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# Relationship of match/mismatch of student- teacher learning styles, stress, and academic achievement

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styles, stress, and academic achievement**

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**Iowa State University, 1989**

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Relationship of match/mismatch of  
student-teacher learning styles, stress,  
and academic achievement

by

William J. O'Neill

A Dissertation Submitted to the  
Graduate Faculty in Partial Fulfillment of the  
Requirements for the Degree of  
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**Approved:**

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Iowa State University  
Ames, Iowa

1989

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## CHAPTER I. INTRODUCTION

Stress in contemporary society is an issue and concern in both research and popular literature. Weiten (1986) noted that interest in stress had intensified since 1976. Gmelch and Swent (1982) reported that over 100,000 articles and books have been written about stress, 1000 research projects conducted, and that each year 6,000 more publications are catalogued under the heading of stress. Moreover, there are a number of documented stress-related problems on American college campuses (Greenberg, 1981, 1984; Heilbrun & Chefitz, 1984). Caudill and Carrington (1986) concluded that instructors need to identify and help students with high stress levels:

While a moderate amount of stress is beneficial in that it can mobilize and motivate a student to perform well . . . too much stress results in high absenteeism, disinterest in class and homework, and lower student satisfaction and self-esteem. (p. 7)

What researchers became increasingly concerned with, then, was stress that exceeded the individual's ability to cope (Lazarus & Folkman, 1984a).

Helms and Gable (in press) defined psychological stress as an "emotional tension or anxiety arising from traumatic life events and situations perceived as threatening to one's self-esteem, security, safety, or way of life." In this study stress will be operationally defined as state anxiety. State anxiety is an emotional reaction "characterized by subjective feelings of tension, apprehension, nervousness, and worry, and by activation or arousal of the autonomic nervous system" (Spielberger et al., 1983, p. 1).

In the United States there were approximately 12.2 million college students enrolled in 3,340 institutions of higher education (U. S. Bureau of the Census, 1987). Greenberg (1981) found that college students were subject to a wide range of stressful experiences including: entering college, conflicts regarding values, getting married, and getting divorced. Harwell (1984) noted that the new freshman student, in particular, is faced with a multitude of adjustments to a new environment. While some students had a minimum of difficulty in making those adjustments, others needed assistance which may or may not have been available on the college campus. Harwell stated that

No matter how highly developed an institution's support mechanisms are, there are students who fall between the cracks, and their adjustment to the new environment is traumatized to such an extent that their chances for success are compromised. (p. 131)

The National Center for Health Statistics (1987) reported that approximately 28,000 persons kill themselves each year. Pfeifer (1986) reported that suicide claimed the lives of more young people than any other cause except accidents. The rate of suicide among young people between the ages of 15 and 24 was 12.9 per 100,000 in 1985 (National Center for Health Statistics, 1987). Cosand, Bourque, and Kraus (1982) found the greatest incidence of suicide occurred for individuals 20 to 24 years of age. While estimates varied, the increase in suicide rates among college students was very high (Dashef, 1984; Draper, 1980; Paffenberger & Asnes, 1969; Trout, 1980). One estimate suggested that 10,000 college students attempt suicide each year, and some 1,000 succeeded (Carroll & Miller, 1986). Westefeld and Patillo (1987) found one estimate that

suggested that suicide rates among college and university students to be "50% higher than for other Americans of comparable age." These figures suggested that a large number of students confronted situations with which they were unable to cope. They faced events which they perceived to be overwhelming and, lacking the capacity to respond in a constructive way, they sought a solution in death. These findings reinforced the need for further study of the nature of stress and stressors among college students since such research could be useful to both college instructors and college student personnel workers.

For both student and teacher, the process of learning exacted demands. The preparation of lectures and materials, the energy expended in the classroom presentation, the necessity of preparing meaningful assignments, and the grading of student examinations all placed demands on teachers. Demands on the student included the effort involved in understanding the material presented in lectures, time needed for study and for the completion of outside reading and/or assignments. These demands were at times perceived as stressful, at other times challenging. Hans Selye wrote that "In life it is not what happens to you that matters, but how you take it; therefore, our interpretation of a stressor determines our reaction to it" (Brallier, 1982, p. vii). As Coyne and Lazarus (1980) found that the experience of stress involved both cognitive and subjective elements, these were factors in the appraisal or evaluation leading to whether or not an event was viewed as challenge or threat. How a situation was appraised made the difference in the stress involved.

Learning style is a construct which describes the unique ways in which individuals approach learning, the ways in which individuals gain access to knowledge. Kuerbis (1988) noted that various researchers and practitioners have different definitions of the construct. However, most agreed that

Learning style has cognitive, affective, and physiological dimensions that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment. (p. 3)

The term "learning" had been used in various ways in the literature. Kolb (1981b) defined learning as acquiring knowledge rather than as modifying behavior. This study examined the learning process and, more specifically, learning styles to demonstrate whether or not they provoked stress for undergraduate college students. The learning process as described by Kolb, Rubin, and McIntyre (1971) consisted of a four-stage cycle:

(1) concrete experience followed by (2) observation and reflection which leads to (3) formation of abstract concepts and generalizations which lead to (4) hypotheses to be tested in future action which in turn leads to new experiences . . . . This learning cycle is continuously recurring in living human beings. Man [sic] continuously tests his concepts in experience and modifies them as a result of his [sic] observation of the experience. In a very important sense, all learning is re-learning and all education is re-education. (p. 28)

Using Kolb's Learning Style Inventory, it was possible to identify four learning styles, each with its own strengths and weaknesses. Kolb labeled the styles as: (1) accommodators, (2) divergers, (3) convergers, and (4) assimilators. Each of the learning styles tended to emphasize different stages of the learning cycle as described by Kolb. These

learning styles represented learned preferences among individuals for ways of acquiring knowledge based on the relative importance of each of the stages to the individual. "The key to effective learning is being competent in each mode when it is appropriate" (Kolb et al., 1971, p. 29). Individuals are not necessarily locked into these styles. Kolb (1981b) has identified four statistically prevalent types of learning styles. These styles, called converger, diverger, assimilator, and accommodator are depicted in Figure 1. The dominant learning abilities of convergers are abstract conceptualization and active experimentation and their greatest strength lies in the practical application of ideas. Divergers, on the other hand, have the opposite learning strengths. Best at concrete experience and reflective observation, their greatest strength lies in imaginative ability. Assimilators excel in abstract conceptualization and reflective observation and their greatest strength lies in the ability to create theoretical models. Accommodators, on the other hand, have the opposite strengths from those of the assimilators. Accommodators are best at concrete experience and active experimentation and their greatest strength lies in doing things. Kolb used the term accommodators because these individuals tend to excel in situations that call for adaptation to specific immediate circumstances.

|                            | CONVERGER | DIVERGER | ASSIMILATOR | ACCOMMODATOR |
|----------------------------|-----------|----------|-------------|--------------|
| Concrete Experience        |           | X        |             | X            |
| Reflective Observation     |           | X        | X           |              |
| Abstract Conceptualization | X         |          | X           |              |
| Active Experimentation     | X         |          |             | X            |

**Figure 1. Kolb's four learning styles and corresponding learning strengths**

Research demonstrated that stress is a concern in the general population and, in particular, in the college population. Data regarding suicide attempts and completions among the college student population underscored the seriousness of the problem. Moreover, a significant variable that determined whether or not a situation would be viewed as stressful was the subjective appraisal of the individual. Learning styles, the typical ways in which individuals perceive and process information, involve a complex interaction of person and environment. An understanding of the concept of learning styles as they affect classroom learning and the college experience has gained increasing attention. A theory and model which is helpful to this end are those of Kolb (1981b) who described a four-stage learning cycle and identified four learning styles that represent four individual approaches to learning.

#### Statement of the Problem

The review of selected literature on stress suggested a relationship between the learner's perception of the learning situation and the level of stress experienced. The review of selected literature on learning styles of students suggested a less productive (or more challenging)

learning situation may result from a mismatch between teacher learning style and student learning style. Yet, no research was identified that examined the possible relationship between learning styles and stress. The effect of particular learning styles and of the match/mismatch of student/teacher learning styles on the severity of perceived stress and academic achievement will be studied to determine the relationship, if any, of the learning process to stress and academic achievement. Specifically, this research is to determine what relationships, if any, existed between these variables and whether or not match between teacher and student learning styles contributed to less stress in the student's life and higher academic achievement.

#### **Purposes of the Study**

The purposes of this study were:

1. to determine the degree of match between learning style of student and learning style of instructor in two samples of undergraduate college students;
2. to describe the perceived levels of stress among the two samples of students;
3. to ascertain the relationship between degree of learning style match/mismatch between student and instructor, levels of perceived stress, and the academic achievement among all students;
4. to determine differences among the four learning styles (diverger, accommodator, assimilator, converger) and matches or mismatches with instructor, perceived stress and academic achievement;

5. to determine the difference in state anxiety among those students with a learning style comparable to that of the instructor and those who evince other learning styles.

#### Definitions of Terms

The following definitions of terms used in this study were:

- Experiential learning model: "The experiential learning model pursues a framework for examining and strengthening the critical linkages among education, work, and personal development" (Kolb, 1984, p. 4).
- Learning styles: According to Kolb et al. (1971), "the four learning modes--concrete experience, reflective observation, abstract conceptualization, and active experimentation--represent the four stages of the learning process" (p. 29). Learning styles are defined as "preferences for one mode of adaptation over the others" (Kolb, 1981a, p. 290).
- Transactional model of stress: "The transactional model views the person and the environment in a dynamic, mutually reciprocal, bidirectional relationship . . . . This model forms the metatheoretical foundation on which [Lazarus's] cognitive theory of stress rests" (Lazarus & Folkman, 1984b, p. 293).
- Cognitive appraisal: Cognitive appraisal is "the process of categorizing an encounter, and its various facets, with respect to its significance for well being" (Lazarus & Folkman, 1984b, p. 31).
- Stress: Psychological stress as defined by Helms and Gable (in press) is an "emotional tension or anxiety arising from traumatic life



events and situations perceived as threatening to one's self-esteem, security, safety, or way of life." In this study stress is operationally defined as state anxiety.

--State anxiety: State anxiety is an emotional reaction "characterized by subjective feelings of tension, apprehension, nervousness, and worry, and by activation or arousal of the autonomic nervous system" (Spielberger et al., 1983, p. 1).

--Trait anxiety: Trait anxiety refers to "relatively stable individual differences in anxiety proneness, that is, to differences between people in the tendency to perceive stressful situations as dangerous or threatening and to respond to such situations with elevations in the intensity of their state anxiety (S-anxiety) reactions" (Spielberger et al., 1983, p. 1).

#### Basic Assumptions

1. It is assumed that the date on which students were tested was not an atypical day in their lives.
  2. It is assumed that students responded to the survey instruments as honestly as they were able.
  3. It is assumed that students in the classes examined were not atypical of students enrolled in such classes in terms of academic achievement, state anxiety, and variety of learning styles.
-

### Delimitations

This study was subject to many of the limitations which are inherent in the use of questionnaires. Lack of personal contact and inability to tailor questions to the situation and understanding of the individual respondents result in an approximation of information.

This study was limited to a population of students enrolling in one mathematics class and in one psychology class at Iowa State University during the Spring Semester of 1988. Examination of the characteristics of the two instructors was limited to academic discipline and learning style.

### Outline of Procedure

The population consisted of 167 undergraduate students enrolled in one of two courses at Iowa State University, Ames. The students surveyed were enrolled in one of two courses taught by two different instructors, one instructor from the psychology faculty and one instructor from the mathematics faculty. Kolb (1981b) maintained that "every discipline has a prime commitment to learning and inquiry and has developed a learning style that is at least moderately effective" (p. 234). Kolb's paradigm suggested that psychology and mathematics are two disciplines that generally represent two distinct learning styles: the diverger and assimilator respectively. Data-gathering will consist of the administration of the Kolb Learning Style Inventory (LSI) and the Spielberger State-Trait Anxiety Inventory (STAI-Y) administered to the subjects during the class period week prior to a major examination in each course. Due to the similarity in the theoretical orientations of Lazarus

and Spielberger, the STAI-Y was selected as an appropriate objective measure of stress. The Learning Style Inventory was also administered to the two teachers to determine their respective learning styles. While the LSI measures learning styles rather than teaching styles, McCarthy (1987) identified teaching behaviors characteristic of teachers in each of Kolb's four learning style categories.

The Learning Style Inventory (LSI) (Kolb, 1985).

The LSI (rev. 1985) is a twelve-sentence, self-description questionnaire. The respondent is asked to rank-order each of four possible endings for 12 sentences in a way that best describes how he or she goes about learning something new: (4) most like you; (3) second most like you; (2) third most like you; and (1) least like you. Each of the four endings for each sentence corresponds to one of the four learning modes or stages. "The LSI measures a person's relative emphasis on each of the four modes of the learning process:

1. concrete experience (CE)
2. reflective observation (RO)
3. abstract conceptualization (AC)
4. active experimentation (AE)

--plus two combination scores that indicate the extent to which the person emphasizes abstractness over concreteness (AC-CE) and the extent to which the person emphasizes action over reflection (AE-RO)" (Kolb, 1984, p. 68). Each of the two combination scores represents an individual's preference on each of these two bipolar continua: (1) Abstract-Concrete

and (2) Active-Reflective. First, four separate scores are obtained by adding the scores from each of the four columns of the inventory. The columns correspond to each of the four learning modes. Scores on the LSI will be tabulated on the four dimensions and the two combinations measured by the inventory. The combination scores, identified as AC-CE and AE-RO respectively, are obtained by subtracting the CE score (column 1) from the AC score (column 3) and the RO score (column 2) from the AE score (column 4). The two resulting combination scores of student and teacher were used to determine whether there was a match or mismatch between student's and teacher's learning styles. This was accomplished by subtracting the instructor's AC-CE and AE-RO scores from each of the student's respective scores. This difference represented the distance of students from their instructors.

The State-Trait Anxiety Inventory (STAI-Y) (Spielberger et al., 1983).

The STAI-Y, revised in 1983, and referred to in the literature as Form Y, is a self-administered questionnaire comprising two separate self-report scales for measuring state and trait anxiety. The student sample was administered the state anxiety (S-Anxiety) scale of the STAI-Y and the trait anxiety (T-Anxiety) scale. State anxiety is defined by Spielberger et al. (1983) as an emotional state "characterized by subjective feelings of tension, apprehension, nervousness, and worry, and by activation or arousal of the autonomic nervous system." The STAI S-Anxiety scale consists of twenty statements that ask subjects to indicate how they feel "right now, at this moment." Subjects are asked to blacken the number on

the test form to the right of each statement that best describes the intensity of their feelings: (1) not at all; (2) somewhat; (3) moderately so; (4) very much so. The STAI T-Anxiety scale consists of twenty statements that ask subjects how they generally feel. Subjects are instructed to indicate how they generally feel by rating the frequency of their feelings of anxiety on the following scale: (1) almost never; (2) sometimes; (3) often; (4) almost always.

Scores are derived from the sum of the weighted scores of each STAI item as explained in the test manual. The scores for both the S-Anxiety and the T-Anxiety scales can vary from a minimum of 20 to a maximum of 80.

The statistical measures in this study included descriptive statistics, correlational analysis, and one-way analysis of variance of all variables. In addition regression analysis was utilized for selected variables.

#### Significance of the Study

The transition from high school to college results in stress for a large number of students. Studies by Greenberg (1981, 1984) found that college students experienced a great deal of life change. O'Brien and Sothers (1984) maintained that the college years may be the most stressful in our lives. Moreover, Pond (1985) found that the biggest worry of college students was their study habits.

This study hypothesized that one of the possible academic stressors was the problem of mismatch between the learning style of students and the learning style of their teachers. There was a need to look at the

possible impact of the learning environment on the perceived stress of college students and academic achievement. There was a need to see whether a relationship existed between learning styles and the perception of stress, and whether, in fact, matches between student learning styles and teacher learning styles created less perceived stress than mismatches. No prior research was identified that determined if there was a relationship between the effects of learning style mismatch, perceived stress of students, and academic achievement. This study determined the influence of different student and teacher learning styles as measured by the Kolb Learning Style Inventory (LSI) on the perception of stress by students as measured by the Spielberger State-Trait Anxiety Scale (STAI) and on their academic achievement as measured by their course grade when adjusted for their incoming cognitive abilities. Those abilities were determined by their pre-college ACT test scores. While the precise value, significance, and application of this study to teaching and learning was not fully evident at the outset of the investigation, the exploration of the relationship between stress and student development appeared germane to the advancement of teaching and learning. Cross (1976) stated:

There is an infinite variety of things that can be done to enhance the personal development of students. Certainly the present state of knowledge about student development does not provide a legitimate excuse for anyone to sit around and wait for the right approach to student development. While research and theory provide no assurance that what we do will work, it is probably safe to assume that doing something in an informed and thoughtful way has an extremely good chance of being more helpful to students than doing nothing. (p. 169)

This study contributed to the body of knowledge regarding two aspects

of student development: stress and learning style. A greater understanding of this area by faculty and student development professionals may promote increased awareness and thereby promote student health and learning. It was intended to be one more contribution to meet Arthur Chickering's challenge (1969) "to reach students 'where they live,' . . . to connect significantly with those concerns of central importance to . . . students" (p. 3).

## CHAPTER II. REVIEW OF THE LITERATURE

### Introduction

This review of selected literature examined stress, stress and college students, and learning styles of college students. Prior research on the topics of the relationship between student/teacher learning styles and stress was examined. Through this review, variables pertinent to stress and learning styles, and commentaries on the issue were identified.

The current literature included the models of stress as well as a consideration of an individual's appraisal of a situation as stressful. In the literature there was a shift of focus from the perception of stress as a response, to stress as a stimulus, and finally, to stress as a relationship. An examination of the relationship between stress and the learning process led to a consideration of Kolb's experiential learning theory. Kolb (1984) based his theory on the learning models of Lewin, Dewey, and Piaget. The theory suggests a four-stage cycle of learning that explains how individuals perceive and process information. Individuals tend to develop differing learning strengths due to both hereditary and environmental factors which are termed learning styles. Attention was focused on the effect, if any, that learning styles had on levels of stress in the life of the college undergraduate student.

Sources for the literature search included books, journals, and scholarly papers identified by computer search of Educational Resources Information Center (ERIC) Clearinghouse. A manual search of Psychological Abstracts identified additional relevant research, and a manual search of



Dissertation Abstracts International identified relevant dissertations. The literature search also included manual searches of bibliographic indexes in Health Science, and Health Education. Searches utilized the subject titles of (a) stress and college students and (b) learning styles.

### Models of Stress

Lazarus and Folkman (1984b), Feuerstein, Labbe, and Kuczmierczyk (1986), and Weiten (1986) have classified the major theoretical models of stress into three broad categories. Briefly, stress models are either response-based, stimulus-based, or based on person-environment interaction (transactional model).

#### A Response-Based Model: Hans Selye

Hans Selye (1980), the Austrian born endocrinologist, pioneered research at the University of Montreal that investigated the response that occurred in all long-continued physical stress. Selye (1976) defined stress as the bodily response that is made to a troublesome event. He contended that the physiological changes, such as increased heart rate and endocrine secretions, in response to environmental events defined the presence of stress. Accordingly he stated that

Stress is the nonspecific response of the body to any demand. Heat, cold, joy, sorrow, muscular exertion, drugs, and hormones elicit highly specific responses. . . . All these agents, however, have one thing in common: they increase the demand for readjustment, for performance of adaptive functions which establish normalcy. This rise in requirements is independent of the specific activity that caused the increase. In that sense, the response is nonspecific. (1980, pp. 127-128)

Selye called this pattern in which the body mobilized to respond to a

demand, the general adaptation syndrome (GAS). Feuerstein, Labbe, and Kuczmierczyk (1986) noted that

During the 1930s and early 1940s Selye reported a complex response in laboratory animals to a diverse set of damaging or "alarming" agents [stressors] including bacterial infection, toxins, trauma, heat, cold, and psychological stimuli. (p. 97)

It involved three stages: (1) an alarm reaction, (2) resistance, and (3) exhaustion. The alarm reaction that Selye described earlier had been termed the fight-or-flight reaction by Cannon (1929). When asked to describe the general adaptation syndrome by McCrie (1979), Selye responded:

G.A.S. [sic] is also referred to as the biological stress syndrome. It works this way: whenever a demand is made upon us, we proceed through three stages. The first is the initial alarm reaction of surprise and anxiety caused by a new situation. The second, or resistance, stage is reached when we have learned to cope with the task efficiently and without undue commotion. And the third stage is exhaustion, a depletion of our energy reserves, which leads to fatigue. (p. 174)

Continued stress in this final stage may result in exhaustion and the likely onset of diseases of adaptation including kidney disease, arthritis, and cardiovascular disease (Gatchel & Baum, 1983) and ultimately to death (Rathus, 1987). Stress has been shown, however, to take a toll on the body even when the effects were not catastrophic.

Selye (1976) indicated that

Experiments on animals have clearly shown that each exposure leaves an indelible scar, in that it uses up reserves of adaptability which cannot be replaced. It is true that immediately after some harassing experience, rest can restore us almost to the original level of fitness by eliminating acute fatigue. But the emphasis is on the word almost. Since we constantly go through periods of stress and rest during life, even a minute deficit of adaptation energy every day adds up--it adds up to what we call aging. (p. 429)

Selye's research on stress and the identification of the GAS draws attention to the nature of stress and its effects. Moreover, it identified for both researchers and practitioners, the interaction of mind and body in the determination of the onset of disease.

A Stimulus-Based Model: T. H. Holmes and R. H. Rahe

The stimulus-based model of stress emphasized characteristics of the environment that are threatening or disruptive to the individual. Feuerstein, Labbe, and Kuczmiarczyk (1986) developed a model based on engineering principles; here stress was defined in terms of the reaction to external stressors or stress that produced strain in the individual. Holmes and Rahe (1967), U.S. Navy physicians, focused on the environmental events as the "stress." According to Holmes and Rahe, stressful life events were related to physical illness. They developed the Social Readjustment Rating Scale (SRRS), a scale to measure the cumulative amount of stress from forty-three life changes or events, both pleasant and unpleasant, which had empirically been found to be important for most people (Holmes & Rahe, 1967). Rahe (1979) noted that this list "was designed to sample from these key areas of life adjustment, rather than to cover all possible life change events" (p. 3). Stress was quantified by measuring the events in terms of life change units (LCUs). Marriage was arbitrarily assigned 50 LCUs on a 100-point scale and samples from the general population rated them according to the amount of readjustment required for each change, as compared with marriage (Masuda & Holmes, 1967). Each of the events was weighted accordingly. Stressful life

events included such situations as divorce (73 LCUs), death of close family member (63), change in responsibilities at work (29), and vacation (13).

In taking the scale the subject is asked to indicate how often they experienced any of these events over a period of time (usually one year). The subject then totals the numbers associated with each event checked to arrive at an index of how much change-related stress the individual has experienced. The researchers found that Navy personnel who had experienced unusually high levels of life stress during the preceding twelve months were more likely to develop a wide range of medical problems while on sea duty than individuals with lower life change unit scores. Holmes (1979) reported that over 1000 studies had been conducted with the SRRS to date.

#### A Transactional Model: R. S. Lazarus

The transactional model of stress as described by Lazarus (1976, 1981) integrated the stimulus- and response-based models. Taylor (1986) observed that "most current definitions of stress emphasize the relationship between the individual and the environment" (p. 145). Stress as defined by Lazarus and Folkman (1984b) "is a particular relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering his or her well-being" (p. 19). Stress involves stimulus-response transactions that require adaptation and tax the individual's resources. What makes an event stressful is the degree to which it is perceived as threatening,

harmful or challenging (Lazarus, 1966).

In their analysis of Lazarus's contribution to current understanding of the stress concept, Gatchel and Baum (1983) described Lazarus's theories as "almost exclusively psychological as Selye's are physiological. . . . By pointing out that stressors can be psychological, Lazarus (1966) made the study of stress more complex and challenging" (pp. 50-51). Stress was defined as a state of alarm produced in an individual due to a perception of threat. Lazarus's model of stress and coping was classified as an organism-environment transaction because stress was dependent on an intervening process, individual cognition, and was not dependent solely on specific situations or specific responses. Derogatis (1982) observed that theorists such as Cox and McKay (1978) and Lazarus (1976, 1981) describe "a dynamic cybernetic system in which reciprocal interactions occur between the individual's cognitive, perceptual, and emotional functioning, on the one hand, and the characteristics of the external environment, on the other" (p. 272).

Rose (1980) pointed out that early models of stress did not emphasize psychological factors. This was primarily due to the fact that early stress research was conducted on animals, with the goal of identifying endocrinological concomitants of stress. However, as work on human populations progressed, the importance of psychological factors became evident. Lazarus (1966) emerged as an early proponent of the psychological view of stress.

Lazarus and Cohen (1977) described three general categories of

stressors that were characterized by the following characteristics: how long the stressor persists, the magnitude of response required by the stressor, and the number of people affected. Gatchel and Baum (1983) summarized the descriptions of these three basic sources of situational stress: (1) cataclysmic events, "stressors that have sudden and powerful impact and are more or less universal in eliciting a response" (p. 55); (2) personal stressors, "include those events that are powerful enough to challenge adaptive abilities in the same way as do cataclysmic events, but that affect fewer people at any one time" (p. 56); and (3) background stressors or daily hassles--"stable, repetitive, low-intensity problems encountered daily as part of one's routine" (p. 57). Cataclysmic events, such as war or a natural disaster, resulted in less psychological damage than personal stressors (illness, death, personal failure) because they involved more people who were able to support one another and share their emotions. Lazarus and Cohen (1977) viewed the third category, daily hassles, as particularly harmful in terms of their long-term cumulative effect. Nevertheless, a crucial factor in the determination of any situation as stressful was the appraisal process. Gatchel and Baum (1983) stated that environmental, social, and psychological variables affect the interpretation of stressors and "the array of . . . variables associated with each encounter with stress determines response" (p. 59).

In Lazarus's model of stress, individuals engage in a cognitive-phenomenological process when they confront a new or changing environment. This process of cognitive appraisal involves continual reevaluations of

Judgments regarding demands and limitations of the environment and of the individuals' ability to adjust or cope. "Cognitive appraisal is thus an intervening variable between the stimulus of the stressor and our response to it" (Zimbardo, 1985, p. 457). Cognitive appraisal involves two steps: (1) primary appraisal, and (2) secondary appraisal.

Primary appraisal refers to the cognitive process of evaluating the seriousness of the demand for one's well-being. An individual may judge the situation in one of three ways: that the demand is (1) irrelevant, (2) benign-positive, or (3) stressful. If the perception is that the demand is irrelevant then it can be ignored. A benign-positive evaluation suggests a judgment that the situation is beneficial or desirable. Stressful appraisals involve judgments of harm-loss, threat, or challenge. Of the three, challenge is the most positive one.

Coyne and Lazarus (1980) maintained that:

the person's current time perspective is important in distinguishing between harm-loss and threat. Harm-loss refers to damage already sustained, such as loss of significant relationships or social roles, blows to self-esteem, or incapacitating injury or illness. Threat refers to the same type of damage but involves an anticipation of what has not yet happened. Field studies of the stress of a complex event, such as serious illness or injury, suggest that harm-loss and threat can occur as alternating or concurrent themes as the person appraises and reappraises harm that has occurred and threats to well-being that may result from the harm (Hamburg, Hamburg, and deGoza, 1953; Visotsky et al., 1961). Thus, a stroke victim might focus on the resulting paralysis and speech and thought disturbance, or the threat of a recurrence, or both, as he or she attempts to come to terms with the condition (Moss, 1972, pp. 150-151).

Primary appraisal, then, is concerned with the stake a person has in a stressful encounter. This judgment as to whether or not one is "in trouble" leads an individual to secondary appraisal which refers to the

options for coping, answering the question "What can I do about it?"

According to Coyne and Lazarus (1980):

Secondary appraisal refers to the person's ongoing judgments concerning coping resources, options, and constraints. The essential difference between primary and secondary appraisal is in the content of what is being evaluated. Actually, the evaluative processes are highly interrelated and even fuse. A firm sense of self-efficacy (secondary appraisal) can lead one to appraise transactions as benign or irrelevant that would otherwise be threatening; in contrast, if one believes that his coping resources are depleted, then he may perceive a transaction as threatening where it otherwise would not be." (p. 153)

Closely related to the concept of appraisal is that of coping.

Lazarus and Folkman (1984a) defined coping as "the process of managing demands (external or internal) that are appraised as taxing or exceeding the resources of the person" (p. 283). The term "coping" was distinguished from "adaptation" in that the definition of coping includes only nonroutine acts that require the mobilization of effort" (p. 284) as distinguished from adaptation, the process of developing automatic patterns that take over when stressful events occur. Furthermore, they maintained the interdependence of coping and appraisal, "because many coping strategies can have an appraisal function in that they shape the meaning of an event, and . . . many forms of appraisal can have a coping function in that they help regulate stress" (p. 293). Coping was viewed in terms of its effect on adaptational outcomes and its implications for health maintenance and restoration as well as for the improvement of morale and social functioning. Just as stress can be psychologically positive or negative, the means of coping can be effective or ineffective in meeting the challenge presented by the stressful situation. Lazarus



and Folkman (1984b) have developed a "Ways of Coping" checklist (pp. 328-333) to assess coping by having individuals "reconstruct recent stressful encounters and describe what they thought, felt, and did" (p. 318).

Research on coping continues in order to ascertain the stability of coping across diverse stressful situations and the relationship of coping processes to somatic health and psychological symptoms (Folkman, Lazarus, Gruen, & DeLongis, 1986).

Lazarus and Folkman (1984b) questioned the concept that has dominated the measurement of stress, the assessment of major environmental changes or life events: death of a spouse or a friend, divorce, marriage, retirement, or being fired. They contended that serious defects existed in the major assumptions of this line of research: first, that change alone is stressful; and second, that life events must be major in order to create stress of sufficient magnitude to impair health. While major setbacks may significantly affect the health of an individual, the link between life events and illness was not found to be invariable. Lazarus and Folkman stated that "Life events have little practical significance in the prediction of health outcomes, but this approach is pursued because it is simple to administer, and there is hope that modifications will prove fruitful" (p. 326). Lazarus (1981) contended that daily hassles, "the irritating, frustrating, or distressing incidents that occur in our everyday transactions with the environment" (p. 58), were better predictors of health outcomes than life events.

To measure stress Lazarus and his colleagues developed a

questionnaire listing 117 hassles, common annoyances that occurred at work, among family and friends, or in other contexts. Kanner, Coyne, Schaefer, and Lazarus (1981) described the Hassles Scale and the results of a research study conducted in Alameda County, California. In addition to the Hassles Scale, several other measures were also used: (1) the Uplifts Scale, a 135-item questionnaire, developed by the research staff that had developed the Hassles Scale, which listed positive experiences including relaxing, spending time with family, using skills well at work, praying and nature; (2) a life events scale developed by Paul Berkman from in-depth interviews of the recent life stresses reported by a sample of 100 middle-aged respondents; (3) the Hopkins Symptom Checklist (Derogatis et al., 1970, 1971, 1974) which includes psychological symptoms that are particularly likely to show short-term changes; (4) the Bradburn Morale Scale (Bradburn and Caplowitz, 1965), a widely used index of psychological well-being; and (5) a health status questionnaire. A sample of 100 individuals between the ages of 45 and 64 took the Hassles Scale and the Uplifts Scale once a month for 10 consecutive months. Additionally, the instruments mentioned above were administered to the subjects.

Kanner and his colleagues found that the Hassles Scale was a better predictor of concurrent and subsequent psychological symptoms than were life events. When the effects of life events scores were removed, hassles and symptoms remained significantly correlated. Regression analysis showed hassles to be a considerably better predictor of psychological symptoms than life events. Uplifts were positively related to symptoms

for women but not for men. The researchers concluded that "chronic daily hassles provide a more direct and broader estimate of stress in life than major life events" (p. 20) and that the "capacity of the Hassles Scale to correlate with adaptational outcome measures quite clearly justifies its use" (p. 21).

Regardless of how researchers conceptualized stress, it was always part of a sequence of events that began with environmental demands and culminated in an outcome. The differences among the three models occurred in the emphasis placed on the various parts of this sequence. The response-based model focused on the physical and emotional outcomes of stress. The stimulus-based model highlighted environmental demands. The transactional model directed primary attention to the process intervening between situational demands and outcomes. Lazarus's transactional model was identified as representative of the current perspective in the research literature.

Stress is part of every person's life experience. Situations that provoke stress differ widely depending upon the respective developmental stage of life that an individual is going through and the coexisting environment. Stressors that affect undergraduate college students are unique to the environment in which the students function and the subjective perceptions of the world and their place in it.

### **Stress and College Students**

While older students enrolled in college in greater numbers, the great majority of college students were between the ages of 17 and 25.

Stress was identified as a significant problem for this group. Powell and Eagleston (1983) stated that

Many college students undergo considerable stress due to the demands associated with change: leaving home, becoming independent decision makers, and competing against new standards. Some experience the transition with excitement as they face the challenge of setting up a new routine. . . . Others regard the change as a threat, appearing tense and hyperactive, reporting somatic problems, and expressing dissatisfaction with their school work, social relationships, and life in general. (p. 23)

Several researchers have studied the sources and significance of stress for college students. Duke and Nowicki (1986) concluded that "in college, students may be subjected to severe stresses and many are often ill-prepared to cope with them in terms of their own identity, self-confidence, and vocational direction" (p. 452). Greenberg (1987) categorized the major stressors for the younger college student (one who enters college from high school or shortly thereafter) as being: (1) stressors associated with life-style change, (2) academic stressors, and (3) interpersonal stressors. "College life involves assuming greater responsibility for one's life, making new friends, a great deal of study, and learning about a new environment" (p. 285). On the other hand, Nowicki and Duke (1978) found that in addition to vocational guidance, students sought help at the Emory University counseling center for problems in three categories they defined as: (1) existential depression, (2) social problems, (3) parental problems. Despite differences in descriptors, these findings concerning the sources of stress for college students were virtually the same. According to Lazarus's categorization, the above stressors were either personal stressors or background

stressors, i.e., daily hassles. This portion of the review of literature examined evidence of stress among college students, in general, as well as stress connected with the learning experience.

Whitman, Spendlove, and Clark (1984) reported that "a critical issue concerning stress among students is its effect on learning" (p. 1). That excessive stress resulted in lowered performance was well documented (Yerkes & Dodson, 1908; Hockey, 1979). This section of the review of literature examined the relevant literature regarding college students and their appraisal of stress. Prior research which identified sources of stress (stressors) for college students was also examined. Referring to Lazarus's model, Whitman et al. (1984) stated that it

provides a useful framework for analyzing psychological stress experienced by students. The educational environment combined with students' thoughts and psychosocial backgrounds form the essential ingredients necessary to understand stress among students. (p. 10)

Whitman, Spendlove, and Clark (1986) reviewed and discussed the literature describing student stress in the context of the learning environment. The stated purpose of their report was "to help college faculty increase students' learning by reducing stress among students" (p. 111). In their report, Whitman and his colleagues summarized the research literature on the effect of stress on learning, the role of the teacher in motivating students, and offered guidelines for college teachers regarding the cause, recognition, and reduction of stress among their students. They concluded that the behavior of college teachers affected student stress and suggested ways in which teachers might modify their behavior in order to reduce stress. In addition they noted the importance of

positive faculty-student interactions both inside and outside of the classroom as contributing factors to the educational objectives of higher learning. To promote relationships, they encouraged "professional intimacy," a term borrowed from Whitman and Schwenk (1983) that describes a relationship between teacher and student which is characterized by honesty and openness on the part of the teacher. "Faculty who are professionally intimate often become role models [or mentors] for students" (p. 35). This relationship encourages learning and expands the learning process. Whitman et al. (1986) then examined the topic of stress awareness, describing a college environment in which teachers were provided with information to help them recognize stress reactions in students. Further, the researchers offered a summary of stress-reduction strategies that teachers could provide for students to help them moderate stress.

In their concluding recommendations, Whitman et al. (1986) observed that research on stress among college students needs further investigation.

The research on stress in higher education--including its effects on learning and how best to work with it in the institution and the classroom--is still in its infancy. The third edition of the Handbook of Research on Teaching (Wittrock, 1986), a project of the American Educational Research Association, underscores this lack of research in that the word "stress" does not even appear in the subject index, test anxiety is barely mentioned in a few paragraphs. . . . (pp. 65-66)

Citing the results of the nationwide study of 200,000 college freshmen conducted by Astin (1986) as further justification for the need for research in this area, Whitman et al. (1986) noted the following findings:

(1) Eight percent of the students surveyed reported they felt depressed frequently; (2) 16 percent said that they frequently felt overwhelmed. Additionally, they offered the findings of Hirsch and Kenniston (1970) that approximately 50 percent of entering freshmen did not graduate from college, "a decision associated with intense anxiety and stress and the combination of a long process of growing dissatisfaction" (p. 66). Whitman et al. (1986) have pointed out the significance of stress in the lives of college students as well as the fact that further research is necessary.

Mucowski (1984) discussed six common situational stressors identified from records by counseling center personnel that affect the new college student's learning process. Those were: (1) a previously "shaky" academic record; (2) social and interpersonal distractions; (3) family crises; (4) financial stresses; (5) a confused career direction; and (6) situational experiences, such as health problems. All of them have the net effect of inhibiting students' academic success. Believing that colleges have the sources for helping students in place, Mucowski maintained that the chief problem was to help students know and to use the services when necessary. He suggested that specific programs be better publicized at appropriate times during the academic year in order to stimulate the interest of students who needed assistance. For instance, before examination periods clinics on study skills and the reduction of test anxiety would be held while other programs (e.g. "women's issues" groups, alcohol education courses) would be offered throughout the year.

Mucowski's essay points up the problem of reaching students who need help to deal with stress, but who may not be aware of the effects it has on their energy, concentration, and motivation to do schoolwork.

Archer and Lamnin (1985) surveyed a random sample of 893 undergraduate students at the University of Florida to determine academic and personal stressors as part of a campus-wide stress management program. Students were asked to describe two situations or conditions they found to be both personally and academically stressful. The researchers developed 16 categories for the academic stressors and 17 categories for the personal stressors. The frequency and percentage of combined stressor responses (first and second choice) were calculated for each personal and academic stressor. A chi-square test of proportions was used to determine differences in stressors reported between various groups which included analyses of sex, age, residence group, and ethnic or racial differences. The major academic stressors identified were four: tests (52%), grade competition (28%), time demands (21%), professors and classroom environment (18%). Major personal stressors included intimate relationships (37%), parental conflicts (29%), finances (27%), and interpersonal conflicts with friends (13%).

The researchers observed that "one interesting stressor category, professors and class environment, was listed by 18% of the sample" but specific aspects concerning "professors or class environments" were not identified. They suggested that further study of classroom stressors and stressors related to professors would yield "useful information to



professors about the classroom environment and those aspects that students perceive as stressors." The findings and recommendations supported the decision to explore the relationship of stress and the learning styles of college students and their professors.

Eisler (1984) discussed the implications of social skills training for individuals who either lack social skills or have learned maladaptive social behaviors. Teaching social coping skills was presented as a viable alternative to treating the symptoms resulting from excessive stress. The development of interpersonal skills was explored from the perspective of the maintenance of psychological and physical health and the prevention of disorder. Using Lazarus's definition and conceptualization of stress, Eisler maintained the importance for adjustment of an individual's ability to cope with everyday stress: "One common thread appears to be the individual's ability to cope with a diversity of life's challenges" (p. 354). Eisler reviewed the pertinent medical and psychological research pertaining to his thesis as well as the merits of various social skills training programs. This study illustrated the application of the Lazarus stress/coping paradigm as a basis for health enhancement strategies.

Hoffman and Weiss (1986) proposed a new system for conceptualizing college students' problems, the Inventory of Common Problems (ICP). The personnel in university counseling centers need to determine at the time of the intake evaluation, the nature of the student's crisis, treatment goals and expectations, as well as the particular problem a student is experiencing. The ICP was developed for this purpose. It consisted of

six subscales: depression, anxiety, academic, interpersonal, physical health, and substance-use problems. After the initial development of the 24-item Likert-type scale questionnaire, researchers administered it to a random sample of 400 undergraduate college students at the University of North Carolina. The highest mean ICP scale score was for academic problems. That academic problems were stressful for a significant percentage of undergraduate college students bolstered the relevance of an investigation of the relationship between learning style and stress.

Greenberg (1984) utilized a one-group pretest-posttest design to investigate the impact of stress resulting from life changes on the health of undergraduate college students. He administered the College Schedule of Recent Experience (CSRE), a modification of the Holmes Rahe Schedule of Recent Experience, a Health Index, and a lie scale to 308 students enrolled in required physical education classes at a major northeastern university. Subjects whose lie scale scores were indicative of dishonesty were eliminated from the analysis. Frequency distributions were computed for responses on the CSRE and the Health Index. Chi-square analyses were conducted to determine whether any differences existed between the low stress and high stress groups on the variables of class in school, sex, marital status, living arrangement, and race. Analysis of variance was employed to determine differences between the low stress and high stress groups on the Health Index scale on the pre-test. Analysis of covariance was performed to determine differences between the low stress and high stress groups on the Health Index for post-test 1 and post-test 2, using

the pre-test Health Index scores as the covariate. When differences between the low stress group and the high stress group were compared on their pre-test Health Index scores, the low stress group reported less illness/disease than the high stress group. Analysis of variance showed this difference to be statistically significant. However, there were no differences on the Health Index between low stress and high stress groups on the two posttests. The researcher suggested that the "anticipation" of the life changes making up the CSRE might be worse than the actual experience of the changes. Greenberg (1984) cited Girdano and Everly in support: ". . . most of the stress you experience is a function of your perception, the meanings and interpretations you give to situations in your life" (p. 14). Greenberg offered an alternative interpretation, suggesting that the preparation, rather than anticipation, of a life change one knows to expect requires adaptive energy. The preparation for a life change event was more stressful than the actual life change. He suggested that longitudinal studies are needed to determine the seasonal and cyclical effects of stress and life changes upon health, and to determine whether the anticipation, preparation for, or the actual experience of life changes damages health status the most. This study revealed the shortcomings of the use of measures of life event changes. It suggested that measures such as the CSRE may not be the most effective kind of instrument to measure stress.

Westefeld and Pattillo (1987) surveyed 178 college and university counseling center directors to determine whether record-keeping procedures

in the area of student suicide existed and, if so, the nature of these procedures. Only 20 of the 147 responding directors indicated that their institutions compiled systematic records concerning student suicide attempters and completers. There was a significant relationship among institutions keeping records about suicide attempters and suicide completers. If the institution collected data concerning one group, it was likely that data concerning the other group would also be collected. Further, records of suicide attempters were more likely to be compiled by smaller institutions. There was no relationship, however, between institutional size and the records of suicide completers. The establishment of a national clearinghouse for compiling data on attempts and completions was advocated by the researchers. Without such a mechanism, the problem of insufficient and inaccurate data prevents colleges and universities from effectively understanding the problem and responding to the problem of student suicide. This study provided further evidence of the institutional response to students who experience overwhelming stress. For reasons that were not clear, but could only be conjectured, many institutions preferred to ignore a serious problem. While suicide estimates are often quoted, this study revealed that reliable data was nonexistent.

Meier and Schmeck (1985) investigated the phenomenon of burnout among college students, using the term burnout as defined by Meier (1983): "diminished expectations for work rewards, accompanied by physical and emotional exhaustion" (p. 63). The researchers developed and validated a

measure of student burnout, and showed that burnout was related to measures of memory, learning style, self-esteem, vocational self-concept, and sensation seeking. The sample was 120 male undergraduate students enrolled in introductory and advanced psychology courses at Southern Illinois University at Carbondale. Their results indicated that burned-out instructors and students may influence one another, creating a downward spiral of decreasing satisfaction. While teachers may burn out because their burned-out students cannot demonstrate the learning progress that teachers value, students may burn out because of the lack of caring and the boring routine in classes taught by burned-out teachers. The results of this study illustrated that teacher-student interaction affects the learning process, particularly, in terms of learning styles and stress.

Irvine (1984) evaluated the possible benefits of a ten-hour, credit (1 hr) course stress management mini-course for college students in a pilot study at Ohio State University. The goal of the course was consciousness-raising, i.e., that students would become more aware of stressors and could learn to practice selected stress management techniques in their everyday lives. Objectives for students included the following: (1) understanding of the theoretical relationship of stress and health; (2) identification of stressors in their own lives; (3) practice of selected stress management techniques; and (4) documentation of such techniques in daily living. The findings of Irvine suggested that the awareness of stressors might have beneficial effects for students.

Tracey and Sherry (1984) noted that "although student personnel as a field has endorsed models of human behavior that address person-environment fit . . . , relatively little research has been conducted using this focus." They assessed relationships of several person, environment, and person-environment fit measures to several indicators of student distress and strain. The researchers surveyed a stratified random sample of five residence halls (1 floor per residence complex), involving 316 students at a large northeastern university. Instruments used included The University Residence Environment Scale--short form (Moos & Gerst, 1974), 14 items from the Biographical and Experience Questionnaire (Moos & VanDort, 1979) to measure the frequency of physical symptoms, and the State-Trait Anxiety Inventory (Spielberger, Gorsuch, & Lushene, 1970) to measure state anxiety. The construct of actual discrepancy--the extent to which one's preferences fit with the actual environment--was developed as a measure of person-environment fit. The researchers found that actual discrepancy was superior to other variables in explaining distress and strain and could be used to help student affairs professionals identify students most likely to experience distress and suggest preventive steps. The significance of this research for the current study lay in its focus on "person-environment fit." If living arrangements were stressful for some students who were mismatched, then research regarding possible stress and the match/mismatch of teacher/student learning styles might be useful.

The review of the limited research on stress and college students indicated researchers endeavored primarily to identify stressors and the

effects of stress on college students. Two particularly relevant studies were those of Archer and Lamnin (1985) and Meier and Schmeck (1985). Although Archer and Lamnin (1985) did identify the professors and class environment as a stressor, they did not pursue the matter in any depth. Additionally, the research of Meier and Schmeck (1985) noted the need to investigate teacher-student interaction in the context of the learning process. While there was a general agreement in the literature that college students experience stress, and that college student personnel services and faculty ought to react to this fact, an emerging focus for action was lacking. While academic stress was identified as a significant area of stress, research concerning student/teacher learning styles and stress was found lacking. The next section of the review of the literature first described representative learning style models. Then it examined the research concerning the construct of learning style within the context of D. A. Kolb's theory of experiential learning and relevant studies concerning the Learning Style Inventory (LSI) developed by D. A. Kolb.

### Learning Styles

In the discussion of stress and college students, the recurring theme in the research was: "Now that we know the sources of stress, what can we do to help those students who are experiencing stress?" Indeed, professional education is very much oriented toward an active and pragmatic mode. In an interview with Garfield and David (1986), Arthur

Arthur Chickering remarked that:

A critical human and social problem is how to help people understand themselves and understand different alternatives in more complex ways so they can fashion a fit between themselves as unique, creative, and growing persons and those resources and alternatives out there in an effective way. (p. 490)

Helping people to understand themselves and the available alternatives in order to fashion a fit . . . is a significant educational objective within the overall framework of American higher education. The learning process has an impact on individuals in that it moves them from potency to act, from the realm of possibilities to the actualization of those possibilities. It is necessary to better understand the learning process in order to see whether different approaches to learning, that is, learning styles, create stress for college students.

#### Models of Learning Styles

Kuerbis (1988) stated that "learning style is a term educators use to describe the way we perceive, interact with, and respond to the learning environment" (p. 3). While learning style has been defined in different ways by various researchers, these definitions tend to describe a consistency in the way learners function. While estimates of the number of instruments developed to identify learning styles varied, sometimes calculating as many as 120, Jensen (1987) stated that 30 instruments have been developed since 1960. The models described in this section represented three differing theoretical perspectives: (1) a perceptual model, (2) a personality model, and (3) a holistic model.



Perceptual Model: H. A. Witkin

Witkin, Lewis, Machover, Meissner, and Wapner (1954) developed a learning style theory based on personality differences in individuals that they identified as field-independent and field-dependent. The research of Witkin et al. grew out of an interest in perception and the distinction between analytical, or field-independent, and global, or field-dependent, modes of perceiving objects and patterns. Their model suggested that these traits were the extremes at either end of a continuum, and that all individuals were inclined in one direction or the other to some degree and these modes of perception determined their approach to learning. The Embedded Figures Test (Witkin, 1969) is one of several instruments currently used to classify an individual's style in the field-independent/field-dependent dimension.

The term "field-independent" identified persons who were able to "overcome effects of distracting background elements (the field) when they attempted to differentiate the relevant aspects of a particular situation" (Dembo, 1988, p. 69). Field-independent persons were able to see the individual aspects of a situation. They were more task-oriented, more analytical, less anxious, and less dependent on social reinforcement. Field-independents were problem solvers who could take unstructured learning material and learn it more easily because they had the ability to readily organize the material.

Field-dependent individuals tended to focus upon the whole and overlook individual elements or be distracted by irrelevant elements.

Moreover, they tended to be more social and relationship oriented.

Hamachek (1987) noted:

Adults who were field-dependent were inclined to be passive and submissive to authority, to be afraid of their sexual and aggressive impulses, and to have low self-esteem and self-acceptance. In general, they were people who were quite dependent on environmental supports. (p. 124)

This description of typical traits of field-dependents should not be viewed as a negative judgment of field-dependents. Witkin, Moore, Goodenough, and Cox (1977) identified field-dependents as reflecting a considerable degree of social sensitivity. They were people oriented, an asset in developing interpersonal relationships. Field-dependent college students tended to major in fields that required a global perspective (e.g., the humanities, the social sciences, education, and social work).

Cross (1976) maintained that "traditional education favors the field-independent and that it is no accident or mere coincidence that students who do not do well in school have some important characteristics in common with field-dependents" (p. 124). The field-independence/field-dependence dimension is a widely investigated construct and has been used to describe learning style differences among minority students, particularly African-American and Hispanic students (Anderson, 1989). Reacting to the issue of the effect of culture on the construct, Guild and Garger (1988) cited the research of Ramirez and Castaneda who found that Mexican-American children had a tendency toward field-dependence and that their culture values characteristics of the style. Guild and Garger (1988) suggested that the socialization process within the family and sub-culture may affect

learning style just as it affects other behaviors.

Personality Model: I. B. Myers and K. Briggs

Provost and Anchors (1987) reported that Isabel Myers and Katherine Briggs began their research on personality typing and the development of the Myers-Briggs Type Indicator (MBTI) (Myers, I. B. & Briggs, K. C., 1975), a personality inventory, in the 1940s. It first appeared on the market for research purposes in 1962 and, in 1975 became available to qualified professionals. Eison and Pollio (1985) reported that "several reviews of investigations using the MBTI in educational settings have indicated that it successfully predicts various educational variables significant for the teaching and learning process" (Claxton & Raiston, 1978; Hoffman & Betkowski, 1981; McCaulley, 1974).

The MBTI rests on the theoretical base of Carl Jung's personality types, part of his comprehensive theory of analytical psychology (Jung, 1921). Jung's theory is considered to be a psychodynamic theory in the tradition of Freud. Psychodynamic theory presumes that the functioning of a dynamic unconscious is an integral part of human personality, and that the mind is "topographical and dynamic; that there are . . . divisions that are always moving and interrelating" (Levin, 1978, p. 431). Myers and Briggs extracted the element of Jung's psychological types and used it as the foundation for the development of their instrument, the MBTI.

The MBTI assesses the relative strengths of four pairs of contrasting variables: (1) Perception: Sensing (S) or Intuition (N); (2) Judgment: Thinking (T) or Feeling (F); (3) Attitude toward life: Extroversion (E) or

Introversion (I); and (4) Attitude toward the outer world or lifestyle: Judgment (J) or Perception (P). In each of the pairs, one mode is the preferred mode for each individual. 16 personality types and "16 approaches to learning" (Jensen, 1987) result from the various combinations of the foregoing eight possible orientations. While the MBTI is primarily an assessment of personality type, Jensen (1987) described the relationship between personality type and learning style: "Once the student's type is identified, teachers can make predictions about how that student learns best, which may or may not be consistent with his or her behavior, and suggest alternative methods of study" (p. 182).

Student development specialists have made extensive use of the MBTI. It has been used in a variety of ways as a counseling and advising tool, and as a way to evaluate learning styles.

#### Holistic Model: D. A. Kolb

Kolb (1981a) defined learning styles as "preferences for one [learning] mode of adaptation over the others" (p. 290). Rather than conceptualizing learning styles as fixed personality traits, Kolb (1984) explained them as

possibility-processing structures resulting from unique individual programming of the basic but flexible structure of human learning. These possibility-processing structures are best thought of as adaptive states or orientations that achieve stability through consistent patterns of transaction with the world. . . . (pp. 95, 97)

The theory and model which encompasses the construct of learning styles is referred to as "experiential learning theory." It cannot be accurately described as either a behavioral or as a cognitive theory.

Kolb (1984) described experiential learning theory as "a holistic integrative perspective on learning that combines experience, perception, cognition, and behavior" (p. 21) based on the common characteristics in the learning models of Lewin, Dewey, and Piaget. The research of Kolb (1981a), while employing different measures, nevertheless extended the observations of Liam Hudson (1966). According to Costley and Todd (1987), Hudson had identified two classes of students labeled convergent thinkers and divergent thinkers. Convergent thinkers "did best in tasks that required following rules, utilizing systematic approaches to problem solving, and careful detail" (p. 525). Divergent thinkers, on the other hand, "were more imaginative, less organized, and less precise, and seemed to rely more on their feelings than on logic" (p. 525). Hudson hypothesized that divergents assigned to convergent tasks would not be successful while convergents assigned to divergent tasks would, at best, be dissatisfied. Costley and Todd observed that "Kolb . . . has extended Hudson's original studies and has developed a strong body of evidence that people have different preferred learning styles. . . . Their styles of learning, to some extent, determine their job preferences" (p. 525).

Kolb's perspective on experiential learning defined learning (experiential learning) as the "process whereby knowledge is created through the transformation of experience" (1974, p. 38). Underlying this definition are four critical aspects of the learning process: (1) an emphasis on the process of adaptation and learning as opposed to content or outcomes; (2) that knowledge is a transformation process, continuously

created and recreated, rather than an independent entity to be acquired or transmitted; (3) that learning transforms experience in both its objective and subjective forms; and (4) that in order to understand learning we must understand the nature of knowledge, and vice versa.

A major advantage of this model is that it takes into account the fact that learning is a continuing process of interaction with the experiences in one's life, past and present, as well as the tensions caused by them. Kolb (1974) proposed a single process, conceptualized as a four-stage cycle, that describes how it is that people generated from their experience, "concepts which in turn are used as guides in the choice of new experiences" (p. 28). Kolb's model suggests that learning style is a result of three variables: "As a result of our hereditary equipment, our particular past life experience, and the demands of our present environment, most people develop learning styles that emphasize some learning abilities over others" (p. 29).

An individual's learning style at any given moment is shaped by: (1) the individual's personality disposition toward introversion and feeling; (2) one's undergraduate specialization; (3) the individual's professional academic career commitment; (4) the demands of an individual's current job; and (5) the specific task (s)he is working on. Conversely, learning style shapes the individual in that there is a tendency to deal with life situations from the strengths of one's unique style (Kolb, 1981b). And thus, the fundamental characteristics of learning style are reflected in teaching, management, and leadership styles (McCarthy, 1987; Guild &

Garger, 1988).

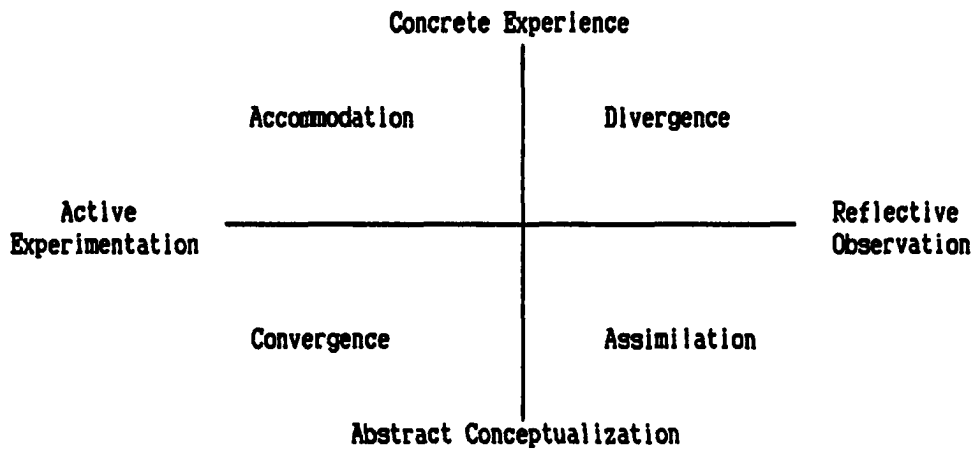


Figure 2. Kolb's learning style model

The four steps of this model (Figure 2) represent two distinct, independent, bipolar dimensions of learning theory. The first dimension characterizes how individuals perceive or take in new information. It involves the choice between concrete (sensing/feeling) and abstract (thinking). The second dimension describes the manner in which individuals process what they take in. It involves the choice between active (doing) and reflective (watching). Kolb held that highly individualized styles of information utilization are developed on each of these bipolar dimensions. It was Kolb's premise, however, that effective learners rely on all four learning modes.

To assess an individual's learning style, Kolb (1976) developed the Learning Style Inventory (LSI) which was revised in 1985. The four quadrants of the grid represent the four statistically prevalent learning styles of Kolb's model. They are converger, diverger, assimilator, and

accommodator.

**Converger:** This type, as characterized by Kolb, emphasizes abstract conceptualization (AC) and active experimentation (AE) and works best when there is a single correct answer to a problem. . . . Convergers tend to be relatively unemotional and prefer working with things rather than people; they also tend to have narrow interests and are most often found in the physical sciences and engineering.

**Diverger:** The major learning orientations of this type are concrete experience (CE) and reflective observation (RO). The diverger's major strength is his imaginative ability. . . . These individuals are good at generating ideas or brainstorming. This type tends to enter fields such as counseling, personnel management, or organizational development.

**Assimilator:** The primary orientations of this type are reflective observation (RO) and abstract conceptualization (AC). Their major strength is in creating theoretical models, as they enjoy assimilating diverse items into an integrated whole. . . . This type tends to specialize in science and math and often works in research and planning areas of organizations.

**Accommodator:** The accommodator has concrete experience (CE) and active experimentation (AE) as his major learning orientations. This type focuses on doing things and on having new experiences. . . . The accommodator tends to use a trial and error approach to problem solving and often appears impatient or pushy to others. He tends to enter field that are technical or business-oriented and likes action-oriented jobs such as sales and marketing.

Younger individuals tend to emphasize specific modes of the learning process as illustrated by each of the learning styles. As individuals progress through later developmental stages, however, there is a tendency toward using those modes that have been previously neglected, leading to integration among the four modes. Kolb did not advocate tailoring all instruction to the student's learning style. Kolb believed that it was important, however, for students to identify their preferred learning style in order to capitalize on their own particular strengths.

Concurrently, they should be helped to develop in other learning modes in



which they lack competence. McKeachie (1978) reported that

Research (Pascal, 1971) on giving students options between different methods of learning, such as independent study, lectures, or discussion, suggests that students realize little benefit from such choices. Perhaps one of the problems is that many students are unable to identify their own most effective style. (p. 240)

Rather than being prescriptive, the LSI is a tool for self-evaluation and an aid to self-development. For the teacher it serves as a guide for helping students to realize increased learning competence, particularly in those modes which need to be strengthened.

Kolb's model of experiential learning is based on a number of assumptions grounded in theory and research. These assumptions serve to clarify the nature of the learning and problem solving process as perceived by Kolb. They are:

- (1) learning and problem-solving are a single process.
- (2) learning/problem solving, as a process, is both active and passive, concrete and abstract. This single process consists of a four-stage cycle: (a) concrete experience is followed by, (b) observation and reflection which leads to, (c) the formation of abstract concepts and generalizations which lead to, (d) hypotheses to be tested in future action which leads to new experience.
- (3) The four-stage cycle represents a learning process in which the individual continuously tests his concepts in experience and modifies them as a result of outcomes of experience.
- (4) The direction which learning takes is determined by an individual's needs and goals.
- (5) Since learning is directed by individual needs and goals, learning styles become highly individualized in both direction and process.
- (6) Individuals tend to develop a learning style characterized by an emphasis on particular components of the four stage cycle. For example, a physicist may place greater emphasis on the formation

of abstract concepts, while an artist may be more inclined toward concrete experience.

- (7) The experiential learning paradigm consists of four learning modes: concrete experience, reflective observation, abstract conceptualization, and active experimentation, which represent the four stages of the learning/problem solving cycle.
- (8) No specific learning mode is regarded as being any better or worse than the others.
- (9) An individual's tendency to emphasize particular learning modes of the four stage cycle does not necessarily mean that the individual is incapable of engaging in the other learning modes.
- (10) Ideally, effective learning means being competent in each learning mode when it is required.

(Kolb et al., 1979, pp. 37-38)

A significant body of research has accrued to support the effective use of the LSI as a viable tool for college faculty and student development professionals. The concept of learning styles has become a popular concept among educators in recent years. Considerable research has been conducted, particularly in elementary and secondary populations (Gregorc, 1979; Kagan et al., 1963; Dunn, & Dunn, 1978, Semple 1982), using a variety of instruments grounded in differing theoretical bases. Researchers sought to determine whether tailoring the presentation of material to individual student learning styles would result in more effective instructional outcomes. The evidence, however, has not supported this hypothesis.

Kolb's model and the LSI, on the other hand, differs in scope and objectives from other theoretical orientations. Grounded in cognitive, developmental, and experiential theory, it evolved into a resource that is

particularly suited to higher education. Sugarman (1985) described it as a "sophisticated conceptualization of the learning and the teaching process [that] is needed for both [management] trainers and students" (p. 266). In her analysis of the experiential learning model and its implications for the counseling field, Sugarman noted that when compared with others, Kolb's model can "be used flexibly and allows the specific manifestations of each stage to be a reflection of the goals of the user" (p. 267). Since counseling involved learning and exploration, she proposed that Kolb's model was ideally suited to be used by counselors to more fully comprehend the counseling process. Further, counselors needed to reflect on their own learning styles to know whether or not the constraints of their styles may inadvertently hamper the progress of the counseling relationship. Sugarman advocated that counselors employ Kolb's concepts "in designing their own interventions with clients, particularly when they involved some form of training or coaching" (p. 268) (e.g., assertiveness training programs). Clients, too, could benefit from an understanding of learning styles. "Clients, like students, can use Kolb's ideas to select compatible learning activities and to expand and improve their repertoire of learning skills" (p. 268).

In related research, Torbit (1981) investigated the assumptions of Kolb and Plovnick (1976) that people choose careers which are consistent with their learning styles and are further shaped to fit the learning norms of the career once they are in it. The subjects were a group of 35 counselor trainees, enrolled in a two-year graduate program in counseling

psychology. At the beginning of the first semester, the subjects completed the Kolb Learning Style Inventory (LSI) to determine their preferred learning style. At the end of the first semester, they completed the LSI according to their perceptions of "counselor" learning style. 83% of the subjects had majored in a BA program, 11% had a BSc degree, and 6% had a BEd degree. The finding that the group displayed the diverger learning style was consistent with Kolb's (1971) research that individuals in the arts and humanities were characterized by a divergent learning style. Counselor trainees also perceived the role of counselor as that of diverger. The results of a t-test analysis of the difference in means between the group measure of "preferred" learning style and "counselor" learning style indicated a statistically significant increase of the Concrete Experience learning mode. This mode is one of the two modes that are indicative of the diverger learning style. Torbit believed that the training program was instrumental in shaping the trainees' perceptions of the counselor role. He suggested that further research be conducted into the implications of Kolb's model for both training methodology and counseling outcomes. This study demonstrated the significance of undergraduate major and of subsequent educational experience on learning style preference. It supported the notion of studying the implications of match/mismatch of student learning styles with the learning styles of teachers from two different disciplines: psychology (diverger) and mathematics (assimilator).

Hayden and Brown (1985) extended research on learning styles to a

college population and established behavioral correlates for Kolb's learning styles. In the first (1980) of two investigations, they assessed the preferred learning styles of 116 middle-class, college men and women, randomly selected from freshmen and senior classes of a four-year liberal arts college. The freshmen were heterogeneous in their choices of learning style, while seniors were homogeneous, preferring learning through the abstract conceptualization mode. In a follow-up study (1983), the researchers again assessed 29 seniors who participated in the first study as freshmen. As seniors they were predominantly abstract conceptualizers, suggesting that learning styles do shift over the four-year college experience. The study thus demonstrated the influence of the curriculum studied on the subsequent development of preferred learning style.

Sadler, Plovnick, and Snope (1978) surveyed the learning styles of family practice residents and faculty of the four residency programs at New Jersey-Rutgers Medical School and four other New Jersey-based programs. The purpose was to gain a better understanding of residents' learning styles and the relationship between instruction and physician performance. This was part of an ongoing program concerned with the assessment and strengthening of the quality of their residents' educational experience. The researchers identified the residents as follows: 40% accommodators, 16% divergers, 31% convergers, and 31% assimilators. In an earlier study, Plovnick (1975) had found the most common learning style among family physicians to be the accommodator. The

current study was generally consistent with Plovnick's predictions. The results of the LSI for faculty yielded the following data: 13% accommodators, 20% divergers, 53% convergers, and 13% assimilators. Thus, faculty learning styles were somewhat more abstract and more reflective than residents' learning styles which showed a preference for concrete examples and active participation. The researchers recommended that faculty might provide learning exercises such as role-playing, simulation, participation in the clinical arena to complement lectures and literature review. However, they raised the question of whether or not the faculty could comfortably and effectively learn to use teaching methods which are incongruent with their own learning styles. Previous research (Goldman, 1972; Margerison & Lewis, 1978; Plovnick, 1978; Wolfe & Kolb, 1979) suggested that learning style is a major factor influencing vocational choice. Sadler et al. supported the premise that learning styles are related to vocation. The study also noted the need to study further the relevance of match/mismatch of student and faculty learning styles.

Garvey, Bootman, and McGhan (1984) surveyed a sample of 501 pharmacy students attending two colleges of pharmacy in the western United States. One site offered a six-year Doctor of Pharmacy Degree, and the other offered a five-year Bachelor of Science Degree. These were illustrative of differences in the manner in which clinical training was added to existing programs. The researchers noted that the effects of curriculum changes on pharmacy students while in the training program or,

subsequently on practicing graduates, had not been objectively evaluated. They suggested the importance of research on how students learn in order to evaluate the impact of curriculum changes on the ability of students to learn while in training and after assuming the professional role. The Kolb LSI was administered along with a questionnaire eliciting information regarding the following variables: age, sex, grade point average, possession of a prior college degree, preference for stated learning situations, primary language, preference for practice setting after graduation, having pharmacist relations, and rating of listed pharmacist activities. 50.8% were classified as convergers, 17.1% accommodators, 12.6% divergers, 19.5% assimilators. These findings were consistent with Kolb (1976) who reported that nurses and engineering students were convergers, and Plovnick (1975) who reported that the majority of medical students he tested fell into this quadrant. Garvey et al. found that the student convergers were more likely to be male and tended to be more successful in their studies than female students or students with other learning styles. Their findings suggested that students who were not convergers would benefit from experiences which would enhance their ability to deal with abstract concepts. The findings further suggested that pharmacists in the field would be more satisfied with continuing education experiences congruent with their learning style preferences. However, the question remained whether or not the preferred continuing education would result in the most beneficial learning for the individual. Such experiences, while being personally more satisfying, would not

necessarily provide individuals with the kinds of learning experiences they actually needed. This study supported the question of whether or not learning style matches between instructor and student were always desirable and whether mismatches in learning styles contributed to learning outcomes.

### Summary

A review of the literature indicated that learning style was a major factor influencing choice of vocation. Moreover, personality disposition toward introversion and feeling, undergraduate specialization, career commitment, the demands of the current job, and the specific task being worked on were identified as elements that shaped the learning styles--accommodation, divergence, convergence, and assimilation. To date, the emphasis of learning style research has been to study the impact of these elements on the development of preferred learning styles. Research has also served to point out the importance of learning styles for the development of curriculum and training programs.

An area found to be lacking in study was an examination of the relationship between learning styles and stress. If stress is a significant variable for the college student's academic success as suggested by Greenberg (1987) and Whitman et al. (1984, 1986), then knowledge and understanding of the influence of match/mismatch of student/teacher learning styles on student stress must be considered important. This study examined the degree of match between learning style of college students and their instructors and the perceived levels of



stress among the students. It sought information about the relationships between the degree of learning style match/mismatch between student and instructor, levels of perceived stress, and the academic achievement among students. It examined the differences among the four learning style matches or mismatches, perceived stress and academic achievement. Finally, it determined the difference in state anxiety among those students with a learning style comparable to that of their instructor and those who evince other learning styles.

### CHAPTER III. METHODOLOGY

The purpose of this study was to examine the possible relationship among learning styles, perceived stress of undergraduate college students, and academic achievement. The analysis of data collected in this study to determine the relationship of selected variables is presented in this chapter. Data from 167 undergraduate students enrolled in two courses at Iowa State University, Ames, Iowa, were described in this research. This information may be useful for increased understanding of the learning process in order to improve postsecondary instructional design.

#### Subjects

The subjects for this study were 167 undergraduate college students at Iowa State University who were enrolled in one of two courses. Sixty-four students were enrolled in a mathematics class, Mathematics for Elementary Teachers (Mathematics 195); 103 were enrolled in a psychology class, Educational Psychology (Psychology 333). Neither of the courses were part of an organized or required sequence of courses. Both courses are part of the teacher education requirements of the University.

When data are collected from people, the Graduate College at Iowa State University requires that the dissertation project be reviewed and certified by the University Human Subjects Review Committee before the onset of the research. The committee requires a copy of the form used to obtain informed consent from subjects, copies of instruments to be used to gather data, and information regarding the dates of contact between

researcher and subjects. This dissertation project was approved on January 25, 1988. A copy of the form indicating the committee's approval of this research study appears in Appendix A. The instructors of the two classes elicited the participation of students in their respective classes. Those students that agreed to cooperate in the research study completed the Subject's Consent Form (Appendix A). In order to maintain the confidentiality of the students, each student was assigned a number by the respective professors and this information was recorded in a book which was kept by the mathematics professor. The researcher, then was not aware of the identity of any of the subjects.

The two instructors were administered one instrument, the Kolb Learning Styles Inventory (LSI), in order to determine the instructor's learning style, and thereby provide a basis for determining the match or mismatch between student and instructor learning styles. While the LSI describes learning styles rather than teaching styles, McCarthy (1987) has described specific teaching behaviors which are characteristic of teachers with differing learning styles. Further, Guild and Garger (1988) cited Barbe and Swassing in support of the impact of learning style on the act of teaching: "[We] teach as we learn best, not as we were taught" (p. 66).

#### Instrumentation

Two instruments were used to collect the research data. These were the The Learning Style Inventory (LSI) (Kolb, 1985) and The State-Trait Anxiety Inventory (STAI-Y) (Spielberger et al., 1983). Additional data

(ACT scores) were obtained from the Office of the Registrar and from the instructors of the students (final course grade).

The Learning Style Inventory (LSI) (Kolb, 1985).

The Learning Style Inventory (LSI 1985) was used to assess the preferred learning styles of both the instructors of the two courses and of the student sample at the beginning of the course. The LSI measures an individual's emphasis on one of four learning orientations: concrete experience, abstract conceptualization, active experimentation, and reflective observation. It was completed by most students in ten minutes. The LSI has been used by professionals in a variety of fields including the following: personnel management (Dixon, 1982; Beck, Cox, & Radcliff, 1980; Sharman, 1980; Wolfe, 1977, Kolb, 1976), postsecondary education (Glaser, 1984; Claxton, Adams, & Williams, 1982; Jason, 1981; Pullen & Delano, 1981), medical education (Laschinger & Boss, 1984; Merritt, 1983; Plovnick, 1975, 1978, 1980; Whitney & Caplan, 1978).

The LSI was normed on a sample of 1,446 adults between the ages of 18 and 60, 638 men and 801 women. The individuals in the normative group represented diverse ethnic groups and represented a wide range of career fields with an average education of two years of college (Smith & Kolb, 1986). The current version is an improved version of the original LSI (1976) developed by David A. Kolb.

Reliability of the LSI was reported by Smith & Kolb (1986). "The four basic scales and two combination scores all show very good internal reliability as measured by Cronbach's alpha. The combination scores show

almost perfect additivity (1.0) as measured by Tukey's test" (p. 97). Reliability measures were not computed for the group of students in the present study.

|                                 | Cronbach's<br>Standardized<br>Scale Alpha | Tukey's<br>Additivity<br>Power |
|---------------------------------|---|--------------------------------|
| Concrete Experience (CE)        | .82                                       | .91                            |
| Reflective Observation (RO)     | .73                                       | 1.09                           |
| Abstract Conceptualization (AC) | .83                                       | 1.07                           |
| Active Experimentation (AE)     | .78                                       | 1.03                           |
| Abstract-Concrete (AC-CE)       | .88                                       | 1.00                           |
| Active-Reflective (AE-RO)       | .81                                       | .99                            |

"Strong correlations between the LSI 1985 with items from the original LSI indicate that their results are comparable. All correlations are significant at  $p < .001$ " (p. 98).

Validity relationships were established by establishing correlations between scores on the LSI and career fields of study. The fields individuals choose to study are consistent with their preferred learning styles.

The State-Trait Anxiety Inventory (STAI-Y) (Spielberger et al., 1983).

Form Y-1 was used to measure state anxiety prior to a scheduled major examination in the course. Form Y-2 of the Spielberger State-Trait Anxiety Inventory (STAI-Y) was used to measure trait anxiety during the same class session. This commonly used measure of anxiety requires about

6 minutes for college students to complete each of the forms. The STAI measures two types of anxiety: state anxiety ("S-Anxiety"), which refers to "an emotional reaction . . . characterized by subjective feelings of tension, apprehension, nervousness, and worry, and by activation of the autonomic nervous system" and trait anxiety ("T-Anxiety") which indicates "relatively stable individual differences in anxiety-proneness" (Spielberger et al., 1983, p. 1).

M. D. Dreger reported in Buros (1978) on the reliability and validity of the STAI, Form X. Form X, published in 1970 was the original edition of the STAI until it was replaced by the 1983 revised version (Form Y):

Test-retest reliabilities are reported for state (Form X-1) and trait (Form X-2) scores separately by males and females, as follows -- one hour interval: .33 (males) and .16 (females) for state, .84 and .76 for trait. Alpha reliability coefficients for the normative samples (high school Juniors, college freshmen, introductory psychology students) range from .83 to .92 for state scores and .86 to .92 for trait scores; alpha coefficients are more suitable reliability indicators for X-I than test-retest coefficients.

Validities for trait scores were estimated by correlating the scores with the IPAT Anxiety Scale, Manifest Anxiety Scale, and Affect Adjective Check List. For 126 college women, coefficients were .75, .80, and .52 respectively.

In his review of the test in Buros (1978), Edward S. Katkin stated:

The bulk of the research tends to indicate . . . that the STAI scale represents a relatively efficient, reliable and valid way to assess individual differences in both anxiety-proneness and phenomenological experience of anxiety in normal as well as in patient populations. (p. 1096)

The evidence for both the reliability and validity of the STAI is strong and indicates that it is an appropriate instrument for the measuring the construct of anxiety.

### Student Variables

This section described the student variables under investigation and the procedures used to collect the data. The variables included distance between student and instructor on the two dimensions of the Kolb Learning Style model, academic aptitude, learning style preference, state anxiety, and academic achievement. The term, distance, referred to the degree to which students differed from their instructors on each of the dimensions of the Kolb model. Each of these dimensions is a continuum, one representing how individuals perceive information (Abstract-Concrete), the other representing how individuals process information (Active-Reflective). The data obtained in this study were coded using statistical procedures based on the Statistical Analysis System (SAS, 1985). The student variables were coded as follows:

1. Distance between student and instructor on the Abstract-Concrete dimension of the Kolb Learning Style model was coded as DAC;
  2. Distance between student and instructor on the Active-Reflective dimension of the Kolb Learning Style model was coded as DAR;
  3. State anxiety was coded as SANX;
  4. Trait anxiety was coded as TANX;
  5. Academic aptitude was coded as ACT;
  6. Course grade was coded as GPA;
  7. Subject was coded as S\_CODE;
  8. Gender was coded as GEN (SEX);
  9. Course grade residuals were coded as GPA-RESA; and
-

10. Learning style was coded as LS.

#### Academic Aptitude

Data about students were collected by the Office of the Registrar. Computerized files contain admissions information including the scores from either the American College Testing Program (ACT) and/or the Scholastic Aptitude Test (SAT), both standardized tests of academic aptitude. The ACT was required of all entering students at Iowa State University. The ACT score is an indicator of prior academic achievement, of general academic aptitude, and is used to predict student success in college academic work. The ACT scores and/or SAT scores for the students were requested from the Office of the Registrar. In one case, a student did not have an ACT score but did have an SAT score. The SAT score was converted to equivalent ACT score by means of a set of ACT/SAT conversion tables published by Langston (1987). The table values have a correlation of .877 for ACT Composite with SAT Total. Neither ACT nor SAT scores were available in the case of a number of students (e.g., transfer students and adult reentrant students).

#### Measure of Anxiety

The Spielberger State-Trait Anxiety Inventory (STAI) (Spielberger et al., 1983) consists of two forms. Form Y-1 measures state anxiety or situational anxiety while Form Y-2 measures trait anxiety or general anxiety proneness. Both forms were administered to students in a single testing session during the week prior to a major examination in each course to determine measures of trait and state anxiety.



### Learning Styles of Students and Instructors

The Learning Style Inventory (LSI) (Kolb, 1985) was administered to students in the same testing session as the STAI in order to ascertain their respective learning styles. The instructors of each course were also administered the LSI in order to determine their learning styles.

### Achievement in Course

Achievement was determined by the final grades received by students in the respective courses. These were obtained directly from the instructors. At the time when grades were requested by the Registrar, a copy was retained for the research study and mailed to the researcher in an envelope provided beforehand.

### Procedures for the Analysis of Data

The initial analysis of the data employed regression analysis using the Statistical Analysis System (SAS, 1985). This statistical procedure makes it possible to make theoretical predictions based on examination of the relationship between data on the predictor variable and the data on the predicted variable from a sample of individuals. Unless two variables are perfectly correlated, there is a tendency for a group scoring at a given level above or below the mean on the first variable to be closer to the mean on the second variable. This is called the regression effect and since the regression is always toward the mean of the second variable, it is called regression toward the mean. Regression, then, refers to the fact that the predicted score will be closer to the mean of the population than is the predictor score. It is designed to analyze the differences

between the means of two or more samples when only one independent variable has been manipulated. In this study, the independent variable was learning style; the dependent variables were stress as measured by state anxiety, and achievement as measured by course grade.

A second procedure utilized was one-way analysis of variance (ANOVA). The purpose of ANOVA is to determine whether the variation between groups is likely to be a function of chance or not. The general rationale of ANOVA is that the total variance of all the data in an experiment can be separated and attributed to two sources: variance between groups and variance within groups. There are three assumptions involved in one-way analysis of variance: (1) the variables under investigation are normally distributed in the population from which the samples are drawn; (2) the variances in the population from which the samples are drawn are equal, an assumption referred to as homogeneity of variance; and (3) all individuals in the study are randomly and independently drawn from the population. Examination of the data collected suggested that these assumptions were met in the distribution of ACT scores, grades, LSI scores, and STAI scores.

Analysis of variance tests for the presence of differences in means in a total set of data; it is not designed nor is it able to answer questions about differences between particular means. A significant F-ratio indicates only that there are statistically significant differences among the groups contributing to the total set of data but it does not indicate where the significance lies. In this study, the independent

variables were match/mismatch between learning style of student and instructor and learning style. For each of the two distance scores and for each of the four learning styles ANOVA was used to determine what effect, if any, differing learning styles had on (1) level of anxiety, and (2) final course grade. The values obtained can then be used for hypothesis testing.

Once an investigator has drawn a conclusion with respect to the null hypothesis, that conclusion can be either correct or in error. Two types of error are possible: (1) concluding that a relationship exists between variables when no genuine relationship exists (called a type I error), and (2) concluding that there is no relationship between variables when there genuinely is such a relationship (called a type II error). The probability of making a type I error is reflected by the alpha level, in this study, .05. The value of the alpha level directly affects the power of the statistical test. The probability of making a type II error is traditionally called beta.

Specifically, this study asked five research questions and proposed statistical methods to answer each of them. The first research question was to determine the degree of match/fit between learning style of student and learning style of instructor among two samples of undergraduate college students at a state university. First, the distribution of students by learning style was calculated. Next the degree of match/fit between the learning style of student and learning style of instructor was determined by subtracting the two LSI combination scores of students from

their respective instructors. This resulted in two variables, the difference on the abstract-concrete dimension (DAC) and the difference on the active-reflective dimension (DAR). Next descriptive statistics were performed and illustrated with a scatterplot. Finally, a one-way analysis of variance was performed to determine the relationship between learning styles and the distance or degree of match/mismatch between student and instructor on each of the two dimensions of learning style.

The second research question called for a description of the perceived levels of stress among the two samples of students. A frequency distribution was calculated for state anxiety scores of the students. The distribution of course grades according to levels of anxiety was then calculated.

The third research question was to ascertain the relationship between degree of match/mismatch between student and teacher, the levels of perceived stress, and academic achievement among students. A one-way analysis of variance was used to determine the degree to which academic aptitude contributed to the course grade earned by subjects. Regression analysis was utilized to obtain course grade residuals. "Residuals are the deviation between the observed data and the predicted values generated model" (Bohannon, 1988, p. 48). Finally, correlation coefficients were calculated between the variables DAC and DAR, measures of match/mismatch between student instructor, state anxiety (SANX), and grade residuals (GPA-RESA).

The fourth research question asked whether there is a significant

difference among the four learning styles (diverger, accommodator, assimilator, converger) and matches or mismatches with instructor and perceived stress and academic achievement. A one-way analysis of variance was performed to determine the relationship between learning styles and course grade and between learning styles and course grade residuals.

The fifth research question queried whether there is a significant difference in state anxiety among those students with a learning style comparable to that of their instructor and those who evince other learning styles. A one-way analysis of variance was performed to determine the relationship between student-instructor learning style matches and student-instructor learning style mismatches and measures of state anxiety.

#### Summary

This study analyzed learning styles, stress, and academic achievement. The purpose of this study was to assess the extent that prior academic aptitude, state anxiety, the match or mismatch of learning styles between student and teacher might influence academic achievement as measured by the final grades in the course. This section presented information on the subjects, the instruments used to collect the data, the data collection process, the student variables under examination, and the procedures for the analysis of the data.

## CHAPTER IV. FINDINGS

### Introduction

This section analyzed the relationship among the match and/or mismatch of student-teacher learning style, perceived stress of students, and their academic achievement. The data collected in this study included:

1. ACT scores obtained from the college transcripts of student subjects;
2. scores from the Spielberger State-Trait Anxiety Inventory (STAI-Y);
3. scores from the Kolb Learning Style Inventory (LSI); and
4. scores from the LSI for each of the two instructors.

The statistical analysis provided descriptive statistics on all dependent variables; simple linear regression on selected variables; and one-way analysis of variance.

The results of the major findings of the research presented in this chapter include information about:

1. the degree of match between learning style of student and learning style of instructor in the two samples of students;
2. perceived levels of stress among the two samples as measured by the STAI-Y;
3. the relationship between degree of learning style match/mismatch between student and instructor, levels of perceived stress, and the academic achievement among all students;

4. the difference among the four learning styles (diverger, accommodator, assimilator, converger) and matches or mismatches with instructor, perceived stress, and academic achievement;
5. the difference in state anxiety among those students with a learning style comparable to that of their instructor and those who evince other learning styles.

### Sample

A total of 167 students participated in the research study. Sixty-four students, enrolled in Mathematics 195, and 103 students, enrolled in Psychology 333, volunteered to be participants. All participants completed a consent form. All subjects were asked to complete the two instruments, the STAI-Y and LSI during a class session in their respective course. The day chosen was the class session immediately prior to a major scheduled examination for the course in order to measure anxiety which might be induced by the anticipation of the testing situation. ACT and SAT scores were obtained from the Office of the Registrar during the following week, and each of the instructors forwarded student course grades to the researcher at the end of the semester.

### Statistical Procedures

The statistical procedures were executed to respond to questions presented in Chapter 1 of this study. The questions were addressed from the results of each test administered.

The following statistical procedures were used to analyze data. The

first step was to compile descriptive statistics for all variables. Coefficients of correlation were then computed to determine relationships among all variables. The next procedure was regression analysis. Regression analysis was used to remove the influence of academic aptitude as described by the ACT score from the final course grade. The resultant course grade residual (GPA-RESA) became the dependent variable for final analysis instead of the original course grade as assigned by the instructor. The next procedure was used to compare one group mean to another within all student variables. First, a standard analysis of variance (ANOVA) using the respective degrees of freedom and mean square within for the two means being compared was utilized. The Student-Newman-Keuls (SNK) test was chosen as an a posteriori contrast test using an alpha of .05. An a posteriori contrast test is a systematic procedure for comparing all possible pairs of group means. SNK uses different range values for different size subsets and holds the experimentwise error rate to alpha for each stage of the testing procedure.

#### Question 1

The first research question addressed in this study was: To determine the degree of match/fit between learning style of student and learning style of instructor among two samples of undergraduate college students at a state university.

The results of the LSI indicated student learning styles of both students and instructor. The learning style is determined by two combination scores on two distinct, independent, bipolar dimensions of



learning theory. One dimension is a perceiving continuum ranging from concrete to abstract (AC-CE); the other is a processing continuum that ranges from active to reflective (AE-RO). The distribution of students according to learning style was presented in Table 1.

Table 1

Distribution of Students by Learning Style

|              | MATHEMATICS |             | PSYCHOLOGY  |             | TOTALS      |              |
|--------------|-------------|-------------|-------------|-------------|-------------|--------------|
|              | M<br>(n=6)  | F<br>(n=58) | M<br>(n=21) | F<br>(n=82) | M<br>(n=27) | F<br>(n=140) |
| Diverger     | 3           | 21          | 2           | 20          | 46          |              |
| %            | 1.79        | 12.57       | 1.19        | 11.97       | 27.52       |              |
| Accommodator | 0           | 14          | 4           | 29          | 47          |              |
| %            | 0           | 8.38        | 2.39        | 17.36       | 28.13       |              |
| Assimilator  | 2           | 18          | 11          | 23          | 54          |              |
| %            | 1.19        | 10.77       | 6.58        | 13.77       | 32.31       |              |
| Converger    | 1           | 5           | 4           | 10          | 20          |              |
| %            | .59         | 2.99        | 2.39        | 5.98        | 11.95       |              |
| TOTALS       | 6           | 58          | 21          | 82          | 167         |              |
| %            | 3.57        | 34.71       | 12.55       | 49.08       | 99.91       |              |

Note: Total percentage does not sum to 100% because of rounding down of percentages.

The learning style of the psychology instructor was diverger, indicating that he tended to be concrete in his perception (AC-CE = -21) and a reflective processor (AE-RO = -5). Individuals who choose psychology as a major field are most often categorized as divergers. The instructor's professional background indicates that he has always taught at the college level. The majority of his teaching experiences has been

at Iowa State University.

The learning style of the mathematics instructor was that of converger, indicating that she preferred an abstract perceptual approach (AC-CE = 12) and an active approach to processing information (AE-RO = 6). The instructor's teaching experience ranges from junior high school mathematics to university teaching. Mathematicians tend to be assimilators rather than convergers. However, plotting the mathematics instructor's score on the learning styles grid suggested that the data point for her mode of processing falls one point from the center of the grid (50th percentile), suggesting that she is balanced on the AE-RO dimension. This indicated that she uses both an active and a reflective approach to processing almost equally well, suggesting a more developed approach to learning. Moreover, only one scaled point distinguishes her from the learning style of assimilator.

In order to determine the degree of match/fit between the learning style of student and learning style of instructor, the scores on the LSI for the students and instructors were first tabulated. Next, the AC-CE score of the psychology instructor (-21) was subtracted from each of the 103 psychology students' AC-CE scores. The AC-CE score of the mathematics instructor (12) was subtracted from each of the 64 mathematics students' AC-CE scores. The same procedure was used with respect to the AE-RO score. The psychology instructor's AE-RO score (-5) and the mathematics instructor's AE-RO score (6) was subtracted from each student score. This difference determined the distance of each student's position contrasted

with the two instructors' positions on the two dimensions or continua which constitute the learning style. DAC represents the distance between student and instructor on the abstract-concrete dimension while DAR represents the distance between student and instructor on the active-reflective dimension. These scores are presented in Table C-1 (Appendix C).

Descriptive statistics, presented in Table 2, indicated that the variable DAC (n=167) had a mean of 10.89, and a standard deviation of 19.96. For variable DAR (n=167), the mean was 2.13, with a standard deviation of 10.22. The mean distance of students in the two classes from their instructors was significantly greater on the abstract-concrete dimension (DAC) than on the active-reflective dimension (DAR). A scatterplot, presented in Table C-2 (Appendix), was created to graphically illustrate the distance between student and instructor for the combined samples. The two instructors were plotted according to their scores at the appropriate points on the abstract-concrete (AC) and active-reflective (AR) scales.

Table 2

Descriptive Statistics for Student Variables

| VARIABLE | N   | MEAN            | STANDARD<br>DEVIATION | MINIMUM<br>VALUE | MAXIMUM<br>VALUE |
|----------|-----|-----------------|-----------------------|------------------|------------------|
| DAC      | 167 | 10.89           | 19.96                 | -35.00           | 50.00            |
| DAR      | 167 | 2.13            | 12.95                 | -27.00           | 32.00            |
| SANX     | 167 | 47.50           | 13.14                 | 20.00            | 77.00            |
| TANX     | 167 | 40.78           | 9.80                  | 21.00            | 71.00            |
| ACT      | 127 | 21.28           | 4.44                  | 8.00             | 32.00            |
| GPA      | 167 | 2.90            | 1.01                  | 0.00             | 4.00             |
| GEN      | 167 | 1.84            | 0.37                  | 1.00             | 2.00             |
| GPA-RESA | 127 | -7.168369135E-7 | 0.9257783             | - 2.80           | 1.57             |

A one-way analysis of variance was performed to determine the relationship between learning styles and the distance or degree of match/mismatch between student and instructor on each of the two dimensions of learning style. Summary data as presented in Table 3 showed the statistic of  $F = 16.15$  for the abstract-concrete dimension (DAC) exceeded the tabular  $F$  of 2.67 at the .05 significance level for 3 and 163 degrees of freedom. A post hoc Student-Newman-Keul's procedure found that the means of the accommodator and diverger were significantly different at the .05 level.

Table 3

Analysis of Variance Summary for Learning Styles (LS) and Distance on  
Abstract-Concrete Dimension (DAC) of Learning Style Model

| Source         | Sum of Squares | Degree of Freedom | Mean Square | F Calc. | F Tab. |
|----------------|----------------|-------------------|-------------|---------|--------|
| Between Groups | 15149.00       | 3                 | 5049.67     | 16.15*  | 2.67   |
| Within Groups  | 50977.06       | 163               | 312.74      |         |        |
| Total          | 66126.06       | 166               |             |         |        |

Student-Newman-Keuls Test for Dependent Variable: DAC  
Means with the same letter are not significantly different.

| GROUPING | MEAN  | N  | LS           |
|----------|-------|----|--------------|
| A        | 22.75 | 20 | Converger    |
| A        | 20.80 | 54 | Assimilator  |
| B        | 5.17  | 47 | Accommodator |
| B        | - .04 | 46 | Diverger     |

Summary data as presented in Table 4 showed the statistic of  $F = 81.55$  for the active-reflective dimension (DAR) exceeded the tabular  $F$  of 2.67 at the .05 significance level for 3 and 163 degrees of freedom. A post hoc Student-Newman-Keul's procedure found that the means of the assimilator and diverger were significantly different at the .05 level.

Table 4

Analysis of Variance Summary for Learning Styles (LS) and Distance on  
Active-Reflective Dimension (DAR) of Learning Style Model

| Source         | Summary of Squares | Degree of Freedom | Mean Square | F Calc. | F Tab. |
|----------------|--------------------|-------------------|-------------|---------|--------|
| Between Groups | 16695.38           | 3                 | 5565.13     | 81.55*  | 2.67   |
| Within Groups  | 11122.98           | 163               | 68.24       |         |        |
| Total          | 27818.36           | 166               |             |         |        |

Student-Newman-Keuls Test for Dependent Variable: DAR  
Means with the same letter are not significantly different.

| GROUPING | MEAN  | N  | LS           |
|----------|-------|----|--------------|
| A        | 14.55 | 20 | Accommodator |
| A        | 13.80 | 54 | Converger    |
| B        | -5.57 | 47 | Assimilator  |
| B        | -6.61 | 46 | Diverger     |

The first research question of this study sought to determine the degree of match/fit between learning style of student and learning style of instructor among two samples of undergraduate college students. The extent of match/mismatch between student and instructor on each of the two bipolar dimensions of Kolb's learning style model was described.

Question 2

The second research question addressed in this study was: To describe the perceived levels of stress among the two samples of students.

The Spielberger State-Trait Anxiety Inventory (STAI-Y) was used to determine a quantitative measure of stress among students. The scores were presented in Table C-1 (Appendix). The inventory was administered during the class session immediately prior to a major scheduled examination. Students were instructed to complete the inventory with the approaching examination in mind. Students were administered both the state portion, which measures situational anxiety, and the trait portion, which measures general anxiety. The distribution of students according to levels of anxiety, presented in Table 5, identified 23.95% of the students as having state anxiety scores in both the 40-49 range and the 50-59 range. 23.35% scored in the 30-39 range, 7.78% in the 20-29 range, the lowest level, while 4.19% scored in the 70-79 range, the highest level.

Table 5

Distribution of Students by Levels of State Anxiety Scores (SANX)

FREQUENCY BAR CHART

| SANX  |       | FREQ | CUM. FREQ | PERCENT | CUM. PERCENT |
|-------|-------|------|-----------|---------|--------------|
| 70-79 | **    | 7    | 7         | 4.19    | 4.19         |
| 60-69 | ***** | 28   | 35        | 16.78   | 20.97        |
| 50-59 | ***** | 40   | 75        | 23.95   | 44.92        |
| 40-49 | ***** | 40   | 115       | 23.95   | 68.87        |
| 30-39 | ***** | 39   | 154       | 23.35   | 92.22        |
| 20-29 | ***** | 13   | 167       | 7.78    | 100.00       |

-----+-----+-----+-----+-----+-----+-----+-----+  
 10 15 20 25 30 35 40  
 FREQUENCY

State anxiety scores, from highest to lowest, the course grades, and corresponding means were tabulated. These are described in Table 6. The highest mean course grade (3.33) was achieved by those students scoring in the 30-39 range of state anxiety, while the lowest mean course grade (2.54) was achieved by those scoring in the 60-69 range. The mean scores for males in the normative sample was 36.47 for male college students, 38.76 for female college students. The STAI manual reported standard scores for male and female college students in the normative sample. T-scores reported for males with raw scores between 60-69 were 73-82 (97th-100th percentile); for females, 68-75 (94th-99th percentile). These scores indicated that the 28 students in this study who scored in the 60-69 range on state anxiety were approximately two standard deviations above the mean when compared with the normative sample. These scores were significantly outside the normal range.

Table 6

Distribution of Students by Levels of State Anxiety Scores (SANX) and Course Grade (GPA)

| SANX  | N  | MEAN COURSE GRADE |
|-------|----|-------------------|
| 70-79 | 7  | 3.00              |
| 60-69 | 28 | 2.54              |
| 50-59 | 40 | 2.77              |
| 40-49 | 40 | 2.77              |
| 30-39 | 39 | 3.33              |
| 20-29 | 13 | 3.15              |



Question 3

The third research question addressed in this study was: To ascertain the relationship between degree of match/mismatch between student and teacher, the levels of perceived stress, and academic achievement among students.

The ACT scores of subjects were collected as indicators of academic aptitude. The ACT scores were used as a control variable in order to determine to what degree academic aptitude itself contributed to the grade subjects earned in their course. The statistical ANOVA indicated a significant difference at the .01 level. As shown in Table 7, the calculated F of 24.57 exceeded the the tabular value of F at 6.84 with 1 and 125 degrees of freedom. These findings suggested the appropriateness of the linear model to the distribution of ACT scores and grades.

Table 7

Analysis of Variance Summary for ACT Scores (ACT) and Course Grade (GPA)

| Source         | Sum of Squares | Degree of Freedom | Mean Square | F Calc. | F Tab. |
|----------------|----------------|-------------------|-------------|---------|--------|
| Between Groups | 21.22          | 1                 | 21.22       | 24.57*  | 3.92   |
| Within Groups  | 107.99         | 125               | .86         |         |        |
| Total          | 129.21         | 126               |             |         |        |

In order to remove the effect of the ACT score on the course grade it was decided to utilize regression analysis. This procedure resulted in grade residuals for all students with ACT scores. Residuals are the deviation

between the observed data and the predicted values generated by the regression model and are estimates of the errors (Bohannon, 1988, p. 49). In this study the grade residual represents the difference between the actual grade and the grade as predicted from the ACT score. Careful analysis of the residuals helps check regression assumptions. Since 40 students did not have ACT scores, residuals could be calculated for only 127 of the 167 students. The individual grade residuals (GPA-RESA) were presented in Table C-1 (Appendix C).

Next correlation coefficients, presented in Table 8, were calculated to determine the degree of relationship between the variables DAC and DAR, measures of match/mismatch between student and instructor, state anxiety (SANX), and grade residuals (GPA-RESA).

Table 8

Pearson Correlation Coefficients for Distance on Abstract-Concrete Dimension (DAC), Active-Reflective Dimension (DAR), State Anxiety (SANX), and Grade Residuals (GPA-RESA)

Pearson Correlation Coefficients / Prob > |r| under  $H_0: \rho = 0$

|          | DAC            | DAR             | SANX            | GPA-RESA        |
|----------|----------------|-----------------|-----------------|-----------------|
| DAC      |                | 0.219<br>0.005  | 0.025<br>0.751  | 0.048<br>0.591  |
| DAR      | 0.219<br>0.005 |                 | 0.009<br>0.905  | -0.147<br>0.098 |
| SANX     | 0.025<br>0.751 | 0.009<br>0.905  |                 | -0.170<br>0.055 |
| GPA-RESA | 0.048<br>0.591 | -0.147<br>0.098 | -0.170<br>0.055 |                 |

In no case was there a significant correlation between variables wherein 44% or more of the variance was explained.

Question 4

The fourth research question addressed in this study was: To determine whether there is a significant difference among the four learning styles (diverger, accommodator, assimilator, converger) and matches or mismatches with instructor and perceived stress and academic achievement.

A one-way analysis of variance was performed to determine the relationship between learning styles and state anxiety. The results of the analysis of variance showed no significant difference in the means of

the four learning styles on the state anxiety measure. Summary data as presented in Table 9 showed the statistic of  $F = 1.66$  did not exceed the tabular  $F$  of 2.67 at the .05 significance level for 3 and 163 degrees of freedom.

Table 9

Analysis of Variance Summary for Learning Styles (LS) and State Anxiety (SANX)

| Source         | Summary of Squares | Degree of Freedom | Mean Square | F Calc. | F Tab. |
|----------------|--------------------|-------------------|-------------|---------|--------|
| Between Groups | 848.19             | 3                 | 282.73      | 1.66    | 2.67   |
| Within Groups  | 27811.56           | 163               | 170.62      |         |        |
| Total          | 28659.75           | 166               |             |         |        |

Tabulation of frequency data on course grades (GPA) by learning style (LS), as presented in Table 10, revealed that 58 students or 34.73% earned grades of "A." Of these, 22 students classified as assimilators earned an "A" grade while 16 divergers earned an "A" grade. These 38 students, or 22.75% of the entire combined samples, with learning styles of assimilators and divergers accounted for 65.52% of all "As" awarded by the two instructors. Data were summarized in Table 10.

Table 10

Distribution of Grades by Learning Style

| GPA   | LEARNING STYLE |        |        |        | TOTAL  |
|-------|----------------|--------|--------|--------|--------|
|       | 1              | 2      | 3      | 4      |        |
| 4.0   | 16             | 13     | 22     | 7      | 58     |
| Row % | 27.59          | 22.41  | 37.93  | 12.07  | 100.00 |
| Col % | 34.78          | 27.66  | 40.74  | 35.00  | 34.73  |
| 3.0   | 16             | 14     | 19     | 5      | 54     |
| Row % | 29.63          | 25.93  | 35.19  | 9.26   | 100.01 |
| Col % | 34.78          | 29.79  | 35.19  | 25.00  | 32.34  |
| 2.0   | 10             | 15     | 10     | 7      | 42     |
| Row % | 23.81          | 35.71  | 23.81  | 16.67  | 100.00 |
| Col % | 21.74          | 31.91  | 18.52  | 35.00  | 25.15  |
| 1.0   | 3              | 5      | 2      | 1      | 11     |
| Row % | 27.27          | 45.45  | 18.18  | 9.09   | 99.99  |
| Col % | 6.52           | 10.64  | 3.70   | 5.00   | 6.59   |
| 0.0   | 1              | 0      | 1      | 0      | 2      |
| Row % | 50.00          | 0      | 50.00  | 0      | 100.00 |
| Col % | 2.17           | 0      | 1.85   | 0      | 1.19   |
| TOTAL | 46             | 47     | 54     | 20     | 167    |
| Row % | 27.54          | 28.14  | 32.34  | 11.98  | 100.00 |
| Col % | 99.99          | 100.00 | 100.00 | 100.00 | 100.00 |

Note. LEARNING STYLE 1 = Diverger, 2 = Accommodator, 3 = Assimilator, 4 = Converger.

A one-way analysis of variance was performed to determine the relationship between learning styles and course grade (GPA). The results of the analysis of variance showed no significant difference in the means of the four learning styles on course grade. Summary data as presented in Table 11 showed the statistic of  $F = 1.32$  did not exceed the tabular  $F$  of 2.67 at the .05 significance level for 3 and 163 degrees of freedom.

Table 11

Analysis of Variance Summary for Learning Styles (LS) and Course Grade  
(GPA)

| Source         | Sum of Squares | Degree of Freedom | Mean Square | F Calc. | F Tab. |
|----------------|----------------|-------------------|-------------|---------|--------|
| Between Groups | 3.99           | 3                 | 1.33        | 1.32    | 2.67   |
| Within Groups  | 164.48         | 163               | 1.01        |         |        |
| Total          | 168.47         | 166               |             |         |        |

A one-way analysis of variance was performed to determine the relationship between learning styles (diverger, accommodator, assimilator, and converger) and course grade residuals (GPA-RESA). The results of the analysis of variance showed no significant difference in the means of the four learning styles on course grade. Summary data as presented in Table 12 showed the statistic of  $F = 1.74$  did not exceed the tabular  $F$  of 2.70 at the .05 significance level for 3 and 123 degrees of freedom.

Table 12

Analysis of Variance Summary for Learning Styles (LS) and Course Grade  
Residuals (GPA-RESA)

| Source          | Sum of Squares | Degree of Freedom | Mean Square | F Calc. | F Tab. |
|-----------------|----------------|-------------------|-------------|---------|--------|
| Between Groups. | 4.39           | 3                 | 1.46        | 1.74    | 2.70   |
| Within Groups   | 103.60         | 123               | .84         |         |        |
| Total           | 107.99         | 126               |             |         |        |

The fourth research question sought to determine whether there was a significant difference among the four learning styles (diverger, accommodator, assimilator, converger) and matches or mismatches with instructor and perceived stress and academic achievement. The findings suggested that there was not a significant difference among the four learning styles, and perceived stress and academic achievement.

Question 5

The fifth research question addressed in this study was: To determine whether there is a significant difference in state anxiety among those students with a learning style comparable to that of their instructor and those who evince other learning styles.

A one-way analysis of variance was performed to determine the relationship between student-instructor learning style matches and student-instructor learning style mismatches and measures of state anxiety. The results of the analysis of variance showed no significant

difference in the means of the four learning styles on the state anxiety measure for either of the two groups of students. Summary data as presented in Table 13 showed the statistic of  $F = 1.52$  did not exceed the tabular  $F$  of 2.67 at the .05 significance level for 3 and 163 degrees of freedom.

Table 13

Analysis of Variance Summary for Student-Instructor Learning Style Match/Mismatch on State Anxiety (SANX)

| Source         | Sum of Squares | Degree of Freedom | Mean Square | F Calc. | F Tab. |
|----------------|----------------|-------------------|-------------|---------|--------|
| Between Groups | 779.89         | 3                 | 259.96      | 1.52    | 2.67   |
| Within Groups  | 27879.85       | 163               | 171.04      |         |        |
| Total          | 28659.75       | 166               |             |         |        |

The fifth research question addressed in this study was: To determine whether there is a significant difference in state anxiety among those students with a learning style comparable to that of their instructor and those who evince other learning styles. The findings did not suggest that there was a significant difference among any of the student groups relative to state anxiety.

#### Summary

Descriptive statistics revealed no particular pattern in the distribution of students in terms of distance of students from their instructors on the two dimensions of learning style. The mean distance of



students in the two classes from their instructors was significantly greater on the abstract-concrete dimension (DAC) than on the active-reflective dimension (DAR). The highest mean course grade (3.33) was achieved by those students scoring in the 30-39 range, or the mean range, of state anxiety, while the lowest mean course grade (2.54) was achieved by those scoring in the 60-69 range or two standard deviations above the mean when compared with the normative group. These scores were significantly outside the normal range.

ACT scores were used as a control variable in order to determine to what degree academic aptitude itself contributed to the grade subjects earned in their course. The statistical ANOVA indicated a significant difference at the .01 level suggesting the appropriateness of the linear model to the distribution of ACT scores and grades. In order to remove the effect of the ACT score on the course grade regression analysis was used. This procedure resulted in grade residuals for all students with ACT scores. The grade residual represented the difference between the actual grade and the grade as predicted from the ACT score. Pearson correlation coefficients for distance on abstract-concrete dimension (DAC), active-reflective dimension (DAR), state anxiety (SANX), and grade residuals (GPA-RESA) revealed no significant correlation between variables wherein 44% or more of the variance was explained. The findings suggested that there was not a significant difference among the four learning styles, and perceived stress and academic achievement. Finally, there was no significant difference among any of the student groups relative to state anxiety.

## CHAPTER V. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

### Summary

This study explored the relationship among the match and/or mismatch of student-teacher learning style, perceived stress of students, and their academic achievement. The population studied were 167 undergraduate college students enrolled in one of two courses at Iowa State University, Ames, Iowa. Sixty-four students were enrolled in Mathematics 195 and 103 students enrolled in Psychology 333. The researcher determined the preferred learning style of each student and of the respective instructors through the administration of the Kolb Learning Style Inventory (LSI). A measure of perceived stress was quantified through the administration of the Spielberger State-Trait Anxiety Inventory (STAI-Y) to all students. Academic achievement was measured by course grade adjusted for the students' incoming cognitive abilities. ACT scores were the measure of those abilities.

A review of the literature indicated that learning style was a major factor influencing choice of the college major field of study and of vocation (Torbit, 1981). Research indicated that the four learning styles--accommodator, diverger, converger, and assimilator--were influenced by heredity, experience, and present environment (e.g., demands of the current job) (Kolb, 1974). While research existed on the impact of these variables on the development of an individual's preferred learning styles and the relationship of learning styles to the development of curriculum and training programs, no studies were found that addressed the

relationship of learning styles and stress.

In an attempt to address this problem, this study asked five research questions. They were the following:

Question No. 1 -- What is the degree of match between learning style of student and learning style of instructor in the two samples of students?

Question No. 2 -- What are the perceived levels of stress among the two samples as measured by the STAI-Y?

Question No. 3 -- Is there a relationship between degree of learning style match/mismatch between student and instructor, levels of perceived stress, and the academic achievement among all students?

Question No. 4 -- Is there a difference among the four learning styles (diverger, accommodator, assimilator, converger) and matches or mismatches with instructor, perceived stress, and academic achievement?

Question No. 5 -- Is there a difference in state anxiety among those students with a learning style comparable to that of their instructor and those who evince other learning styles?

Descriptive statistics were compiled for all variables and coefficients of correlation were computed to determine relationships among all variables. Regression analysis was utilized in order to remove the influence of academic aptitude from the final course grade which resulted in a course grade residual for each student. A standard analysis of variance (ANOVA) using the respective degrees of freedom and mean square within for the two means being compared was then utilized. Finally, the Student-Newman-Keuls (SNK) test was used as an a posteriori contrast test,

using an alpha of .05.

The degree of match between learning style of student and learning style of instructor was described. It was determined that there was no pattern in the distribution of student scores on the two dimensions of learning style. Moreover, the mean distance of students from their instructors was significantly greater on the abstract-concrete (perception) dimension than on the active-reflective (process) dimension. Next, the perceived levels of stress were determined by a measure of state anxiety. No significant relationship was found between degree of learning style match/mismatch between student and instructor, levels of perceived stress, and the academic achievement among all students. No significant relationship was found among the four learning styles (diverger, accommodator, assimilator, converger) and matches or mismatches with instructor, perceived stress, and academic achievement. Neither was any significant relationship identified in state anxiety among those students with a learning style comparable to that of their instructor and those who evinced other learning styles.

### Conclusions

Archer and Lamnin (1985) reported that 18% of the sample they studied indicated "professors and class environment" as a stressor. The present study considered mismatch of learning styles as one example of this type of stressor but did not find it to be a significant factor. Archer and Lamnin's conclusions were not affirmed by this study.

Tracey and Sherry (1984) found that discrepancy in person-environment

fit was a significant stress producing variable for residence hall students. This study did not find that differing learning styles between student and instructor created significant stress as evidenced by state anxiety.

The research of Torbit (1981) supported the relationship between academic discipline, chosen career, and learning style. This study found this to be true in the case for the psychology instructor's learning style which was that of diverger. This was not so in the case of the mathematics instructor's style which was that of converger. The predicted learning style for the mathematics instructor would be that of assimilator. This discrepancy may have been due to the influence of a more diverse teaching background of the mathematics instructor whereby a greater balance in learning style had been developed.

Hayden and Brown (1985) found that freshman college students were heterogeneous in their choice of learning styles. This study found that students in this study, who were either sophomores or juniors, were also heterogeneous in their choice of learning styles.

Sadler et al. (1978) had found that faculty were predominantly divergers and convergers and, thus, somewhat more abstract and more reflective than students. The two instructors in this study were also diverger and converger, respectively. The smallest number of students were convergers in their learning style preference. Thus the majority of students tended to be more concrete in their approach to learning.

### Recommendations for Further Research

Based upon the findings from this investigation the following recommendations for further study are suggested:

1. It may be more difficult for some individuals to admit to feelings of anxiety. This may be particularly true for males influenced by cultural expectations, or it may be more difficult for them to assess their level of anxiety. Therefore, it is recommended that future research would utilize blood pressure checks concurrently with the administration of the STAI-Y in order to get a more accurate appraisal of stress level.

2. Since this investigation included only 16% male subjects or 27 out of 167 students, it is recommended that future research consider a population with more male subjects.

3. It is recommended that a broader sample of discipline areas with several instructors within each discipline area be used to avoid the limitations on match/mismatch distance estimates.

4. Because of the inherent limitations of survey instruments, it is recommended that future research include, in addition, personal interviews with subjects to obtain a more accurate appraisal of both state anxiety and preferred learning style of subjects.

5. It may be of value to concentrate on students who are already experiencing difficulties with the content of the course in which they are enrolled as evidenced by one or more low or failing grades on tests and/or assignments.

6. Since both of the instructors who participated in this study were

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experienced teachers, they may have been more skilled at teaching to all of the four learning styles. It might prove useful to study students who are being taught by a less experienced teacher to ascertain whether those students experience greater stress or lower academic achievement.

7. It may be valuable to study the extent of interrelation between different measures of learning style and learning environment, including Kolb's Learning Style Inventory (1985), the Myers-Briggs Type Indicator (1975), Witkin's Embedded Figures Test (1969), and the Environmental Assessment Technique (Astin & Holland, 1961).

8. Since the development of an individual's learning style is to some degree shaped by experience, entering college freshmen might benefit from formal instruction concerning learning styles and the relationship between learning styles and academic disciplines.

#### Final Comments

Inquiry into the teaching and learning process are considerations for higher education as well as within the entire framework of the American educational system. Research on the implications of student and instructor learning styles and the impact of stress on the learner are variables that need further consideration for future planning in the areas of curriculum and pedagogy. Continuing interest in these variables and the further refinement of techniques to study them may serve to enhance the teaching-learning process in such a way that it will more effectively meet the needs of individual learners. A case in point is the fact that it is not possible to remove the effect of cognitive ability as measured,

for example, by the ACT. Hence, it is important to be cognizant of learning style differences in the classroom. Historically, the burden has been placed on the student to remedy the mismatch between instructor and student learning styles. This study supports the contention that instructors need to develop strategies which minimize the mismatch by teaching to all four learning styles.

This study of stress and learning style attempted to contribute to the knowledge base of teaching and learning, "to connect significantly with those concerns of central importance to . . . students" (Chickering, 1969, p.3). The questions raised and the questions answered were the product of that continuing endeavor.



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**APPENDIX A. INFORMED CONSENT**

INFORMATION ON THE USE OF HUMAN SUBJECTS IN RESEARCH  
IOWA STATE UNIVERSITY

(Please follow the accompanying instructions for completing this form.)

114

1. Title of project (please type): The Relationship of Match/Mismatch of Student-Teacher Learning Styles, Student Stress and Academic Achievement

2. I agree to provide the proper surveillance of this project to insure that the rights and welfare of the human subjects are properly protected. Additions to or changes in procedures affecting the subjects after the project has been approved will be submitted to the committee for review.

|                                      |                            |                                     |
|--------------------------------------|----------------------------|-------------------------------------|
| <u>William J. O'Neill</u>            | <u>1-15-88</u>             | <u>William J. O'Neill</u>           |
| Typed Name of Principal Investigator | Date                       | Signature of Principal Investigator |
| <u>RR 1, Box 137</u>                 | <u>319-385-6314 (work)</u> |                                     |
| <u>Mt. Pleasant, IA 52641</u>        | <u>319-986-2190 (home)</u> |                                     |
| Campus Address                       | Campus Telephone           |                                     |

3. Signatures of others (if any)      Date      Relationship to Principal Investigator

|                    |                 |                      |
|--------------------|-----------------|----------------------|
| <u>[Signature]</u> | <u>12/17/87</u> | <u>Major Advisor</u> |
|--------------------|-----------------|----------------------|

4. ATTACH an additional page(s) (A) describing your proposed research and (B) the subjects to be used, (C) indicating any risks or discomforts to the subjects, and (D) covering any topics checked below. CHECK all boxes applicable.

- Medical clearance necessary before subjects can participate
- Samples (blood, tissue, etc.) from subjects
- Administration of substances (foods, drugs, etc.) to subjects
- Physical exercise or conditioning for subjects
- Deception of subjects
- Subjects under 14 years of age and(or)       Subjects 14-17 years of age
- Subjects in institutions
- Research must be approved by another institution or agency



5. ATTACH an example of the material to be used to obtain informed consent and CHECK which type will be used.

- Signed informed consent will be obtained.
- Modified informed consent will be obtained.

6. Anticipated date on which subjects will be first contacted:      Month      Day      Year  
2      1      88

Anticipated date for last contact with subjects:      4      29      88

7. If Applicable: Anticipated date on which audio or visual tapes will be erased and(or) identifiers will be removed from completed survey instruments:

Month      Day      Year

8. Signature of Head or Chairperson      Date      Department or Administrative Unit

|                    |                 |                             |
|--------------------|-----------------|-----------------------------|
| <u>[Signature]</u> | <u>12-18-87</u> | <u>Professional Studies</u> |
|--------------------|-----------------|-----------------------------|

9. Decision of the University Committee on the Use of Human Subjects In Research:

- Project Approved       Project not approved       No action required

|                               |                |                                    |
|-------------------------------|----------------|------------------------------------|
| <u>George G. Karas</u>        | <u>1-25-88</u> | <u>PM Keith</u>                    |
| Name of Committee Chairperson | Date           | Signature of Committee Chairperson |

**Subject's Consent Form**

The purpose of this study is to investigate the relationship of the match/mismatch of student-teacher learning style, student stress, and academic achievement. Accordingly, you will be asked to take two short written inventories (tests). One will measure your learning style, the way in which you prefer to learn new material. The other will measure your perception of stress. These instruments will be administered during one of your regular class periods for this course.

In order to measure the relationship between these variables and your academic achievement, you are asked to give your permission for access to your ACT score to be obtained from the Office of the Registrar and your final grade in this course which will be obtained from your professor.

The researcher will not be aware of your identity. Your instructor will assign a number to you which will be used on the two tests that you take. Likewise, the ACT score and final grade will have the same number attached rather than your name.

The results from the two inventories will be made available to you. You may benefit from this study by learning what your preferred learning style is and in what ways you can improve your learning efficiency. Also you may be interested to know your stress level while taking this course. This information may help you with your university studies. Your involvement in this study may help people learn better and more efficiently than is presently the case.

There is no risk in this study, and no discomfort or embarrassment involved with any of the questions. However, if you do not wish to participate, please feel free to withdraw at this time without consequences.

Your responses will be kept confidential and reported only as "mass data" in the researcher's doctoral dissertation or any publication resulting from this study. The data will be maintained until the dissertation and any publications resulting from the study are completed.

Do you have any questions? If so, please ask them now.

PRINT your name: \_\_\_\_\_ Date: \_\_\_\_\_

Signed: \_\_\_\_\_ Class & Section \_\_\_\_\_

Time of class: \_\_\_\_\_ Instructor: \_\_\_\_\_

**APPENDIX B. INSTRUMENTS**

**PLEASE NOTE:**

Copyrighted materials in this document have not been filmed at the request of the author. They are available for consultation, however, in the author's university library.

These consist of pages:

117-118: Learning Style Inventory

**U·M·I**

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## SELF-EVALUATION QUESTIONNAIRE

Developed by Charles D. Spielberger  
in collaboration with  
 R. L. Gorsuch, R. Lushene, P. R. Vagg, and G. A. Jacobs  
 STAI Form Y-1

Name \_\_\_\_\_ Date \_\_\_\_\_ S \_\_\_\_\_  
 Age \_\_\_\_\_ Sex: M \_\_\_\_\_ F \_\_\_\_\_ T \_\_\_\_\_

**DIRECTIONS:** A number of statements which people have used to describe themselves are given below. Read each statement and then blacken in the appropriate circle to the right of the statement to indicate how you feel *right now*, that is, *at this moment*. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

- |  |   |  |
|--|---|--|
|  | NOT AT ALL<br>MODERATELY SO<br>VERY MUCH SO |  |
| 1. I feel calm .....                                       | ( ) ( ) ( ) ( )                             |  |
| 2. I feel secure .....                                     | ( ) ( ) ( ) ( )                             |  |
| 3. I am tense .....  | ( ) ( ) ( ) ( )                             |  |
| 4. I feel strained .....                                   | ( ) ( ) ( ) ( )                             |  |
| 5. I feel at ease .....                                    | ( ) ( ) ( ) ( )                             |  |
| 6. I feel upset .....                                      | ( ) ( ) ( ) ( )                             |  |
| 7. I am presently worrying over possible misfortunes ..... | ( ) ( ) ( ) ( )                             |  |
| 8. I feel satisfied .....                                  | ( ) ( ) ( ) ( )                             |  |
| 9. I feel frightened .....                                 | ( ) ( ) ( ) ( )                             |  |
| 10. I feel comfortable .....                               | ( ) ( ) ( ) ( )                             |  |
| 11. I feel self-confident .....                            | ( ) ( ) ( ) ( )                             |  |
| 12. I feel nervous .....                                   | ( ) ( ) ( ) ( )                             |  |
| 13. I am jittery .....                                     | ( ) ( ) ( ) ( )                             |  |
| 14. I feel indecisive .....                                | ( ) ( ) ( ) ( )                             |  |
| 15. I am relaxed .....                                     | ( ) ( ) ( ) ( )                             |  |
| 16. I feel content .....                                   | ( ) ( ) ( ) ( )                             |  |
| 17. I am worried .....                                     | ( ) ( ) ( ) ( )                             |  |
| 18. I feel confused .....                                  | ( ) ( ) ( ) ( )                             |  |
| 19. I feel steady .....                                    | ( ) ( ) ( ) ( )                             |  |
| 20. I feel pleasant .....                                  | ( ) ( ) ( ) ( )                             |  |



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## SELF-EVALUATION QUESTIONNAIRE

STAI Form Y-2

Name \_\_\_\_\_ Date \_\_\_\_\_

**DIRECTIONS:** A number of statements which people have used to describe themselves are given below. Read each statement and then blacken in the appropriate circle to the right of the statement to indicate how you *generally* feel. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel.

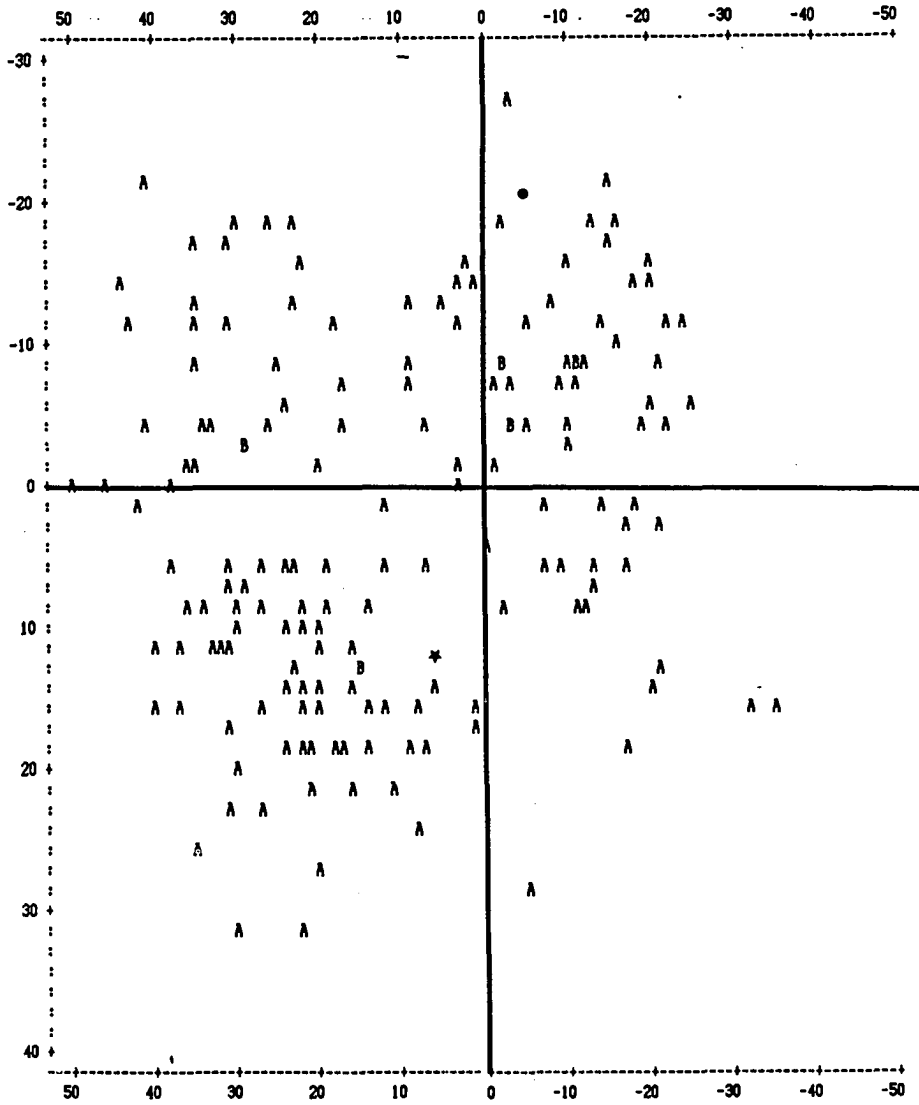
- |   |   |  |
|---|---|--|
|   | ALMOST NEVER<br>SOMETIMES<br>OFTEN<br>ALMOST ALWAYS |  |
| 21. I feel pleasant .....   | ( ) ( ) ( ) ( )                                     |  |
| 22. I feel nervous and restless .....   | ( ) ( ) ( ) ( )                                     |  |
| 23. I feel satisfied with myself .....  | ( ) ( ) ( ) ( )                                     |  |
| 24. I wish I could be as happy as others seem to be .....   | ( ) ( ) ( ) ( )                                     |  |
| 25. I feel like a failure .....   | ( ) ( ) ( ) ( )                                     |  |
| 26. I feel rested .....   | ( ) ( ) ( ) ( )                                     |  |
| 27. I am "calm, cool, and collected" .....  | ( ) ( ) ( ) ( )                                     |  |
| 28. I feel that difficulties are piling up so that I cannot overcome them .....                   | ( ) ( ) ( ) ( )                                     |  |
| 29. I worry too much over something that really doesn't matter .....                              | ( ) ( ) ( ) ( )                                     |  |
| 30. I am happy .....  | ( ) ( ) ( ) ( )                                     |  |
| 31. I have disturbing thoughts .....  | ( ) ( ) ( ) ( )                                     |  |
| 32. I lack self-confidence .....  | ( ) ( ) ( ) ( )                                     |  |
| 33. I feel secure .....   | ( ) ( ) ( ) ( )                                     |  |
| 34. I make decisions easily .....   | ( ) ( ) ( ) ( )                                     |  |
| 35. I feel inadequate .....   | ( ) ( ) ( ) ( )                                     |  |
| 36. I am content .....  | ( ) ( ) ( ) ( )                                     |  |
| 37. Some unimportant thought runs through my mind and bothers me .....                            | ( ) ( ) ( ) ( )                                     |  |
| 38. I take disappointments so keenly that I can't put them out of my mind .....                   | ( ) ( ) ( ) ( )                                     |  |
| 39. I am a steady person .....  | ( ) ( ) ( ) ( )                                     |  |
| 40. I get in a state of tension or turmoil as I think over my recent concerns and interests ..... | ( ) ( ) ( ) ( )                                     |  |

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APPENDIX C. TABLES

Table C-1

Distance of Student from Instructor on Abstract-Concrete (DAC) and Active Reflective (DAR) Dimensions of Learning Style Model



Note. A = 1 obs, B = 2 obs, etc.



Table C-2

Description of Distance between Student and Instructor Learning Styles,  
State Anxiety, Course Grade, and Course Grade Residuals

| SUBJ NO | DAC | DAR | SANX | GRADE | GPA-RESA |
|---------|-----|-----|------|-------|----------|
| 1       | -24 | -12 | 31   | 4.00  | -        |
| 2       | -11 | -9  | 54   | 3.00  | .94      |
| 3       | -14 | -12 | 33   | 3.00  | -.08     |
| 4       | -22 | -12 | 49   | 1.00  | -.97     |
| 5       | -21 | -9  | 47   | 4.00  | .64      |
| 6       | -22 | -4  | 34   | 3.00  | -.17     |
| 7       | -25 | -6  | 34   | 2.00  | -.62     |
| 8       | -20 | -14 | 67   | 2.00  | -.06     |
| 9       | -18 | -14 | 63   | 1.00  | -2.08    |
| 10      | -10 | -4  | 65   | 2.00  | -.43     |
| 11      | -9  | -7  | 39   | 3.00  | .10      |
| 12      | -10 | -3  | 69   | 2.00  | -        |
| 13      | -15 | -17 | 43   | 3.00  | .01      |
| 14      | -20 | -16 | 45   | 4.00  | .83      |
| 15      | -15 | -21 | 43   | 3.00  | -        |
| 16      | -16 | -18 | 39   | 2.00  | -        |
| 17      | -13 | -19 | 30   | 4.00  | .73      |
| 18      | -19 | -5  | 33   | 4.00  | -        |
| 19      | -10 | -8  | 33   | 4.00  | 1.04     |
| 20      | -11 | -9  | 37   | 2.00  | -        |
| 21      | -12 | -8  | 65   | 0.00  | -2.16    |
| 22      | -16 | -10 | 44   | 3.00  | .10      |
| 23      | -11 | -7  | 38   | 3.00  | .38      |
| 24      | -10 | -16 | 36   | 4.00  | .83      |
| 25      | 22  | 10  | 56   | 4.00  | .92      |
| 26      | 23  | -13 | 27   | 4.00  | 1.10     |
| 27      | 23  | 5   | 41   | 2.00  | -        |
| 28      | 22  | 8   | 74   | 4.00  | 1.10     |
| 29      | 24  | 6   | 57   | 1.00  | -2.08    |
| 30      | 20  | 10  | 54   | 3.00  | .94      |
| 31      | 19  | 9   | 39   | 4.00  | 1.29     |
| 32      | 24  | 10  | 36   | 4.00  | 1.29     |
| 33      | 14  | 8   | 56   | 2.00  | -.80     |
| 34      | 3   | -15 | 43   | 3.00  | -.17     |
| 35      | 5   | -13 | 25   | 4.00  | -        |
| 36      | 18  | -12 | 28   | 4.00  | -        |
| 37      | 12  | 2   | 50   | 2.00  | -.34     |

Table C-2 (Continued)

| SUBJ NO | DAC | DAR | SANX | GRADE | GPA-RESA |
|---------|-----|-----|------|-------|----------|
| 38      | 23  | -19 | 43   | 3.00  | -.54     |
| 39      | 22  | -16 | 64   | 3.00  | -        |
| 40      | 9   | -9  | 56   | 3.00  | -.27     |
| 41      | 17  | -5  | 22   | 3.00  | -        |
| 42      | 17  | -7  | 43   | 4.00  | .46      |
| 43      | 3   | -1  | 43   | 4.00  | .64      |
| 44      | 7   | 5   | 43   | 2.00  | -        |
| 45      | 24  | -6  | 53   | 3.00  | -.17     |
| 46      | 21  | -1  | 30   | 3.00  | -.45     |
| 47      | -13 | 5   | 64   | 1.00  | -1.99    |
| 48      | -11 | 9   | 37   | 4.00  | 1.10     |
| 49      | -17 | 5   | 38   | 4.00  | -        |
| 50      | -21 | 13  | 64   | 4.00  | 1.20     |
| 51      | -13 | 7   | 29   | 2.00  | -.80     |
| 52      | -20 | 14  | 56   | 1.00  | -1.25    |
| 53      | -17 | 3   | 53   | 3.00  | .38      |
| 54      | -32 | 16  | 33   | 3.00  | .47      |
| 55      | -17 | 19  | 26   | 4.00  | -        |
| 56      | -21 | 3   | 32   | 3.00  | .57      |
| 57      | -9  | 5   | 41   | 3.00  | -.08     |
| 58      | -35 | 15  | 61   | 3.00  | .29      |
| 59      | -14 | 2   | 71   | 4.00  | -        |
| 60      | -18 | 2   | 37   | 4.00  | 1.47     |
| 61      | 12  | 6   | 65   | 3.00  | -.45     |
| 62      | 12  | 16  | 58   | 2.00  | -        |
| 63      | 19  | 27  | 40   | 3.00  | -.27     |
| 64      | 21  | 21  | 59   | 4.00  | 1.20     |
| 65      | 8   | 24  | 21   | 3.00  | .57      |
| 66      | 14  | 16  | 33   | 3.00  | .29      |
| 67      | 9   | 19  | 71   | 3.00  | -.17     |
| 68      | 22  | 14  | 47   | 2.00  | -.80     |
| 69      | 24  | 14  | 41   | 4.00  | 1.57     |
| 70      | 16  | 22  | 41   | 2.00  | -.62     |
| 71      | 17  | 19  | 39   | 2.00  | -1.08    |
| 72      | 18  | 32  | 38   | 4.00  | -        |
| 73      | 20  | 14  | 44   | 2.00  | -.25     |
| 74      | 7   | 19  | 41   | 2.00  | -.99     |
| 75      | 20  | 16  | 66   | 2.00  | -        |
| 76      | 20  | 12  | 52   | 2.00  | -1.17    |
| 77      | 14  | 18  | 25   | 2.00  | -        |
| 78      | 8   | 16  | 26   | 2.00  | -        |

Table C-2 (Continued)

| SUBJ NO | DAC | DAR | SANX | GRADE | GPA-RESA |
|---------|-----|-----|------|-------|----------|
| 79      | 1   | 15  | 52   | 2.00  | .30      |
| 80      | 18  | 18  | 60   | 2.00  | -        |
| 81      | 1   | 17  | 68   | 3.00  | -.17     |
| 82      | 21  | 19  | 44   | 4.00  | .46      |
| 83      | 23  | 13  | 51   | 3.00  | -.08     |
| 84      | 24  | 18  | 55   | 1.00  | -        |
| 85      | 22  | 18  | 39   | 2.00  | -.80     |
| 86      | 15  | 13  | 20   | 4.00  | -.09     |
| 87      | -4  | 28  | 47   | 1.00  | -1.90    |
| 88      | 16  | 14  | 60   | 1.00  | -1.16    |
| 89      | 11  | 21  | 48   | 2.00  | -.99     |
| 90      | 15  | 13  | 30   | 4.00  | .55      |
| 91      | 19  | 6   | 62   | 4.00  | .92      |
| 92      | 22  | 16  | 51   | 3.00  | .01      |
| 93      | 16  | 12  | 50   | 3.00  | -.08     |
| 94      | -8  | -13 | 38   | 3.00  | -.27     |
| 95      | -3  | -27 | 56   | 3.00  | .10      |
| 96      | 2   | -16 | 58   | 1.00  | -1.25    |
| 97      | 1   | -15 | 32   | 3.00  | -.45     |
| 98      | -5  | -11 | 54   | 3.00  | .38      |
| 99      | -2  | -18 | 50   | 3.00  | .10      |
| 100     | 3   | -11 | 50   | 3.00  | -        |
| 101     | -3  | -5  | 58   | 4.00  | 1.97     |
| 102     | -2  | -8  | 65   | 3.00  | .66      |
| 103     | 7   | -4  | 41   | 2.00  | -        |
| 104     | -1  | -7  | 54   | 3.00  | -.27     |
| 105     | 9   | -7  | 25   | 2.00  | -        |
| 106     | -3  | -7  | 57   | 3.00  | .10      |
| 107     | -2  | -8  | 35   | 4.00  | 1.01     |
| 108     | 9   | -13 | 56   | 0     | -2.62    |
| 109     | -1  | -1  | 64   | 3.00  | -.08     |
| 110     | -5  | -5  | 30   | 4.00  | 1.10     |
| 111     | -12 | 8   | 62   | 3.00  | .08      |
| 112     | -20 | -6  | 70   | 2.00  | -        |
| 113     | -3  | -5  | 59   | 2.00  | -.62     |
| 114     | 42  | 2   | 44   | 2.00  | -        |
| 115     | 50  | 0   | 57   | 4.00  | .46      |
| 116     | 41  | -21 | 36   | 3.00  | -.27     |
| 117     | 42  | -12 | 52   | 3.00  | -.54     |
| 118     | 38  | 6   | 29   | 3.00  | -.36     |
| 119     | 46  | 0   | 60   | 3.00  | .01      |

Table C-2 (Continued)

| SUBJ NO | DAC | DAR | SANX | GRADE | GPA-RESA |
|---------|-----|-----|------|-------|----------|
| 120     | 30  | -18 | 58   | 4.00  | -        |
| 121     | 36  | -2  | 42   | 4.00  | -        |
| 122     | 35  | -1  | 68   | 3.00  | -.17     |
| 123     | 30  | 8   | 39   | 4.00  | .83      |
| 124     | 31  | 5   | 57   | 4.00  | .37      |
| 125     | 34  | 8   | 60   | 2.00  | -.62     |
| 126     | 30  | 10  | 41   | 3.00  | -.54     |
| 127     | 31  | 7   | 32   | 2.00  | -.90     |
| 128     | 27  | 9   | 59   | 4.00  | -        |
| 129     | 36  | 8   | 59   | 4.00  | .73      |
| 130     | 29  | 7   | 64   | 2.00  | -1.08    |
| 131     | 35  | -17 | 46   | 4.00  | -        |
| 132     | 26  | -4  | 25   | 4.00  | 1.10     |
| 133     | 44  | -14 | 39   | 4.00  | -        |
| 134     | 26  | -18 | 77   | 1.00  | -        |
| 135     | 35  | -13 | 32   | 4.00  | 1.10     |
| 136     | 31  | -17 | 60   | 4.00  | 1.57     |
| 137     | 25  | -9  | 53   | 4.00  | 1.38     |
| 138     | 35  | -11 | 40   | 4.00  | .73      |
| 139     | 35  | -9  | 60   | 2.00  | -        |
| 140     | 29  | -3  | 40   | 4.00  | .46      |
| 141     | 34  | -4  | 44   | 3.00  | -        |
| 142     | 31  | -11 | 39   | 4.00  | .92      |
| 143     | 33  | -5  | 40   | 2.00  | -        |
| 144     | 41  | -5  | 44   | 3.00  | .47      |
| 145     | 38  | 0   | 53   | 4.00  | 1.10     |
| 146     | 29  | -3  | 76   | 4.00  | 1.38     |
| 147     | 27  | 5   | 46   | 4.00  | .73      |
| 148     | 6   | 14  | 42   | 2.00  | -1.08    |
| 149     | 3   | 0   | 68   | 2.00  | -.25     |
| 150     | 0   | 4   | 49   | 3.00  | .29      |
| 151     | -7  | 5   | 65   | 3.00  | .10      |
| 152     | -2  | 8   | 48   | 2.00  | -.62     |
| 153     | -7  | 1   | 72   | 3.00  | -        |
| 154     | 31  | 17  | 63   | 4.00  | .73      |
| 155     | 40  | 16  | 57   | 4.00  | -        |
| 156     | 40  | 12  | 46   | 2.00  | -        |
| 157     | 37  | 11  | 30   | 4.00  | 1.38     |
| 158     | 30  | 32  | 32   | 4.00  | .09      |
| 159     | 37  | 15  | 33   | 2.00  | -.90     |
| 160     | 32  | 12  | 44   | 3.00  | -.45     |

Table C-2 (Continued)

| SUBJ NO | DAC | DAR | SANX | GRADE | GPA-RESA |
|---------|-----|-----|------|-------|----------|
| 161     | 27  | 23  | 58   | 4.00  | -        |
| 162     | 33  | 11  | 51   | 2.00  | -1.17    |
| 163     | 36  | 26  | 66   | 4.00  | .73      |
| 164     | 31  | 23  | 46   | 1.00  | -2.08    |
| 165     | 30  | 20  | 51   | 0.00  | -2.80    |
| 166     | 27  | 15  | 38   | 3.00  | .38      |
| 167     | 31  | 11  | 48   | 2.00  | -.53     |

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Subject #    Learning Style

1 - 46    Diverger  
47 - 93    Accommodator  
94 -147    Assimilator  
148 -167    Converger

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