item is:

Find this

In this



Though the skill of seeing parts in a whole is considered useful when studying charts and graphs, there was no relationship between scores for HF and grades in any of the four subject areas.

RI - 2

The label RI - 2 was assigned to variations in the number of blanks left for HF. There was no relationship between the number of blanks and the grade for any of the subject areas.

Clerical Diligence (CD)

Clerical diligence is a subscale from the Study Strategies Questionnaire. It reflected a student's perception of effort in preparation for classes. A sample item is:

> "I do research at the library on class material even if it is not required."

The lower the score the greater the effort the student saw himself/herself putting into class preparation.

Clerical Diligence related to grade for History but not for the other three subject areas. The lower the score the higher the grade was likely to be.

Academic "Savvy" (AS)

Academic "Savvy" reflected sensitivity to the academic "game". A sample item is:

"I try to find out what the instructor expects and study with that in mind."

The lower the score the more important a student saw working in the system to be.

This variable had no relationship to grade for any of the four subject areas.

Mnemonics (MN)

The variable Mnemonics indicates the use of memory devices for learning material. A sample item is:

"I memorize specific facts for use in exams."

The lower the score the greater the importance one placed on memory.

This variable was important for History and somewhat important for Psychology. It was not important for Economics and English.

The lower the score the higher the grade was likely to be for History and Psychology.

Planfulness (PL)

The variable planfulness reflected concern for punctuality and planning ahead. A sample item is:

"I keep up with the assigned readings week by week."

The lower the score the greater the importance one placed on Planfulness. This variable proved to have an important relationship for English, History, and Psychology but not for Economics. A lower score was associated with a higher grade.

Formal Thinking (FT)

The variable Formal Thinking was concerned with the type of thinking one preferred. A sample item is:

"I try to find a logical reason for all information."

The lower the score the more one favored this type of thinking. Generally variations in this variable did not relate to grades.

Note Taking (NT)

The variable Note Taking reflects a person's preference for writing while studying. A sample item is:

"I extract the important points from the assigned reading and write them down."

The lower the score the stronger the preference for taking notes. This variable did not relate to grades in any of the four subject areas.

Transformation (TR)

The variable Transformation reflects a person's interest in trying to tie things and ideas together. A sample item is:

> "I read the same material from three or four different sources and then combine all specific views into one large view."

The lower the score the greater the preference for putting ideas together. This variable did not have a relationship to grade for any of the four subject areas.

Extraversion-Introversion (EI)

This variable represents two different directions. Those scoring high prefer to deal with ideas and concepts. Those scoring low prefer to work with people and things. Those who score about the middle have no real strong preference for either direction.

This variable was not related to grade for any of the four subject areas.

Sensing-Intuiting (SN)

This variable represents two different directions. Those scoring high prefer to take in information through the senses and attach meaning to this information from ideas stored away. This is what is meant by intuiting. Those who score low tend to prefer to "take things the way they see them."

This variable had an important relationship to grades for Economics. The higher the score the higher the grade. This variable was not important for the other three subject areas.

Thinking-Feeling (TF)

This variable represents two different directions. Those who score high prefer to appreciate ideas and things and judge them on a personal basis. Those who score low tend to prefer to judge ideas and things by means of logic in an attempt to reach an impersonal conclusion.

This variable had no relation to grades for the subject areas.

Judging-Perceiving (JP)

This variable represents two different directions. Those who score high prefer to look at things and ideas openly without making immediate judgments. Those who score low prefer to look at things and ideas critically with the aim of judging them.

This variable was related to grades for History with a lower score implying a higher grade.

Tolerance for Ambiguity (TOA)

This test was constructed to determine how a person would respond to an uncertain situation. The more tolerant a person is of a ambiguous idea the less quickly does he/she have to come up with an answ . The lower the score the more likely a person will be willing t wait and see what happens.

There was no relation between this variable and grades for any of the four subject areas.

VITA

Alphonsus Peter Niec

Candidate for the Degree of

Doctor of Education

Title of Study: A STUDY OF THE INTERACTIONS AMONG THE LEARNING STYLES OF COLLEGE STUDENTS, INSTRUCTIONAL STYLES AND ACADEMIC FIELDS RELATED TO ACHIEVEMENT

Major Field: Educational Psychology

Biographical:

Personal Data: Born in Chicago, Illinois, January 23, 1942, the son of Mr. and Mrs. Louis S. Niec. Married to Maria I. Davila, February 9, 1963; two daughters: Larissa Nicole and Alysia Loraine.

Education: Graduated from Divine Word High School, East Troy, Wisconsin, in May, 1959; received the Associate of Arts degree in Mathematics from Wright Junior College in 1963; received the Bachelor of Science degree in Mathematics from Loyola University (Chicago) in 1966; received the Masters of Science degree in Counseling and Guidance from Illinois Institute of Technology in 1970; enrolled in the doctoral program at Oklahoma State University, 1973-1975; completed requirements for Doctor of Education degree in July, 1975.

Professional Experience: Junior high school teacher, Our Lady of Good Counsel, 1963-63; industrial engineer, Spiegel, Inc., 1964-65; junior high school teacher, St. Adalbert, 1965-66; high school mathematics teacher, St. Viator, 1966-68; Niles Township Community, 1968-73; graduate teaching assistant, Oklahoma State University, Department of Applied Behavioral Studies in Education, 1973-75; Coordinator of Learning Resources, Oklahoma State University, College of Veterinary Medicine, 1974-75.

Publications and Institutes: Produced a workbook, "Learning Styles and Instructional Variables," Oklahoma State University College of Veterinary Medicine Learning Center; institutes: faculty institute on "Effective Teaching," assistant facilitator, Oklahoma State University, February, 1974; facilitator, faculty retreat on "Learning Styles and Instructional Methods," Oklahoma State University College of Veterinary Medicine, May, 1974; facilitator, faculty workshop, "Systems Approach to Effective Instruction," Oklahoma State University College of Veterinary Medicine, January, 1975; facilitator, faculty workshop, "Evaluation: A Prescription, Not a Cure," Oklahoma State University College of Veterinary Medicine, May, 1975.