AN INVESTIGATION OF THE RELATIONSHIP BETWEEN THREE CATEGORIES OF COLLEGE MAJOR AND SELECTED MEASURES OF COGNITIVE STYLE

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ABSTRACT

AN INVESTIGATION OF THE RELATIONSHIP BETWEEN THREE CATEGORIES OF COLLEGE MAJOR AND SELECTED MEASURES OF COGNITIVE STYLE

By

John Thomas Deines

The term cognitive style refers to basic ways in which people approach learning situations. The purpose of the present investigation was to determine the relation of cognitive style to college major. Should students majoring in different subjects be found to differ in cognitive style, this could influence instructional strategy and provide more information for counselors dealing with student concerns relative to choice of major.

The cognitive style constructs selected for use were field-dependence-independence, reflection-impulsivity, intuition as defined by Malcolm Westcott, and the Jungian dominant types. American College Test composite score and grade point average were included for purposes of comparison. Humanities, social science, and natural science constituted the college major categories. Two samples of 150 undergraduate students (divided equally by sex and major) served as subjects for the study.

There were four major hypotheses. The first tested the related measures simultaneously in their ability to differentiate the categories of major and the sexes. The second examined the distribution of dominant Jungian types across the major categories. The third and fourth tested the related measures simultaneously in their ability to differentiate the dominant sensors and intuiters and to differentiate dominant thinkers and feelers. Analysis was via multivariate analysis of variance for testing

the related measures simultaneously and via chi-square for testing the distribution of dominant Jungian types across the categories of major. Each measure was also tested via univariate analysis of variance.

No hypothesis in the study was confirmed as stated. However, in one sample cognitive style was found to differentiate college majors with field-dependence-independence contributing most to the differentiation. The univariate analyses revealed that natural science majors tended toward field-independence, were more concerned with accuracy on the measure of reflection-impulsivity, and tended to require less information to draw conclusions on the intuition measure. While it was expected that the strongest differentiation would be between natural science and humanities majors, differences between social science majors and the other two were more consistent. When the attitudes of extraversion and introversion were combined with the dominant functions, extraverted and introverted sensors were found to tend toward the natural sciences, extraverted intuiters to tend away from the natural sciences, and extraverted thinkers were found to tend toward the humanities.

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By

John Thomas Deines

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To

Beverly Jane

and

Sara Jane

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CHAPTER I

INTRODUCTION

Background

The position that the campus counseling psychologist deals with the developmental needs of students as opposed to remedial needs has long been emphasized (Morrill, Ivey, & Oetting, 1968; Oetting, 1967). Many universities have reorganized their student services offerings in a manner such that the divisions frequently are clustered under a title such as "Student Development Services." In such organizations, remedial needs continue to be met by existing units and personnel but the concept is broadened to include some assistance in the process of living effectively while obtaining a college education. Brown (1971) states

> ...that student development staffs must have input into and involvement with the academic dimensions of the collegiate experience. This could well be one of their most important functions in the future. However, it is not likely to be a function that is going to be handed them freely, nor is it a function they can usurp. It will be one that they will have to earn by possessing clearly defined skills and concepts (p. 48).

Sperry (1973), in a more recent but similar appeal, writes

> The need to understand individual differences--especially learning styles--is emerging as the number one priority for the teacher and the counselor (p. 483).

He also reported that researchers, in their efforts to improve

instruction, have discovered the importance of the context in which learning takes place, particularly the interaction between the learner and his environment--a book, programmed unit, teacher, or counselor. An important component of the interaction is the mode by which the learner learns and how assistance is provided to him.

The goal of the present study is to explore some of the dimensions related to and resulting from the cognitive development of students--cognitive or learning style. This effort is made to provide the counseling psychologist with additional understandings for assisting the student to achieve maximum development during the college years. The counseling psychologist thus will have more concepts and skills with which to augment student development both when dealing with the student directly and when acting as consultant to other university officials who will in turn deal directly with the student.

Cognitive Style Defined

The term "cognitive style" or "learning style" is not one that has a precise definition. While most terms in psychology are subject to interpretation, cognitive style ranks on the lower end of the less-precise-to-more-precise-definition continuum.

That consensus as to a precise and exact definition is lacking is due in part to a lack of a single unifying theory which underlies the phenomenon, though the work of proponents of a specific system may be theory inspired, e.g., the cognitive controls of the Menninger group are rooted in psychoanalytic theory. Kagan and Kogan (1970) say that the research on cognitive styles and controls has been conducted within a broad theoretical base while Spitler (1971) says that cognitive styles

are more empirical observations of researchers than deductions from a theoretical system. Ziegler (1963) criticizes the work of Witkin, one of the foremost researchers in this area, on the grounds that it has no theory to which his work can be linked.

From a systematic review of the literature, there seem to be three groups of studies to which the label "cognitive style" has been attached. The first most obvious group (Category I) includes those studies which employ measures labeled as estimates or dimensions of cognitive style. In this category belong the work of Witkin (Witkin, Dyk, Faterson, Goodenough, & Karp, 1962; Witkin, Lewis, Hergzman, Machover, Meissner, & Wapner, 1954) on field-dependence-independence, the work of Kagan (Kagan, Rosman, Day, Albert, & Philips, 1964) on conceptual tempo, the work by a group of researchers (Gardner, Holzman, Klein, Linton, & Spence, 1959) at the Menninger Foundation on cognitive controls, the work of Bieri (Bieri, Atkins, Briar, Leaman, Miller, & Tripoldi, 1966) on cognitive complexity, and the work of Broverman (1960a, 1960b) on ipsative analysis of cognitive functioning.

The second classification (Category II) includes those phenomena which operationally use instrumentation similar to the cognitive style researchers referred to above but which do not employ the actual term "cognitive style." Some of these researchers published their work before the "cognitive style" label became popular. Such is the case with the work of Thurstone (1944) and Mooney (1954) in their research on the various aspects of closure. Other researchers chose not to use the term. Such is the case with the work of Westcott (1968b). The view of the present author, which will be presented in Chapter III, is that Westcott's operational definition of intuition is in fact an operational

definition of cognitive style. Pengel (1971) used the Westcott measure and referred to it as a measure of "cognitive-affective style." The present author is unable to explain why the term "affective" was added. No other source has equated cognition with affect, nor does Pengel explain herself on this point.

The third classification (Category III) includes as measures of cognitive style some phenomena more readily identified as personality variables. Messick (1972) says that cognitive styles are frequently implicated in personality and social functioning. As an example of this, Johansson (1971) refers to Holland's (1966) six personality types as cognitive styles. Cohen, Johnson, and Hanson (1971) define cognitive style as basic level of intentionality. Snyder (1966) used the Sensation and Intuition scores of the Myers-Briggs Type Indicator (Myers, 1962) to assess students' cognitive "horizons." Similarly, Child (1965), in a study of esthetic judgment in college students, employed the Myers-Briggs Type Indicator as a measure of cognitive style along with measures of the cognitive controls of the Menninger group, field-dependence, and others.

With this categorization in mind, it might be well to review some definitions of cognitive style. De Cecco (1968) uses this definition:

> Learning styles are personal ways in which individuals process information in the course of learning new concepts and principles (p. 75).

He also points out in common with others that these modes of processing are considered to be relatively free of content and to cut across different types of information.

Kagan and Kogan (1970) say cognitive style is an approach to cognition and cognitive processes and then define those terms as follows:

> ...cognition stands for those hypothetical psychological processes invoked to explain overt verbal and motor behavior as well as certain physiological reactions. Cognitive process is a superordinate term, subsuming the more familiar titles of imagery, perception, free association, thought, mediation, proliferation of hypotheses, reasoning, reflection and problem solving (p. 1275).

Child (1965) operationally defines cognitive style by saying

> People differ greatly one from another in their orientation toward various aspects of experience and the label cognitive style has come to be applied to such variations (p. 483).

As has been stated, it is the aim of the present study to provide the counseling psychologist with information which can be utilized primarily in an instructional setting. With this end in mind, De Cecco's definition seems most appropriate for the present study since it expresses specifically what the other two imply.

Purpose of the Study

The purpose of this study is to investigate the relationship of cognitive style to college major in the belief that knowledge of cognitive style will facilitate the role of the counseling psychologist as consultant to students and faculty.

Benefits of the Study

Vocational theorists, among others, have pointed out that different characteristics are required for success in different occupations (Super, 1953; Holland, 1966). Choice of major is closely related to

choice of occupation in that choice of major frequently leads to choice of occupation and in that a similar process is involved in choice of either. An understanding of the relation of cognitive style to college major can provide the counseling psychologist with an additional tool for assisting students in their search for the best major for them. The input of one more characteristic relevant to the choice of major can increase the accuracy of prediction formulae.

Brown (1971) has emphasized that it is important for the student personnel worker to become more involved in the academic dimensions of the collegiate experience, e.g., as consultant to faculty. Knowledge that cognitive style is related to college major can be used to assist faculty in grasping its implications for instruction. That is, if faculty are aware that a significant number of their students utilize a particular learning style, this information can be put to use in their instructional strategy.

Messick (1972) elaborates on the applicability of cognitive style for instruction by suggesting that measures of cognitive style could provide a more effective characterization of the student than achievement measures alone. In this regard he says,

> These stylistic characteristics should have relevance, although direct research evidence is admittedly very scanty, not only for the course of individual learning in various subject matter areas, but also for the nature of teacher-pupil interactions and of social behavior in the classroom, the family, and the peer group (p. 110).

Other possibilities outlined by Messick include using cognitive style as the basis for placement of students in classes, either homogenously or in special mixes, and matching students to faculty.

Mode of instruction can also be geared to cognitive style. For instance, at least in science, instruction via an inductive method of teaching (i.e., having the student discover the principles to be learned) or through a more direct approach (i.e., one in which principles are specified) can be related to cognitive style. The field-independent (Witkin et al., 1962; Witkin et al., 1954) and possibly reflective students (Kagan et al., 1964) may well learn more efficiently with the inductive approach, while field-dependent and impulsive students may learn more efficiently with the more direct approach.

Messick tempers all his proposals by saying that more empirical evidence concerning cognitive styles is needed. It is the aim of the present research to further knowledge in this area by focusing on the relation of cognitive style to college major.

Awareness of the range and variation of clients' cognitive styles can be beneficial to the counseling psychologist in dealing directly with students, individually, in groups, and in outreach programs. Carkhuff (1969) says that, while a great deal of emphasis has been placed on the style which counselors bring to sessions with clients, it is equally important to consider the client's style. A very important component of "style" is cognitive style.

Knowledge of client style including cognitive style can be utilized in one of two ways. Either the counselor can gear his style to the client's style or he can refer the client to another counselor whose style is more in harmony with that of the client.

In summary, a knowledge of cognitive style provides a very useful conceptual system from which the counseling psychologist can draw in his role as consultant to faculty and administration for student

development, or in providing services to students directly through individual, group, or outreach programs. Also since nearly all conceptual systems make some assumptions about cognitive style (although many are not very explicit) in a university setting where the cognitive domain is so emphasized, it seems especially important that such conceptualizing be made explicit.

Cognitive Styles and College Majors to be Investigated

Four cognitive styles were selected for use in this study. They are field-dependence-independence (Witkin et al., 1962; Witkin et al., 1954), reflection-impulsivity (Kagan et al., 1964), intuition (Westcott, 1968b), and the four Jungian (Jung, 1971) functions of sensation, intuition, thinking, and feeling.

Sperry (1973) noted that there were three cognitive styles which had received most attention and were therefore regarded as most important--learning modality, learning tempo, and learning differentiation. This statement provided the rationale for inclusion of learning tempo (reflection-impulsivity) and learning differentiation (field-dependence-independence). Learning modality refers to the sense through which the student best learns. Since it seemed to have minimal relevance for higher education, it was not included in the present study.

The Jungian functions were included in the study because they were of particular interest to the present author, and provide a way of relating cognitive "style" into a broader theoretical framework. The instrument which currently is most widely used to assess Jungian typology, the Myers-Briggs Type Indicator (MBTI) (Myers, 1962), enjoys wide popularity in colleges and universities throughout the country, and

research has been conducted with it relevant to choice of occupation and college major. The four functions are very similar to cognitive controls and styles (Child, 1965).

The choice of intuition as a measure for this study was made for two reasons. First, Westcott's (1968b) measure for intuition yielded scores for success in solving, in an inductive manner, abstraction problems and the amount of information demanded in seeking that solution. The variation in performance on the task seems to provide most useful information in keeping with the purposes of the study outlined above. Second, the present author hoped to provide more data on the relation of Westcott's measure to the Jungian notion of intuition.

College major will be categorized in the present study as majors in the humanities, social sciences, and natural sciences. The inspiration for this classification is found in the work of Goldschmid (1967) who successfully was able to predict college major (humanities to natural science dimension) on the basis of personality tests. While Goldschmid used the humanities to natural science dimension, he felt that the social sciences should be included in future studies.

Secondary Purpose of the Present Study

A secondary purpose of the present study proposes to correlate the four Jungian functions to measures of cognitive style. It builds in part on the work of Stanfiel (1966). He tested the hypothesis that field-independence was related to the two Jungian attitudes of extraversion-introversion. In two of three studies, he found support for that hypothesis but found no relation between the Jungian functions and field-dependence-independence. However, he did not take into account

Jung's concept of dominance of function, which says that one of the four functions is more important and more fully developed than the other three. The present author hypothesizes that a relationship will be found between dominant Jungian function and the cognitive styles which are the subject of the present study.

Hypotheses

From the discussion above it is now possible to state the hypotheses in the present study.

1. Students in different categories of college major will differ among themselves and between sexes on the dimension of field-dependence-independence.

2. Students in different categories of college major will differ among themselves and between sexes on the dimension of reflection-impulsivity.

3. Students in different categories of college major will differ among themselves and between sexes on the dimension of intuition.

4. The proportion of subjects divided on the basis of dominant Jungian function will differ by category of college major.

5. Differences will exist in performance on the dimension of field-dependence-independence between dominant Jungian sensors and intuiters.

6. Differences will exist in performance on the dimension of field-dependence-independence between dominant Jungian feelers and thinkers.

7. Differences will exist in performance on the dimension of reflection-impulsivity between dominant Jungian sensors and intuiters.

8. Differences will exist in performance on the dimension of reflection-impulsivity between dominant Jungian feelers and thinkers.

9. Differences will exist in performance on the dimension of less to more intuition between dominant Jungian sensors and intuiters.

10. Differences will exist in performance on the dimension of less to more intuition between dominant Jungian thinkers and feelers.

Summary

In this chapter, the position was advanced that the role of the campus counseling psychologist may expand to that of consultant to faculty on academic dimensions of the collegiate experience. It was proposed that examining the relationship of cognitive style to college major would provide the counseling psychologist with useful information in fulfilling that role and also in fulfilling his current role of assisting in student decision making.

The problems associated with defining cognitive style were discussed and the definition of personal ways people approach learning situations was adopted. Four conceptualizations of cognitive style--all applicable to learning situations--were chosen for investigation in the present study: field-dependence-independence, reflection-impulsivity, intuition, and dominant Jungian typology. Secondarily, an investigation of differential performance on field-dependence-independence, reflection-impulsivity, and intuition among the dominant Jungian functions was proposed.

10. Differences will exist in performance on the dimension of less to more intuition between dominant Jungian thinkers and feelers.

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CHAPTER II

REVIEW OF RELATED LITERATURE

The plan of this chapter is to present first a brief description of selected cognitive style systems which, though of theoretical interest, were not utilized in the present study. It portrays the process through which a neophyte student of cognitive style might proceed and which the present author used in arriving at the concepts utilized in the present study. Second, an overview of the cognitive style measures used in the present study will be presented along with research relevant to their relation to college major. Third, a review of those studies which relate other measures of cognitive style to college major will be presented. Finally, the implications of the findings for the present study will be discussed.

Cognitive Style Systems

Cognitive Complexity

Bieri (Bieri, 1971; Bieri et al., 1966) is among those scholars who view cognitive style as a mental set with which individuals construe their environment. Bieri's work has focused on how highly differentiated or complex those mental functions are and has been limited to the social

domain. His definition of cognitive complexity is

> ...the capacity to construe social behavior in a multidimensional way. A more cognitively complex person has available a more differentiated system of dimensions for perceiving others' behavior than does a less cognitively complex individual (Bieri et al., 1966, p. 185).

The construct is evaluated by having a subject list ten people with whom he is familiar. For these ten people he is to make ten ratings of each such as "outgoing," "calm," "cheerful," etc., on a Likert-type scale from one to six. Those individuals who rate their subjects much in the same manner, e.g., use mostly 5's or 6's, are said to be cognitively simple because they do not use much differentiation in their rating, while those who use more of the range are said to be cognitively complex.

The work of Bieri was not chosen for the present study because it focused on a domain not as directly applicable to the learning environment as the selected measures.

Conceptual Systems

Bieri's system represents an approach which is specific in conceptualization and application. On the other hand, the conceptual systems approach of Harvey, Hunt, and Schroder (1961) adopts a more pervasive view of cognitive functioning. The following statement by Schroder (1971) would lead one to conclude that he equates cognitive functioning with personality.

> ...personality is viewed as the style a person uses in processing information about a given domain of stimuli, e.g., interpersonal, political, or religious stimuli (p. 240).

The earlier position of Harvey et al. (1961) does not eliminate psychophysical and functional determinants, but their position is still in marked contrast to Bieri's. The Harvey et al. system concerns itself not only with differentiation but also with hierarchic integration which is considered a characteristic in the highest system of functioning.

The systems are four in number and the basis for differentiating them is a concreteness-abstractness dimension with System I being characterized by concreteness and System IV being characterized by abstractness. While the description of characteristics of the four types is couched in esoteric language, the following is a brief summation of them.

Each system is centered on a specific attribute which is said to be characteristic of that system. When a specific system is operative in an individual, events which are in harmony with it are said to be bolstered and those which are not are said to be neutralized.

The central attribute in System I functioning is adherence to an external standard and is said to be characterized by the following behaviors: forming standards quickly, rigidity, and overgeneralized submission to authority. The central attribute in System II functioning is imposition of control and is said to be characterized by the following behaviors: Aggression against the source of the control, flight from a situation in which strong control is perceived, and taking an opposite stance to the source of control.

The central attribute in System III functioning is mutuality and friendship and is said to be characterized by the following behaviors: self-evaluation based on others' opinions rather than one's own, submission to influence in an overgeneralized fashion, and seeking support of others. System I and III functioning are said to be related and

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System III functioning resembles the functioning of field-dependents in Witkin's system. The central attribute in System IV functioning is autonomy and is said to be characterized by the following behaviors: less susceptibility to social pressure, more ability to see self negatively and take corrective action, and more exploratory behavior.

Assessment in the conceptual systems approach is done with a sentence completion instrument which uses "This I believe" as its stem. Reactions are solicited on such areas as friendship, guilt, religion, and people.

While the conceptual systems approach in theory sees cognition as all pervasive, its application is primarily to the realm of social behavior. Also there seems to be a good measure of overlap between functioning in the three systems, and their method of assessment seems not to tap system specific functioning directly. For these reasons the present author chose not to deal extensively with the conceptual systems approach.

Cognitive Controls

The system Gardner, Holzman, Klein, Linton, and Spence (1959) have developed is referred to as cognitive controls. In common with the conceptual systems approach, this system attempts to explain a wide range of human behavior, but utilizes several concepts as opposed to one in achieving that end. Also the two systems differ in theoretical origin. The conceptual systems approach, as well as that of Bieri, derives its basic premises from Lewin's ideas on differentiation while proponents of cognitive controls look to the neo-Freudians for their inspiration. They postulate the controls as mediating links between

drives and situational requirements and have identified the following six cognitive controls. The combination of them in an individual constitutes his cognitive style.

1) Leveling-sharpening refers to a characteristic of individuals to relate previous stimuli to present perceptions. The person who tends to see present stimuli as relevant to past perceptions is referred to as a leveler; the person who tends to see past perceptions as not relevant to present perceptions is termed a sharpener. The test usually used to assess this characteristic is the Schematizing Test developed by Hollingworth. It is a test in which the subject views a series of square figures of varying size, both in a presentation ordered by size and one in which the squares are presented in random fashion.

2) Scanning refers to the number of times a subject looks at a standard and a comparison object in a size estimation task. One test of scanning requires the subject to adjust a disc of light to the size of a disc in his hand. There are several discs which vary according to color and weight. The other test requires the subject to estimate size in circles which have been constructed to present optical illusions.

3) Field articulation is the same concept identified by Witkin as field-dependence-independence. Gardner includes Thurstone's Concealed Figures Test as a measure of this variable.

4) The constricted-flexible control principle governs the manner in which a person handles conflicting or intrusive cues. The test used is modeled on Stroop's Color Word Test in which interference is created by requiring the subject to identify the color of the word "blue" when it is printed in red. Those whose performance on the test is relatively poor are referred to as constricted, and those who are relatively successful are referred to as flexible.

5) Equivalence range concerns itself with the manner in which an individual categorizes objects into broad or narrow categories or ranges. The characteristic is measured by the Object Sorting Test, the Photo Sorting Test, and two Thematic Apperception Test (TAT) cards. The first two tests require the subject to sort objects and photos into groups and then indicate the reasons he formed the groups he identified. On the TAT, subject's responses are scored on the conceptual distance the stories moved from physical features in the TAT cards.

6) Tolerance for unrealistic experiences refers to the ability of an individual to perceive something he knows to be unreal and accept it as such. Many individuals perceive an unrealistic experience and try to make it fit into the mold of previous perceptions. Optical illusions provide the means of assessing this characteristic. One is a situation in which two still photographs of a horse are progressively manipulated so that they give the appearance that the horse is moving. Subjects are assessed on this dimension by how long it takes them to recognize that what they are seeing is an optical illusion.

Research utilizing cognitive control principles more frequently deals with topics of relevance to mental health than to instructional practice. This, coupled with the fact that Chung (1967) had utilized four of the control principles in a study similar to the present study, led the present author to utilize only the concept of field-dependence-independence which had its origins independent of cognitive control research.

Ipsative Analysis of Cognitive Functioning

The work of Broverman (1960a, 1960b) stands alone among cognitive style researchers, not in conceptualization of specific styles but in a unique method of assessing an individual's cognitive style. Instead of using inter-individual differences to characterize an individual on a cognitive style dimension, relative intra-individual differences are used. That is, the subject is given a battery of cognitive style measures and then scores relative to the mean score of all the tests are used to categorize the subject on a cognitive style dimension. Factor analysis of a number of cognitive style measures analyzed using the intra-individual approach yielded a dimension Broverman refers to as strong or weak automatization. Kagan and Kogan (1970) point out that the measure strongly resembles Witkin's field-dependence-independence but that Broverman's method of analysis makes comparison difficult.

It did not seem that Broverman's system was so rewarding that there would be sufficient gain from leaving the mainstream of cognitive style research to warrant such a move. It was for this reason that Broverman's system was not utilized in the present study.

Sigel's Work on Conceptual Styles

Of the four systems described thus far, Sigel's work is the most directly applicable to instructional settings. His work started with an interest in the manner in which children organize phenomena in the world around them. Originally (Sigel, 1953), he dichotomized that mode of organization into perceptual or conceptual. The child who used the perceptual mode formed concepts on the basis of sense data. The

developmentally more advanced child used the conceptual mode and consciously imposed an organization on the material into deliberately conceived categories.

Kagan, Moss, and Sigel (1963) refined Sigel's (1953) formulation to include three categories--relational, inferential-categorical, and analytic-descriptive. A conceptual category is said to be relational when the subject groups at least two objects on the basis of a perceived relationship. For instance, he may identify in a picture two adults and a child as family, or in a picture a horse and a wagon as a unit because they "go together."

A conceptual category is said to be inferential-categorical when the subject groups objects and each object is an individual instance of the general category. That grouping is an inferred characteristic of what he perceives. For instance, in a picture of a cow and a horse, the two are identified as animals; a picture of a bed and a cradle are identified as things to sleep in.

A conceptual category is said to be analytic-descriptive when the subject groups one part of the stimulus field common to at least two objects in it. His conclusion is based on his analysis of what he perceives. For instance, if in a picture of three people two had no shoes, he would say that two people had no shoes. Sigel, Jarman, and Hanesian (1967) renamed the analytic-descriptive category analytic part-whole to which the term descriptive-global was contrasted. A conceptual category was said to be descriptive-global when the subject groups at least two entire parts of the stimulus field. For instance, in a picture of three people in which two are uniformed and one not uniformed, the subject may identify the uniformed people as such.

Sigel's instrument is the Conceptual Styles in Categorizing Behavior Task (SCST). In it three line drawings are presented to the subject who is asked to tell what is common in the drawings. They are so constructed that any of the conceptual categories can be identified. The conceptual categories which the subject identifies determine his style. Those subjects who use more analytic concepts are said to be more advanced.

The work of Sigel and his associates serves as a transition between the systems just discussed and some systems used in the present study. Kagan et al. (1964) used the Conceptual Styles Test (CST) in the first of their series of studies. As Kagan's work progressed, he found that those who formed analytic concepts were more reflective, that is, they took longer to make a response. This began his work on reflection-impulsivity, utilized in the present study. Also Kagan et al. (1963) say they believe that there is a relation of the tendency to form analytic concepts to what Witkin terms field-independence.

To acquaint the reader with specific systems to which the label "cognitive style" has been attached, five systems have been briefly described. While they all deal with the manner in which people construe the world they perceive, the difference among them seems to be the area of application. The systems of Bieri, and Harvey et al. have their application primarily in the world of social interactions, the work of Gardner et al. to mental health applications, and the work of Sigel to educational instruction, the focus of the present work. Broverman's work presents a unique way of assessing an individual's cognitive style.

In the next section the cognitive styles chosen for the present study will be discussed. First, an overview of each style will be presented to acquaint the reader with the system. Following this discussion, research linking that system to college major will be reviewed.

Cognitive Style Systems Utilized in the Present Study

Field-Dependence-Independence

Overview Witkin's work (Witkin et al., 1962; Witkin et al., 1954) started nearly thirty years ago with an interest in perception. A subject was placed in a perceptually embedding context, for instance, in a tilted room which contained a chair which could also be tilted. The subject was to orient himself upright.

Originally Witkin termed his construct "perceptual field-dependence-independence." As research evidence built, he found that intellectual as well as perceptual functioning was involved and so the term "global-analytical" was applied. Further research which uncovered dimensions of personality functioning such as body concept led to the term "global vs. articulated" functioning. The current conceptualization is that of "psychological differentiation." While the Witkin terms have a specific historical significance, they are used interchangeably in the literature and that practice will be continued in the present review.

Differentiation, a concept also utilized in biology, is related to the degree of complexity of an organism. In psychology it is found in the theory of Lewin and underlies other cognitive style systems as

well as Witkin's. Under this concept, that organism is considered to be less developed which is less complex. When the concept is applied to human growth, the infant is seen as less differentiated from his environment than the older youth who experiences his body as separate from the environment and develops a sense of identity.

Witkin's theory postulates that the level of a person's development is equal to the level of his differentiation. Level of differentiation is assessed by using one of three measures. The first is the Body Adjustment Test (BAT) in which the subject is placed in a tilted chair in a tilted room and adjusts his chair until he perceives he is in an upright position. The second is the Rod and Frame Test (RFT). In this test the subject is placed in a totally darkened room with a luminous frame which encloses a luminous rod. Both the rod and the frame are adjustable. The experimenter varies the tilt of the frame and the rod, and the subject then adjusts the rod to what he believes is the upright position.

The third measure is the Embedded Figures Test (EFT). In this test the subject is to identify a geometric figure which has been embedded in a maze of geometric designs.

Kagan and Kogan (1970) have reviewed the literature on field-dependence-independence extensively. They conclude that in Western cultures the EFT, RFT, and BAT all measure the same phenomena. There is evidence that in Nigerian culture these may not be valid measures and, therefore, possibly also in other non-Western cultures. The position of a person on the continuum from field-dependence to field-independence is relatively stable over time, although as children develop, they become progressively more field-independent. Evidence

that geriatric groups are more field-dependent suggests that perhaps there is a peaking of this characteristic in mid years and then a decline, the peak possibly occurring in the late thirties (Witkin, Oltman, Raskin, & Karp, 1971).

Perhaps the area of greatest controversy concerning the work of the Witkin group centers on the relation of analytic vs. global functioning to general intelligence and verbal ability. Witkin et al. (1962) point to research which links performance on the three measures of field-dependence-independence and performance on a cluster isolated through factor analysis--the object assembly, picture completion, and block design portions of the Weschler Intelligence Scale for Children (WISC). These three WISC subtests are believed to measure the ability to overcome an embedding context as do the measures of field-dependence-independence. Since there were two other verbally oriented clusters of WISC subtests isolated which did not require the ability to overcome an embedding context, Witkin's group concludes that verbal ability is not relevant to the dimension of psychological differentiation.

Ziegler (1963) has contended that the Witkin group, in arriving at this conclusion, has ignored research which suggests that there may be a link (a general intelligence factor) between verbal ability and analytic-global functioning. Indeed, Kagan and Kogan (1970) cite studies which have found significant correlations between verbal ability and analytic-global functioning. They conclude that the relationship between verbal ability and analytic-global functioning is not substantial since only a few researchers have found it, and there is more evidence to the contrary.

Analytic-global functioning has been related to other concepts involving perception. Such is the case with speed of closure and

flexibility of closure identified through factor analysis by Thurstone (1944). Witkin et al. (1962) discusses the relationship at length and points to research which strongly links overcoming an embedding context to flexibility of closure but not speed of closure. The work of Mooney (1954) on closure seems to involve both speed and flexibility of closure and it, therefore, is related in part to Witkin's work.

Witkin et al. (1962) comments on the apparent duplication of effort.

> In a period of extensive research on cognitive styles it is not surprising that there should be overlap or even identity among the cognitive styles established by different investigators. There is clearly a need for studies aimed at codifying these cognitive styles (p. 80).

To the best of the present author's knowledge, no one has seriously undertaken what Witkin has recommended.

There is evidence that field-independent individuals produce more sophisticated line drawings of human figures than field-dependent persons. Witkin makes the inference from these data that field-independent persons have a more differentiated body concept.

The personality variable of activity-passivity has been posited by the Witkin group as relating to field-dependence-independence. In only one study, which investigated posture of ten year old boys, did the hypothesized relationship receive confirmation. Also there has been evidence (using projective tests) to show that field-independent subjects used more specialized defenses such as isolation and intellectualization as opposed to repression and denial used by field-dependent subjects. Field-dependent subjects also have more uncontrolled aggression.

Socially, field-dependents have been found to exhibit more other directed (passive-dependent) behaviors while field-independents have been found to be less influenced by their social environments.

Witkin cites strong correlational evidence that field-dependent mothers foster field-dependence in their sons, but other research in this area has been confusing as to the influence of parents in fostering the analytic-global function in their children.

Except in four to eight year old groups and geriatric populations, males have been found to be significantly more field-independent than females, though the difference is relatively small. However, in some college populations, males and females have scored the same. The determinants of this observed difference have yet to be discovered with certainty, but cultural influences as well as spatial ability seem to be involved.

Further evidence for the validity of the global vs. articulated dimension has been collected in cross-cultural studies. Temne tribes in Sierra Leone, Africa, and Canadian Eskimos were subjects. The Temne have strict child-rearing practices while the Eskimos allow their women and children more autonomy. Also, the Eskimos live in a bleak and barren environment which requires a greater degree of field articulation. Since field-independence is associated with more moderate child-rearing practices, as well as greater need for field articulation, one would expect the Eskimos to be more field-independent than the Temne. Research evidence supports this.

Some of Witkin's earlier statements imply that it was more desirable to be field-independent. Kagan and Kogan (1970) challenge this notion saying that in today's climate the need may well be as great for those who are socially more accommodating (field-dependents) as for those who are able to resist the influence of others (field-independents). Witkin et al. (1971) have clarified their position which is now in basic harmony with that of Kagan and Kogan.

Field-dependence-independence is perhaps the most thoroughly researched of all the cognitive style systems. In this section it has been shown that the dimension has been effective in differentiating a wide range of phenomena from an individual's perception of his body image to differentiating cultures from one another. Against this background of research evidence, the argument of Ziegler (1963) that the dimension lacks a foothold in an established theory and may be no more than a factor of general intelligence seems pale. Of the dimensions chosen for the present study, field-dependence-independence has been shown to be the most successful in differentiating college majors. That evidence is presented in the next section.

Research Relevant to Field-Dependence-Independence and College Major

De Russy and Futch (1971) investigated the relation of field-dependence-independence to a humanities or natural science orientation. They administered the Embedded Figures Test to thirty-two subjects--eight males and eight females in the natural sciences, eight males and eight females in the humanities. They found males were significantly more field-independent than females and that science students were significantly more field-independent than humanities students. There were no interaction effects. The authors hypothesized that training in geometry might explain why science students were more field-independent.

Chung (1966), in a study to be reported in more detail later in this chapter, found that a group measure of field-dependence-independence discriminated science from humanities majors much in the manner as in the De Russy and Futch (1971) study.

Barrett and Thornton (1967) tested the hypothesis that engineers were more field-independent than the general population. They administered the Rod and Frame Test to forty-six male engineers and technicians employed by a midwest aerospace firm and to eleven non-engineering male students. The engineers and technicians were more field-independent than either the eleven college students or Witkin's standardization sample. There was no significant difference between Witkin's standardization sample and the college students.

Reflection-Impulsivity

Overview The dimension of reflection-impulsivity is concerned with the length of time subjects reflect on the solution to a problem where the solution is not absolutely clear. As has been pointed out, its development was an outgrowth of the work of Jerome Kagan (Kagan, et al., 1963; Kagan et al., 1964) on the analytic attitude in children. Most subsequent research has focused on children.

Since most of the research has focused on children, it might be questioned why it is being used with an adult population. The rationale for its use is that the variation which is found in children is also found in adults (Burgbacher, 1973; Gatewood, 1972). Specifically in reference to the present study, it is also reasonable to believe that science majors who are oriented to quantitative precision would tend toward a more reflective attitude than social science and humanities majors who are oriented to a more verbal and less quantitatively oriented methodology.

Reflection-impulsivity is usually measured using the Matching Familiar Figures Test (MFF), a test in which the subject is presented

a standard line drawing and eight variants. He is to identify the variant which duplicates the standard. Performance is measured by time to first response and errors made before identifying the correct variant.

The research on this dimension is much less extensive than that on the dimension of field-dependence-independence. This is particularly true in the area of personality variables such as self-concept, etc. Kagan and Kogan (1970) cite the following research relevant to the dimension.

1) Even for young children the dimension of reflection-impulsivity has been found to be reliable. In three studies the lowest test-retest correlation for the response time score was .31 (over 2½ years) and the highest .70 (over ten weeks).

2) Subjects have been found to be impulsive or reflective on other tasks from similar perceptual tasks to an interview situation. In the interview situation, the time a subject took to respond to a question of a general nature was recorded and correlated with response time on the MFF. The Pearson product moment correlation was .31.

3) Reflective children have been found to recall words in a serial recall list better than impulsive children under conditions of both low and high anxiety.

4) Reflective first grade children are better able to recognize spoken words than impulsive children. These same children served as subjects in a study one year later and the reflective children made fewer errors in reading a paragraph of English prose than did the impulsive children. Reflective children made fewer errors on tasks of inductive reasoning (e.g., responding to a question such as what barks, has fur, and walks on four legs?) than did impulsive children.

5) Reflective children made more eye movements in the first six seconds when they compared a standard with a variant than impulsive children. When the standard and variants were put behind frosted glass and it was necessary for each child to remove the glass, reflective children removed more of the glasses and examined the variants more carefully.

6) The characteristic of reflection-impulsivity can be modified. Four short-term experimental studies are cited in which the characteristic was modified in some way (e.g., in time to first response, but not errors) through direct training or modeling. In a fifth study, first grade teachers and students were categorized as reflective or impulsive thinkers at the beginning of the school year and at the end. Students did change in the direction of the tempo of their teachers. Therefore, evidence thus far presented has suggested that the characteristic of reflection-impulsivity is relatively stable over time and tasks but is somewhat modifiable if there is an intent to modify.

Only one study, Gatewood's (1972), has investigated the relation of reflective or impulsive individuals to choice of college major, and it is reviewed in the following section.

Research Relevant to Reflection-Impulsivity and College Major Gatewood (1972) investigated the relationship of two measures of cognitive style to grade point average, academic aptitude, and college major. The cognitive style measures were the MFF and Sigel's Conceptual Styles in Categorizing Behavior Task (SCST). The measure of academic aptitude was the American College Test (ACT), and college major was categorized as either "arts" or "sciences." No criterion was reported, however, for making this categorization, and only 39% of the subjects in the study

were classified as either arts or science majors for purposes of investigating hypotheses relating to science and arts students. Subjects for the study were 129 junior college sophomore males who were paid volunteers.

None of the seven hypotheses tested in the Gatewood study were substantiated by the data. The present author feels that failure to uphold hypotheses of relationship of cognitive style to college major was more due to the age of the population and the fact that not all subjects could be used to test the hypotheses. Gatewood cites data which show that only 50% of junior college students matriculate at four year institutions and that they tend to declare a given major more on the basis of prestige than ability. Furthermore, because not all subjects could be classified as analytic vs. non-analytic or impulsive vs. reflective, the number used for the statistical tests for these hypotheses was smaller than that used for the other tests.

Intuition

Overview Westcott's (1968b) work on intuition started with the simple observation that some people get the point more quickly than others. This seemingly obvious statement triggered questions such as, Do people in fact get the point more quickly? If so, to what degree do they vary? What are the implications of this variation?

A study of the psychology of intuition has its roots in philosophy. The classical position on intuition is that it is an avenue by which knowledge gained is characterized by non-sensory attainment of knowledge, the knowledge being non-empirical and non-verifiable. The

knowledge need not come as the result of prior intellectual endeavor, but it frequently does.

Westcott points out that there are basically two opposing views concerning intuition. They differ on the scope of the knowledge attained in this manner. The pure intuitionists hold that the knowledge gained through intuition is that of ultimates, while those of the positivistic school hold that the knowledge is more limited and immediately useful. An example of the former is that God is to be glorified and of the latter is that events have causes.

Westcott reports three views on intuition in psychology. The first view he terms the Verstehenist (or global understanding) position. This position holds that intuition is the step from inference to understanding. It is akin to what is referred to among psychotherapists as clinical as opposed to empirical understandings. The clinician suddenly achieves "insight" into the dynamics of the client, though he may not be able to trace in a one-two-three fashion just how he came to the conclusion. The non-intuitively-oriented empiricist, on the other hand, demands hard data to form a conclusion.

The second position (Jung, 1971) on intuition deals not so much with it as a form of mystical knowledge but as personality trait found in all people. Jung refers to intuition as perception by the unconscious as opposed to perception through the senses. Through the intuitive process Jung believes the intuiter perceives the generalities and implications while a sensing oriented person perceives the physical properties of the object or event. For instance, an intuiter may be likened to an abstract artist who is portraying the implications of his subject while the sensor would portray a replica of the physical properties of his

subject. Jung has, therefore, taken the mystery out of classical intuition by saying that it is just as much a function of human behavior as is perception by the senses. He feels that the reason people are not more aware of the function is that it is suppressed through societal pressure. His reasoning is that a person who has a constitutional predisposition toward intuition and develops it will likely be regarded as a dreamer and, therefore, a social outcast.

Jung's position links the Verstehenist position with the third position which can be termed the inference position. Westcott reports that those who aspire to the inference position hold that intuition is a special case of inference. It differs from the Verstehenist position in that knowledge is gained through definite sensory channels and cognitive manipulations but that some parts of the process--a specific manipulation or mediating link--may be obscure.

It is the latter position which Westcott holds and upon which his work has been based. When Westcott points to the research dealing with the inference view of intuition, he points to that body of research which others could readily term cognitive style. He says the research is

> ...catalogued under the headings of learning, perception, concept attainment, problem-solving, and so on, all occurring under less than optimum conditions. We are also directed to a literature not yet so large, but rapidly growing, which is concerned with personality and attitude differences in the acquisition of knowledge...(Westcott, 1968b, p. 189).

From this, it can be concluded that Westcott treats intuition as cognitive style which focuses on the amount of information an individual needs to solve a "cognitive riddle."

Westcott believes that one application of his work on intuition is in instructional practice in situations where information is lacking or apparently lacking. Such is the case with language instruction. Some students must extract the rules through a mental osmosis process, an intuitive process, while others learn best through "active" teaching of the rules. In graduate education the apprentice system is often advocated. It is a system in which the pupils learn informally, at the feet of the master so to speak, and it seems geared to an intuitive thinker while non-intuitives may gain more from a more formal approach. Westcott's overall contention is that cognitive style should influence instructional practice, and at every level--nursery school through graduate school.

Westcott's (1968b) operational definition of intuition is

> ...the event which occurs when an individual reaches a conclusion on the basis of less explicit information than is ordinarily required to reach that conclusion (p. 100).

The instrument (Westcott Intuition Test, WIT) which he uses to measure the concept consists of a series of verbal and numerical abstraction problems with five clues to the solution of the problem. The clues are so arranged that the subject uncovers them one at a time and in sequence. The subject is to use as few clues as possible. The correct response is that which is consensually valid when all the clues are known. The dependent variables are clue use, number correct, and efficiency or the ratio of the number correct to clue use. The efficiency score is rarely used.

Westcott has produced considerable research on characteristics associated with differential performance on the WIT. Subjects for his

study were several groups of college students which he terms samples. The samples he used for a specific study varied from study to study.

His first studies were correlational in nature comparing measures of academic achievement and aptitude with WIT scores. His major finding concerning academic aptitude was that the clue use score was negatively related to both the verbal and numerical scores of the Scholastic Aptitude Test (SAT), that the number correct score is positively related to both academic aptitude and achievement, and the efficiency score is related to SAT Mathematical Scores. Since the correlation coefficients between WIT and the aptitude scores were generally of a low magnitude and there were virtually no significant coefficients when course grades were compared with WIT scores, Westcott's overall conclusion is that neither academic achievement nor aptitude are much related to intuitive thinking. This finding coincides with the findings of other cognitive style researchers who posit that cognitive style is for the most part independent of intelligence.

After failing to find significance using correlational techniques with personality measures of impulse expression, and flexibility (adapted from the Vassar College Attitude Inventory), and manifest anxiety (Taylor Manifest Anxiety Scale), Westcott turned to using subjects whose performance was extreme on the measures of clue use and number correct. Extreme was defined as any score which was plus or minus one standard deviation from the mean on the two measures. (Sometimes the criterion was ± .75 s.d.) Sometimes extreme scorers on clue use and number correct were studied, but more often four quadrants were established for those who were extreme on the two measures combined. Thus those low on clue use and high on number correct were termed "intuitive thinkers;" those

high on clue use and high on number correct were termed "careful successes;" those low on clue use and low on number correct were "wild guessers;" and those high on clue use and low on number correct were "careful failures." There were from six to seven percent in each of the groups selected from the subjects used in the correlational studies cited previously.

One study cited by Westcott involved ratings by faculty members of extreme performers on the efficiency score. An overall rating of quality of performance failed to produce significant differences in the two groups. Extreme performers in the four categories mentioned above were rated on items concerning "quality of thinking," "grasp of concepts," "conscientiousness," and "involvement." Again there were no significant differences.

Next a series of studies were undertaken to discover personality correlates of the extreme scorers. The Allport-Vernon-Lindzey Study of Values yielded essentially identical profiles for the four groups.

Use of other instruments yielded more positive results. However, the manner in which significant results were found was in many cases less than straightforward, and to report in detail the methodology and results in the present study would unnecessarily belabor the point. Instead the methodology will be reported for one study and brief mention will be made of the instrumentation used in other studies and Westcott's overall conclusions. Westcott acknowledges that other methods of data analysis serve to generate hypotheses rather than come to definitive conclusions about personality traits of extreme scorers on the WIT.

One instrument which Westcott used was the California Psychological Inventory (CPI). There were no significant differences among the four

groups on the scales established by the CPI authors. At this point Westcott selected individual test items which discriminated one group from the other three, or which discriminated high number correct from low number correct groups and high clue use from low clue use groups. Subjects from this study were three samples of the college students mentioned above. Items were said to discriminate if they did so in any of the three samples, and in fact there were few items which discriminated in more than one sample. So if item 58 discriminated intuitive thinkers from the other three groups in the second sample but not the first and third samples, it was put in the pool of items which discriminated intuitive thinkers from the other three groups. Those items which were found to discriminate were then grouped on the basis of psychological coherence. Descriptions of the four groups were developed from this information.

Other instruments which were used were the Allport-Vernon-Lindzey Study of Values, the instrument previously described which measured impulse expression, flexibility, and manifest anxiety responses to a six question open-ended interview situation, and an adjective check list of indeterminate origin.

Using the methodology and instrumentation mentioned above, Westcott arrived at the following conclusions concerning extreme performers. He concluded discussion of characteristics of the intuitive thinkers in the following manner:

> This is a coherent picture of self-determining persons, willing to deal with the world on its own terms and unwilling to be swayed by social pressures. Their goals and their aspirations are high, but are often quite different from what most people seem to want (Westcott, 1968b, p. 143).

The wild guessers are described as socially complex and involved, but their involvement seems clouded with cynicism, rigidity, and bull-headedness. They seem not to have a firm grasp on reality or to organize or consolidate their efforts toward achieving a goal.

The careful successes, Westcott (1968b) describes as

> ...conservative, cautious, somewhat repressive people who function well in situations where expectations are well established and well met (p. 147).

The careful failures are described as conservative, authority-oriented individuals who seemingly adopt the conservative stance in a desperate effort to attain stability in a world which they little understand and are unable to control.

Research Relevant to Westcott's Conception of Intuition to College Major

The present author could find no studies relating Westcott's measure of intuition to college major. However, Westcott (1968a) did compare scores on the WIT to scores on the Strong Vocational Interest Blank.

The selection of vocation and college major is thought to be closely parallel, though not identical in all cases. However, a person aspiring to be a mathematician is very likely to major in mathematics. That selection of college major and vocation is closely parallel also seems to be the view of Holland (1966) who reports characterizing university environments by major as one method for categorizing vocational environments. It is for this reason that the present author will report research relating cognitive style to vocational choice when research relating cognitive style to choice of major is unavailable.

Westcott's (1968a) subjects were ninety-five college female seniors. They were administered the WIT as freshmen and as seniors. He then formed two samples from this group--those who were extreme performers on the WIT either as freshmen or as seniors. There was considerable overlap in these groups. The entire sample was administered the 1945 edition of the Strong Vocational Interest Blank for Men (SVIB-M).

As in previous studies, correlational analysis using the entire group failed to produce significant coefficients.

Two other methods were used to analyze the data. In each method thirty-two of the original ninety-five subjects were divided into the four groups--intuitive thinker, careful success, wild guesser, or careful failure. In the first method each subject was assigned a rank from one to four on each individual scale of the SVIB-M, depending on the closeness of her interest pattern to that of each occupational profile. The individual scores were averaged by group on each individual scale and were compared to the mean score for the other three groups via t test. Thus on the physician scale the rank of intuitive thinkers might differ from that of the other three groups. It appears that this procedure required multiple t tests on the same population and was therefore inappropriate.

The second procedure took the group rank of the subjects in each of the four groups on each occupation in one of the SVIB-M occupational clusters. Thus on the physician scale the intuitive thinkers might rank four indicating their interests were the most similar of the four groups to those of physicians, wild guessers might rank two, etc. This procedure was followed for each occupation in the cluster. Then

the ranks for each group were added and rank chi-square analysis was performed. The procedure was repeated for each occupational cluster.

From this analysis Westcott draws the following conclusions. The intuitive thinkers show more interest in diverse occupations. They share the interests of abstract scientists and those who perform manual labor. They have least interest in business and social service.

The wild guessers dislike the vocation of music teacher and salesman and are interested in a cluster of mathematical subjects. They are most interested in the professional service occupations.

The careful successes prefer the vocation of music teacher and librarian and the school subjects of geometry and civics. They have interest in practical manual vocations and are interested in business and social service occupations.

The careful failures produced the fewest findings. They show interest in the vocation of clergyman and have the least interest in the vocation of politician. They share more interests with people in the professional services and least with people in business.

Overall, Westcott (1968a) concludes

> The significance of the particular preferences and dislikes which distinguish the groups is not entirely clear, of course, but those described above are quite congruent with the earlier descriptions offered (p. 19).

In view of the fact that Westcott had to use somewhat extreme measures to find correlates of intuitive thinking and that he admits that the fruits of his efforts are more suggestions than definitive results, it is incumbent upon the present author to justify use of this particular measure for further study.

Originally a comparison of the theoretical and operational definitions of intuition by Jung, Myers (1962) (as expressed by the Myers-Briggs Type Indicator), and Westcott was of interest to the present author. However, Westcott (1968a) reported essentially negative correlations between intuition as measured by the WIT and the Myers-Briggs Type Indicator (MBTI). However, when the present author considered Westcott's work more fully, the cognitive style implications became more apparent and more important. As has been mentioned above, Westcott's comments concerning the importance of the manner in which information is presented at all levels of instruction provided sufficient cause in the mind of the present author for further investigation.

Jungian Functions

Overview In the discussion in the previous section, Jung's thoughts on intuition were presented. In this section his ideas on psychological types will be discussed--that part of his work in which his thinking on intuition was first presented. In a new collection of his works (Jung, 1971), Jung explains the rationale for classifying people by psychological type. He said he developed his theory of type

> ...to provide an explanatory basis and theoretical framework for the boundless diversity that has hitherto prevailed in the formation of psychological concepts (p. 555).

He points out that type has been a concern with which even the ancients have dealt. He says his formulation is grounded in a purely psychic foundation whereas other formulations have been built upon a foundation in physiology.

Jung wrote that he developed his particular system empirically, that is, in trying to explain the diversity of behavior in his patients, he discovered that they had characteristic orientations to their environments. Some were oriented to the world outside themselves (extraverts), some more to the forces within (introverts). However, he discovered that there remained much diversity to be explained in the behavior of extraverts and introverts. The explanation lay in the fact that individuals differed in their use of functions which he identified as thinking, feeling, sensation, and intuition. He argued that while the names of the functions might be changed and that other formulations might be developed, his four were the most practical. Research by Cook (1970) and Gorlow, Simonson, and Krauss (1973) has given empirical support to the existence of a typology as posited by Jung.

The function tells which of four tools the person typically uses in experiencing his world. Some prefer to rely most on data from the senses, and are, therefore, said to be sensation oriented. What they perceive by the five senses becomes the basis for their actions. Others prefer to use intuition. While they perceive with their senses, they do not focus on the object itself, but rather on its implications and possibilities. Since these two functions are perceptive functions, Jung refers to them as irrational, that is, not concerned with judgment. The judging or rational functions are thinking and feeling. Those who are disposed to use thinking need a rational basis in drawing conclusions, and those disposed to feeling make judgments on the basis of what is valued at an emotional level.

Jung (1971) characterizes the interrelation of the functions in this manner:

> Sensation establishes what is actually present, thinking enables us to recognize its meaning, feeling tells us its value, and intuition points to possibilities as to whence it came and whither it is going in a given situation (p. 540).

The spice and variety of individual differences is due, in Jung's view, to a differential weighting, so to speak, of the functions in a given individual. That function which is most predominant and most used is referred to as the dominant function. The function which is second in time is referred to as the auxiliary function. If the dominant function is perceptive (i.e., sensing or intuition), then the auxiliary must be judgmental (i.e., thinking or feeling). The other functions may come into play in a given instance but generally they are less developed and more in the unconscious, particularly that function which is opposite the dominant. For instance, if thinking is dominant, then feeling is most undeveloped, and the auxiliary must be either sensing or intuition.

The Jungian formulation thus established a system by which an individual's characteristic orientation to the world about him can be discerned. Jung (1971) seemed to establish a linkage between the personality types and cognitive style by the statement:

> It (introversion) is therefore oriented by the factor in perception and cognition which responds to the sense stimulus in accordance with the individual's subjective disposition (p. 374).

That part of the statement, "that introversion is oriented by a factor in perception and cognition," provides a basis for linking the personality types to cognitive style.

Myers (1962) also indicates that the Jungian type can be considered cognitive style.

> Preference type is the product of the person's conscious orientation to life, his habitual, purposeful ways of using his mind, chosen because they seem to him good and interesting and trustworthy (p. 74).

Sundberg's (1965) statement clearly indicates he views the MBTI as a measure of cognitive style.

> Purely as a potential research procedure for getting at individual differences in cognitive preferences, it would seem the Indicator would merit a great deal of attention from cognitive theorists (p. 325).

It is precisely for the purpose of "getting at individual differences in cognitive preferences" that the MBTI has been employed in the present study.

It is on similar bases that Child (1965) made the statement that the Jungian typology could be included in the category cognitive style. The present author has reached the same conclusion.

Research Relevant to Jungian Typology and Choice of Major Myers (1962) and Reynolds and Hope (1970) point to research which suggests that choice of major is relevant to Jungian typology and the intent of this section is to review those studies. Most studies are reported by Myers based on findings arrived at through the use of the MBTI.

The MBTI has four scales--three reflecting the Jungian dimensions [extraversion-introversion (E-I), sensing-intuition (S-N), and thinking-feeling (T-F)] and a fourth called judging-perceiving (J-P) which is used to identify the dominant life style attitude (the extraverted process). If a subject chooses more items related to needing conclusions rather than to observing phenomena, he is identified as J on the J-P dimension, and it is taken to mean that one of the judging functions (either T or F) will be the manner in which that individual interacts with the world. In the case of extraverts, that dominant function will be

displayed prominently to the world as it is used to facilitate interaction with the environment. However, introverts are said to display their auxiliary in their everyday life and show their dominant only when the pressures of life compel it. Therefore, an introvert who is a judging type will have as his dominant one of the perceptive functions, either S or N.

Myers reports results, not in Jungian terminology (e.g., introverted feeling type), but by using the initial of the preference on each of the four scales. In this manner an introverted sensing type is reported as ISTJ or ISFJ, an extraverted sensing type as ESTP or ESFP, an introverted intuitive type as INFJ or INTJ, an extraverted intuitive type as ENFP or ENTP, an introverted thinking type as ISTP or INTP, an extraverted thinking type as ESTJ or ENTJ, an introverted feeling type as ISFP or INFP, and an extraverted feeling type as ESFJ or ENFJ.

Most research reported in this section is based on Myers (1962). A critical examination of her sources is beyond the scope of the present work and would be a difficult task. While she reports the sources of her data, much of it is in technical reports or unpublished material. Also the sources of some of her own analyses are cross-referenced in a complicated manner.

Myers reports correlational data comparing MBTI scales with SVIB-M scales. The manner of presentation was to say that certain SVIB-M occupational groups attracted a particular MBTI type or combination of types. Thus SVIB-M groups I and II (professional and technical-scientific, nomenclature used by Myers) were said to attract IN-- types. This means that MBTI scores on the I-E scale and on the S-N scale

correlated highly with most SVIB-M scores in groups I and II, in the direction of I and N, but there were no significant correlations between those groups and the T-F and J-P scales. In the same manner groups III, VII, VIII, IX, and XI (production manager, CPA, business detail and administration, business contact and president of manufacturing firm) were said to attract ESTJ and "partial" ESTJ types. Groups VI and X (musician, verbal or linguistic) were said to attract -N-P types and and group V (uplift) was said to attract ENF- types.

Also listed are the individual SVIB-M occupations which correlated highest (range .20 to .55) with each MBTI dimension. E correlated highest with the sales manager scale; I, with the mathematician scale; S, with the banker scale; N, with the psychologist scale; T, with the purchasing agent scale; F, with the minister scale; J, with the accountant scale; P, with the artist scale.

The report of another series of studies was that among creative occupations, i.e., architects, research scientists, writers, and matheticians, the writers tended to be -NF- and mathematicians -NT-. All four occupations were N.

Myers also reports data which show that the composition of student bodies in different colleges and professional schools differs by type. The relative frequencies of the sixteen types of college prep high school students were compared with the relative frequencies of students at liberal arts, engineering, science, business, and medical schools. On the basis of this comparison, the following conclusions were drawn.

For liberal arts students the characteristics identified as being predominant were -NF- and -IN- against EST-; for science students,

IN-- against ES--; for engineering students, -N-J against -S-P and ES--; for business students, -ST- and ES-- against IN--; for medical students, --F- and IN-- against ESTJ. These findings do not have immediate usefulness for the present study since the primary thrust of the findings is that business types can be clearly differentiated from science types. Business was excluded as a dimension in the present study for reasons to be cited later. However, the findings are significant for the present study in that they do show that Jungian typology as operationalized by the MBTI is a useful tool for assessing differential characteristics of college majors.

Another comparison, one step closer in relevance to the present study, is of the effects of combining the perceptive and judging functions, i.e., the occupational choice or choice of major a person who is an -ST- combination is apt to make as opposed to one whose preference is -NT-. The data were derived by investigating the percentages of the combinations among various occupational and/or student groups. The table is presented here as Myers (1962, p. 64) presented it.

Function choice	ST	SF	NF	NT
	Production	Sales	Research	Research
	Construction	Service	Teaching	Science
	Accounting	Customer relations	Preaching	Invention
	Business		Counselling	Securities analyst
	Economics	Welfare work	Writing	
	Law	Nursing	Psychology	Management
	Surgery	Gen. practice	Psychiatry	Cardiology
	Etc.	Etc.	Etc.	Etc.

Reynolds and Hope (1970) investigated the hypotheses that there would be a greater proportion of science students classified INTP on the MBTI than in the general population and that students with those preferences would score higher on science achievement and aptitude tests,

in grade point average, and on academic aptitude tests. The population for this study was 326 secondary school students in required general science and biology classes representing students in general and 58 advanced science students representing science students. The authors concluded that science students did move in the direction of INTP when compared to students in general, but the support was marginal in that the results were in the predicted direction but not always statistically significant. The latter hypothesis concerning higher achievement and aptitude scores by science students was for the most part not supported.

Further considerations of the MBTI are contained in the instrumentation section of Chapter III.

In this section four conceptualizations of cognitive style chosen for the present study have been surveyed and research having relevance to their relation to college major has been reviewed. The research with the dimension of field-dependence-independence was the most direct, followed by the research on Jungian typology via the MBTI. Reflection-impulsivity was discussed as an important concept for instructional settings though research relative to college major is all but non-existent. Westcott's conceptualization of intuition was seen as important to instructional settings because it had implications for the manner in which information is presented in instructional settings. It is the least well researched, possibly because findings via the WIT have been scanty.

Other Research Relating Cognitive Style to Choice of Major

The third major section of this chapter, as outlined in the introduction, deals with a review of studies which in some manner have

linked a cognitive style with college major, with the exception of the study to be presented next.

Campbell (1967) through multivariate procedures analyzed eight predictor variables derived from the Scholastic Aptitude Tests (SAT) and the Milwaukee Academic Interest Inventory as to their effectiveness for predicting college major. Of interest for the present study are the findings that a science vs. non-science dimension (as well as a helping people vs. commercial-business interest) was identified and that all variables discriminated among the groups of interest.

Brubaker (1972), conceptualizing creativity and critical thinking as two dimensions of dissimilar cognitive styles, investigated the relationship of these variables and Scholastic Aptitude Test scores to the educational-vocational areas of agriculture, biological science, business, education, humanities, physical science, and social science. Subjects for the study were 1,233 entering freshmen at the University of Delaware. Findings of relevance to the present study were that students in the different areas did differ among themselves, and from a control group of undecided students, on the SAT scores and critical thinking measure, but only females differed among themselves and from a control group of undecided students on the measure of creativity. The undeclared students differed from the other students in combinations of the dependent variables.

Osipow (1969) studied the relationship between cognitive style, selected college majors directly related to occupational choice, and profiles on Holland's Vocational Preference Inventory (VPI). Osipow's basic hypothesis was that people tend to organize their perceptual experiences in distinctive and significant ways, which results in differential

behaviors--including those in the occupational realm. He used four measures of cognitive style--Word Similarity, the Object Sort (cf. the discussion on cognitive controls earlier in this chapter), a measure of rejecting vs. accepting response set, and Thurstone's Closure Flexibility Test as a measure of field-dependence-independence.

Female students majoring in nursing, home economics, dental hygiene, and special education, and male students majoring in pharmacy and fisheries technology served as subjects in the Osipow study. The four groups of female majors could be differentiated on the Object Sort, two of the three measures of rejecting vs. accepting response set, and field-dependence-independence, and on five of eleven VPI scales. The two groups of male majors could be differentiated on word similarity, one of the three measures of rejecting vs. accepting response set, and on three of eleven VPI scales.

It was also hypothesized that those who scored at the extremes on one measure of cognitive style would be significantly different on other cognitive style measures and VPI scales. This hypothesis was upheld in five out of a possible twenty cases for the cognitive style measures and in eleven of a possible 55 cases for the VPI. It should also be mentioned that the questionable practice of using multiple t tests was used in obtaining these results.

Other hypotheses were investigated concerning the VPI scales. Their results are not reported here because they have marginal relevance to the present study. Overall, Osipow concluded that his study lends support to the general hypothesis that students preparing for different occupations vary in cognitive style.

Hudson (1967) conducted a series of studies of British school boys. The British system is such that at age fifteen a student is categorized as either an arts or a science student. In his search to find intellectual ability correlates of the arts-science dimension, Hudson discovered that a "style-of-reasoning" dimension which he terms convergent-divergent thinking discriminated science from arts students remarkably well. (It might be added that he had already developed a composite of ability test profiles which also discriminated well.) In conjunction with an intelligence test, he used two tests, one a Use of Objects Test in which a student is to name as many uses as he can of an object (e.g., barrel), and another in which the student gives as many meanings of a word as he can. Convergent students tend to score well on an IQ test (termed A. H. 5), to give fewer definitions and uses, and to be in the sciences. Divergent students do relatively poorly on the IQ test, give more definitions and uses, and tend toward the arts.

Mackay and Cameron (1968) replicated Hudson's findings in a Scottish university where the decision to specialize in the arts or sciences is not made as soon. Their sample came from an introductory psychology class in which a cross section of students enrolled. The same tests administered in Hudson's study were used. The battery did not differentiate students when non-specializing students were in the sample, but when they were eliminated from the sample so that there were only arts specialists and science specialists in the sample, then the results strongly confirmed Hudson's findings.

Hervey (1967) investigated the relationship between cognitive style as measured by Sigel's SCST (also used by Gatewood, 1972) and performance in two school related tasks. When six of the seven hypotheses

relating to that investigation were not confirmed, and the seventh was not able to be analyzed statistically, she refocused the study and investigated the influence of cognitive style on the choice of major and grade point average. Categories for choice of major were basically the same as for the present study. They were literature and communications, natural sciences, and social sciences. The sampling of specific majors in the general categories differed little from those in the present study except that history was included as a social science by Hervey and as a humanity in the present study.

Hervey concluded after examining the data via analysis of variance and chi-square that there was indeed a relationship between those majoring in the sciences and the inferential-categorical mode of concept formation. She also compared unidentified "entrance test subscores (pp. 51-52)" to the three modes of concept formation and found a relationship between "numerical" aptitude and the inferential-categorical mode. Science majors had significantly higher grade point averages and higher "information" and "numerical" aptitude scores.

In a similar study, Williams (1971) devised a Cognitive Preference Test (CPT) which yielded preference scores for 1)facts or terms, 2) fundamental principles or generalizations, and 3) practical application in each of three areas--natural sciences, social sciences, and mathematics. Subjects were 231 community college and university freshmen and sophomores.

Of significance for the present study are findings that 1) no difference in CPT scores were found between the sexes, 2) differences were found between subjects majoring in different fields, 3) CPT scores were unrelated to academic aptitude test results, and 4) surprisingly

CPT scores were unrelated to scores on unnamed "traditional psychological tests of cognitive styles."

Chung (1966) investigated the relationship among four measures of cognitive style, major in college, vocational preference, and vocational commitment.

The measures and instrumentation for cognitive style were: field-dependence-independence as measured by a group test very similar to the Group Embedded Figures Test used in the present study; a test of leveling-sharpening developed by Gardner; constricted-flexible style as measured by the Stroop Color Word Test; and equivalence range as measured by Clayton and Jackson's Object Sorting Test.

Vocational preference was assessed by scores on the Kuder Preference Record. College majors used in the study were identified on the basis of the investigator's judgment as to what would maximize differences between areas and minimize differences within areas. The groups he selected were social science, natural science, humanities, engineering, elementary teaching, music, social service, and library science majors.

Vocational commitment was established by evaluating two responses on Chung's Personal Data Blank. Subjects for the study were 141 junior, senior, and graduate level paid volunteers from three schools in the Nashville, Tennessee, area. There were seventy-one female and seventy male subjects ranging in age from 19 to 39 ($\bar{X}$=22.8).

Of particular interest for the present study was that scores of those majoring in different areas were differentiated on the various cognitive style measures. However, the pattern was mixed, i.e., the pattern of scores of those majoring in different areas clustered

differently on the different measures of cognitive style. The statistical tool was multiple discriminant analysis. On the measure of field-dependence-independence, engineering and natural science students had the most field-independent scores, while social service, elementary teaching, library science, and humanities clustered toward the field-dependent end. Social science and music majors stood between the two groups; they were significantly different from the former but not the latter.

On the constricted-flexible dimension, library science and social service were toward constricted style while elementary teaching and social science were toward the flexible dimension. On the leveling-sharpening dimension, natural science and library science majors were the strongest sharpeners while music and the humanities were the strongest levelers. The equivalence range dimension was found to be an ineffectual dimension for differentiating college major.

The analyses of Kuder Preference Record types indicating vocational commitment yielded negative results.

Field (1954) administered five personality measures, a perceptual task, an attitude scale, and seven measures of identification with the father figure to subjects majoring in physical sciences and social sciences. Of significance for the present study was the finding that the physical science majors scored more toward sharpening on the leveling-sharpening measure than did the social science majors.

Conclusions

A careful review of the literature has led the present author to the following conclusions.

1. There is substantial evidence that cognitive style, although defined in many diverse ways, is related to college major.

2. The most promising dimension for differentiating humanities from natural science students is Witkin's field-dependence-independence. However, there has been no study using many subjects, both male and female, and incorporating a social science dimension. The present study intends to provide the next step in exploring this dimension.

3. While Westcott's measure of intuition has not been demonstrated to be an effective measure in differentiating college majors, some research has alluded to the possibility of such a finding. However, as has been pointed out, the primary reason Westcott's work is included in the present study is that it has implications for instructional practice--that while some students seem to prefer an inductive, "discovery" approach to learning, others prefer a more structured presentation approach. As has also been pointed out, the intent of the present study is to investigate whether these differences are systematic by college major.

4. The nature of Gatewood's study leaves inconclusive the relation between reflection-impulsivity and college major. However, as with intuitive thinking the dimension has implications for instructional practice. As it was pointed out in Chapter I, should it be found that students in different major groups vary systematically on the dimension of reflection-impulsivity, either instructional practice could be geared to that difference or attempts be made to alter the characteristic.

Therefore further investigation seems warranted.

5. Jungian typology as indicated by the MBTI has been shown to be effective in differentiating college majors. An impressive array of evidence has been presented using various combinations of MBTI scale types, but there has been no test of the concept of the dominant function and college major. The present study proposes to meet that need.

CHAPTER III

METHODOLOGY AND ANALYSIS

In this chapter the design of the present study, a description of the sample, procedures used in gathering data, the measures selected for evaluating the concepts, testable hypotheses, and the method for analyzing the data will be presented.

Design

The present study was descriptive in nature. Its primary purpose was to investigate whether students cast into three categories of college major would differ on dimensions of cognitive style and to determine which measure best differentiated categories of college major when several related measures of cognitive style were used. This basic hypothesis was investigated using two techniques. On all measures which yielded continuous scores--field-dependence-independence, reflection-impulsivity, and intuition--mean differences and vectors were tested. On the measure which identified dominant Jungian function and yielded discrete data, the relative percentages of subjects exhibiting particular dominant functions in each major category were compared.

The technique investigating mean differences included comparison not only of mean differences among the three major categories--humanities, social science, and natural science--but also between the sexes. The

dimension of sex was added for three reasons. First, most investigators have reported finding small but statistically significant differences between the sexes on field-dependence-independence. It seemed appropriate to investigate the phenomenon further. Second, it made the present study more complete. Studies most similar to the present study either controlled for sex differences by eliminating one sex (Hervey, 1967; Gatewood, 1972) or did not control for sex differences at all (Chung, 1966). Third, adding sex as a dimension made possible testing for interaction effects between sex and major, i.e., whether differentiation on cognitive style dimensions might be strongest in a combination of the two. It must be added, however, that the present author found no reason to hypothesize interaction effects and therefore no hypotheses were formulated concerning them.

Grade point average (GPA) and American College Test Composite (ACT-C) score were collected from university records and included in the analysis. They were included as comparison measures since the review of the literature discussed the relationship between academic aptitude and achievement and cognitive style. Such an addition made the present study a more thorough investigation.

Two samples were drawn and tested, the second sample replicating the first.

The technique for analyzing the relation of Jungian dominant types to college major, as has been pointed out, was to compare the relative percentages of subjects exhibiting a dominant Jungian function in each category. Thus the data were cast into a 4 X 3 table. The sample size prohibited separating subjects by sex and it was also impossible in this

design to make comparisons with GPA and ACT-C. However, the replication was performed for this analysis.

The secondary purpose of the present study was to compare subjects identified as dominant sensors with dominant intuiters and subjects identified as dominant thinkers with dominant feelers on measures of field-dependence-independence, reflection-impulsivity, and intuition. The same design was followed for this part of the present study as was followed for comparing majors on the cognitive style dimensions yielding continuous scores, except that sex could not be included as an independent variable. The scarcity of subjects identified as dominant sensors and dominant thinkers rendered the sample size too small.

Sample

Each sample in the present study was comprised of 150 volunteer subjects, so divided that there were 25 males and 25 females in each of three categories of college major--humanities, social science, and natural science. The majority of subjects were upperclassmen.

Roughly one-sixth of the students solicited volunteered as subjects except in one case in the first testing and two cases in the second in which the professor made class time available for testing. Only a few in those instances chose not to participate.

Sample 1 consisted of undergraduate students present on the campus of Central Michigan University (CMU) during the spring term mini-session of 1973 and the first three weeks of the regular 1973 summer session. The subjects were tested from May 15 to June 1, 1973, and June 18 to July 9, 1973. They ranged in age from 17 to 55 years with the mean age being 22.2 and the standard deviation 4.3 years. The mean grade

point average for the sample was 2.90 (s.d. = .53). Since the average of all grade point averages for students at the end of the winter term 1973 was 2.74, this sample had on the average slightly higher academic achievement than the student body as a whole. The mean ACT-C score for 88 of the students for whom the score was available in this sample was 23.1 (s.d. = 4.0) while the median of mean ACT-C scores for freshmen admitted from the 1969-1970 to 1972-1973 academic years was 21.0. While it is apparent that the mean ACT-C score for Sample 1 was higher than the median of mean ACT-C scores for incoming freshmen and that the mean GPA for this sample was higher than that of the student body as a whole, the question remains whether the sample was higher than a random sample of their peers on these measures or whether the fact that most of the sample was upperclassmen accounted for the difference.

In Sample 1, 29 females in the humanities were enlisted since the experimenter experienced difficulty in soliciting male subjects. When it was realized that sufficient male subjects would participate, four females in that category were randomly removed from the data analysis. One subject in this sample had to be excluded because he would not answer all MBTI items, so another volunteer was solicited.

Sample 2 consisted of undergraduate students present on the campus the first three weeks of the fall 1973 semester. They were tested from August 27 to September 14, 1973. They ranged in age from 17 to 33 years with the mean age being 20.7 and the standard deviation 2.2 years. The mean GPA for this group was 2.91 (s.d. = .48) and the mean ACT-C score for 117 of the students for whom the score was available in this sample was 22.8 (s.d. = 4.1).

From the data presented, it can be seen that the two samples were quite similar in academic achievement and aptitude and that the mean age of Sample 2 subjects was 1.5 years less than that of Sample 1 subjects. The mean differences were analyzed by means of the t test. Differences were not significant on GPA and ACT-C, but the age difference was significant ($\bar{s}$ = 3.804, $p < .001$). It can be concluded that on GPA and ACT-C the samples were drawn from the same population, but on age it appears they were not.

Procedure

Specific majors were classified humanities, social science, or natural science using the ranking system devised by Goldschmid (1967). He used the constant sum method for developing two scales of the same 55 majors. One scale was anchored on philosophy and the other on physics. Groups of counselors, faculty, and upper-level students rated the subjects on each scale in relation to an anchor subject. On the science scale, physics was the anchor subject and therefore was given 100 science points and 0 humanities points. On the humanities scale, philosophy was given 100 humanities points and 0 science points. The result was two scales of 55 majors ranked on their relation to science or humanities in descending order. One scale was reversed so that there were not two scales, each headed by natural science subjects. Both scales were divided into thirds so that the top third contained mostly natural sciences, the middle third contained mostly social sciences, and the bottom third contained mostly humanities. Those subjects which were included in the same third were immediately chosen as appropriate for

the present study. Those majors which were in different thirds were chosen using the best judgment of the present author consistent with commonly accepted classifications.

Some majors were specifically excluded from the present study. Goldschmid (1967) concluded that certain majors seemed not relevant to the arts vs. science dimension, namely business, home economics, and librarianship. Likewise, they were not included in the present study. Education as a major fell in the humanities category. However, though CMU has a strong tradition of teacher education, no one majors in education as such. There are a few curricula which have, in effect, a major in education such as special education, physical education, and industrial education. Since the major is a combination of education and other subject areas, e.g., psychology on the special education curriculum, these majors were also excluded from the present study.

The criterion for determining a student's major was self-report. If a student was a double major, then he was asked which was his preference if he had to choose between the two. While the soliciting was done for the most part in upper-level classes because more upper-level students know their majors, freshmen or sophomores who could say they were majoring in a specific area were accepted for the study.

Table 1 contains a list of the majors accepted in the present study and the number of male and female subjects in each testing by subject area.

The present author or one of his assistants asked professors for ten minutes of class time to solicit subjects from the professor's classes. No professor refused the request. Potential subjects were informed of the nature of the study, time required, the general nature of

TABLE 1

Composition of Sample 1 and Sample 2
by Sex and Number in Each Major Area and Specific Major

Majors	Sample 1		Sample 2	
	Male	Female	Male	Female
Humanities				
Speech	6	6	6	9
Music	2	1	2	1
English	8	3	7	4
Journalism		3	4	3
Religion			1	
Foreign Language	2	6		2
Philosophy	1			
Art	2	4	2	4
History	4	2	3	2
Total	25	25	25	25
Natural Science				
Mathematics	4	10	6	3
Biology	12	12	17	21
Chemistry	5	1	2	1
Earth Science	1	2		
Geology	1			
Physics	1			
Civil Engineering	1			
Total	25	25	25	25
Social Science				
Psychology	13	13	14	14
Sociology	7	11	3	8
Political Science	4	1	4	
Economics			2	1
Social Science	1		2	1
Health Education				1
Total	25	25	25	25

the tests to be administered, and that, since the design of the study required two samples of 150 subjects each, the experimenter was unable to pay his subjects. Subjects were also told that they could receive an interpretation of the test results at the end of the term or testing period.

A small number of students were solicited in other ways, e.g., students known personally by the present author or his assistants. Subjects were solicited until each of the six categories of 25 subjects was filled.

A few subjects, particularly those who were tested in a class session, did not keep an appointment to complete the testing. In those cases, subjects were solicited to fill in the number of required subjects for each category.

Subjects were scheduled for testing at a specific time to maintain an orderly atmosphere for testing. Since there were only two examiners for the individually administered MFF and the administration time for the whole battery was quite lengthy, the order of administration of the tests varied so that the subjects were occupied most of the time. The four tests administered were the Group Embedded Figures Test (GEFT), the WIT, the MFF, and the MBTI. Maximum utilization of the subject's time was accomplished by breaking up the administration of the untimed MBTI, usually with administration of the MFF. For instance, if subjects A, B, C, and D were tested at the same time, they all would be administered the two timed tests (GEFT and WIT), and then subjects A and B would start the MBTI and subjects C and D would be given the MFF. When subjects C and D completed the MFF, then subjects A and B would be interrupted to take the MFF while subjects C and D were given the MBTI. There is no

reason to believe that the data were distorted using this system since the MBTI is untimed and the nature of the items is such that responses are not likely to change with an interruption of short duration. Also, the interruptions were random so that no systematic differences were introduced.

The present author was assisted in test administration for Sample 1 and Sample 2 by two people, both with graduate degrees and known to be reliable and accurate. One was paid; the other volunteered. In addition, for Sample 2, two reliable psychology students, one graduate and the other a senior, were paid to assist in test administration since the time required to solicit subjects for the first study far exceeded the expectations of the present author. The role of the two psychology assistants in Sample 2 was relatively minor and their primary function was to fill gaps which would expedite the testing.

Instruments

This section contains the instrumentation used in the present study, rationale for its use, and reliability and validity information.

Group Embedded Figures Test The Group Embedded Figures Test (Witkin et al., 1971) was chosen for the present study as the measure of field-dependence-independence because evidence presented in the manual suggests it is a reliable and valid measure of the construct, and it offered the advantage of relative speed and ease of administration.

The test presents the subject with eighteen geometrically complex figures. Within each figure is a more simple figure, which the subject is asked to identify by outlining it with a pencil in the complex figure.

The test is divided into three timed sections, one two-minute practice section, and two five-minute test sections. The score is the number of simple figures correctly identified. Subjects are classified field-independent if they score above the mean of their group and as field-dependent if they score below it.

The manual reports preliminary norms based on undergraduate men and women at an eastern liberal arts college. For men, it reports a mean of 12.0 and a s.d. of 4.1 based on 155 cases; for women, it reports a mean of 10.8 and a s.d. of 4.2 based on 242 cases. The grand mean for 397 cases is 11.3. The data from the two samples collected for the present study yielded mean and s.d. scores of 12.3 and 4.6 respectively for Sample 1 and 13.0 and 4.0 respectively for Sample 2. The scores from the present study seem acceptably close to those from the preliminary norm group. It was found that no sex difference existed in the present study though the difference reported in the manual is significant at the .005 level of significance.

A reliability estimate of .80 is reported for a sample of 80 males and 97 females. The correlation was based on number identified in the first section of nine problems, as opposed to the nine problems in the second section, and corrected by using the Spearman-Brown prophecy formula.

Since the GEFT, as well as the WIT, were administered using time limits, the question of the propriety of the split-half method of computing reliability coefficients is raised. Were the tests purely speed tests, there would be no question that the method was totally inappropriate. However, Magnusson (1967) speaks of tests which do not depend on pure speed but which have time limits. In such situations he says

the effect is to diminish the magnitude of the reliability coefficient. On the other hand, Cronbach (1960), speaking in the context of tests of general ability, makes the comment that short speed tests may be more reliable than tests with very few items. Clearly the GEFT and WIT fall in the former category.

The criterion for assessing the effect of a time limit on performance is whether most subjects finished all the items they could in the required time. It was the observation of the present author that most subjects taking the GEFT were not pressed for time. Therefore, it seems that the effect on reliability was more severe for the WIT than for the GEFT since Westcott shortened the ten item test used in the present study to eight items because some subjects were pressed for time (M. Westcott, personal communication, May 17, 1973). The situation is somewhat alleviated for the WIT since Westcott does report test-retest coefficients. In both cases, however, caution seems warranted in interpreting the split-half coefficients.

The manual cites three cases of concurrent validity for the GEFT. Correlations of -.82 for 73 males and -.63 for 68 females with scores on the EFT are reported. Correlations of -.39 were reported for 55 males and -.34 for 68 females with the Portable Rod and Frame Test (PRFT), and of .71 and .55 for the same number of males and females respectively on the ABC scale which measures degree of body articulation. (The negative correlations are in the expected direction because of the nature of the EFT and PRFT scores.) Degree of body articulation, as discussed in Chapter II, was found to be an indicator of degree of field-dependence-independence.

Witkin et al. (1971) conclude

> The combined evidence suggests that the GEFT may prove to be a useful substitute for the EFT when individual testing is impractical (p. 29).

The Matching Familiar Figures Test As reported in Chapter II, the Matching Familiar Figures Test (MFF) presents the subject with a standard line drawing and eight variants. One line drawing is an ocean liner. In the variants the shape of the prow is altered, the height of the smoke-stacks, the position of the anchor, or the tilt of the smokestacks. The subject is to select the line drawing which is the exact duplicate of the standard. The time he takes to make the first selection as well as the number of the selections he makes before identifying the correct one are recorded as scores.

The time score is the most important index of a reflective or an impulsive attitude in an individual. Impulsive subjects score below the mean response time of their group and reflective subjects score above it. Most impulsive subjects' error scores are above the mean and most reflective subjects' error scores are below it. However, the correlation is not perfect. Kagan and Kogan (1970) report correlations between the scales which range from -.40 to -.65. In the present study the correlation in Sample 1 was -.59 and in Sample 2 was -.60. (See Appendix H.)

There appear to be no published norms for the test, and inquiries on the part of the present author and another investigator to the test author produced no data. Gatewood (1972) reports that for her 129 junior college subjects the median of mean response times was 45.58 seconds. In the present study, the median of all response times was 50.75 seconds in

Sample 1 and 46.08 in Sample 2. The median error score in Gatewood's study was 7.5. In the present study the median error score for Sample 1 was 6.4 and in Sample 2 was 6.3.

Burgbacher (1973) administered the MFF in two sections, by separating the odd and even items, to 40 male junior, senior, and graduate students (the majority were graduate students) whose median age was 24.8. The median age for Sample 1 in the present study was 21.7 and for Sample 2, 21.0. Burgbacher divided the test to facilitate the pre-post test design used in his study. On one half of the MFF, the mean error score for Burgbacher's sample was 4.3 and on the other half was 3.4. The mean error score for Sample 1 in the present study was 8.6 and for Sample 2, 8.5. The mean time score on one half of the MFF for Burgbacher's sample was 337.2 seconds and on the second half was 346.4 seconds. The mean time score for all items was 630.9 seconds in Sample 1 and 593.7 seconds in Sample 2 in the present study.

The descriptive data presented by the present author, Gatewood, and Burgbacher are fairly consistent when the mean scores for each half of the MFF in Burgbacher's study are combined. Burgbacher's combined error scores are slightly lower and time scores are slightly longer which could be explained by the fact that his older and mostly graduate student population could be expected to be more reflective in their test taking behavior. Thus it is contended that the three samples do not differ in kind and could serve as a norm group.

In Chapter II, it was reported that the dimension of reflection-impulsivity was found to be a reliable one. Kagan and Kogan (1970) cite specific research which points to the reliability of the MFF. One hundred and four third and fourth grade boys and girls were administered one form

of the MFF and then another form one year later. The correlation for the response time score between administrations averaged .62. One hundred and two children were administered the same form of the MFF a year apart. The correlation for the response time score was .48 for boys and .52 for girls. After 2½ years, the correlation was .31. Kagan and Kogan do not report coefficients for the error scores.

Burgbacher (1973) cites evidence for the reliability of the MFF. As was reported previously, he divided the test items into two groups according to an odd-even split, so that he could use half of the items for a pre- and half for a post-test. He had, in effect, parallel forms of the same test. The correlation between the two forms was .76 for the time score. The correlation between the two forms on the error score was .55. These correlations seem quite acceptable as evidence for the reliability of the MFF especially in view of the fact that the tests were shortened and no correction formula was applied and came from a very similar population on the same campus.

One source of validity for the MFF is face validity, i.e., Kagan et al. (1964) have proposed a dimension which they believe is an important factor in information processing. They have termed this dimension reflection-impulsivity. Clearly the MFF measures how rapidly and accurately a subject responds to the task. The research reported in Chapter II concerning the generality of the dimension across tasks provides a form of concurrent validity.

The Westcott Intuition Test As was pointed out in Chapter II, the Westcott Intuition Test (WIT) requires the subject to solve an abstraction problem using as few of five clues to its solution as possible. The

correct solution is that which consensual validation dictates when all five clues are known.

The format of Westcott's original test was two masonite boards which had twenty rows of five oblong slots cut through both boards. The clues were typed on a piece of paper attached to the back of the bottom of the two boards so that they showed through the 100 holes. A piece of aluminum foil was inserted between the two boards which served to cover up the clues. The subject uncovered the clues by inserting a stylus in the slots and tearing away the foil.

The present author contracted with a person a duplicate the board he had received from Westcott and after six weeks of frustration that person gave up the task. Fortunately, another process was found to produce the test. This was a latent image spirit duplication process whereby the clues were invisible until they were developed with a special pen which the subject brushed across the clues which were outlined by visible boxes.

The WIT has been shortened three times to make its administration more convenient. The original test was twenty items; the second, ten; and the third, eight. The present author was supplied with the ten item version and learned of the eight item version only in a data sheet (M. Westcott, personal communication, May 17, 1973) containing information on the ten and eight item tests. By this time data collection was underway and it was too late to change to the eight item version.

The data sheet provided normative data for the ten and eight item versions. The population was 49 social agency employees (mean age, 35.6 years) recruited from all levels. However, of those volunteering, 41 had at least a bachelor's degree. There were 37 females and 12 males.

Westcott reports that as many as 10% of the protocols in this sample had to be eliminated because of failure to comprehend instructions, as opposed to 2% to 5% in his college populations. In the present study, no subject who finished all tests misunderstood directions. Perhaps this was due to careful monitoring by the present author or his assistants and to administration of the WIT in small groups.

For his sample on the ten item scale Westcott reported the mean clue use score was 33.9 (s.d. = 6.5), as opposed to 32.3 (s.d. = 6.7) in Sample 1 and 31.8 (s.d. = 6.0) in Sample 2 of the present study. For Westcott's sample the mean number correct was 4.3 (s.d. = 2.0) as opposed to 4.2 (s.d. = 2.0) for Sample 1 and 4.5 (s.d. = 2.1) for Sample 2. It can be seen by these data that the measures of central tendency and dispersion are very stable, even though Westcott's group was much older.

There is no reliability information supplied for the ten item version of the WIT. However, Westcott (1968b) does provide extensive reliability information for the twenty item version. Subjects were 900 female and 197 male college students in eleven samples of data collected over a period of nine years. There was no noticeable difference in descriptive statistics between male and female samples. For all but 70 in the entire population tested, split-half correlations corrected for test length were available. For the number correct score, correlations ranged between .36 and .72 with the median correlation being .48. For the clue use score, coefficients ranged from .70 to .91 with the median being .82. For two of the samples (N=95), both split-half reliabilities were computed. For the number correct score, the split-half reliability was .80 and the three year test-retest reliability was .50. For number correct the split-half reliability was .70 and the three year test-retest

reliability was .66. The split-half reliability coefficients are possibly higher than for the form presently employed: first, because the number of items in the form used for the present study is half those in the original form; second, as has been discussed in the section on the GEFT, because the time limit on the present form of the WIT places it in the category of a speed test. It is unclear at what point Westcott introduced the time limit. While split-half reliability is not appropriate for speed tests, some mitigating circumstances were cited which show that the attenuation of the coefficient may not be as great as if the test were a pure test of speed.

The number correct and clue use scores have been found to be uncorrelated. Westcott (1968b) reports correlations from eleven samples ranging from -.24 to +.24. Of the eleven, only three were significant. In the present study the correlation between the two scales was -.01 in Sample 1 and .03 in Sample 2. (See Appendix H.)

Validity for this test is again face validity. Westcott has so operationalized the definition that the WIT measures it.

The Myers-Briggs Type Indicator The Myers-Briggs Type Indicator (MBTI) is a 166 item forced-choice self-report inventory. Ninety-five of the items are scored on the four dimensions mentioned previously: extraversion-introversion (E-I), sensing-intuition (S-N), thinking-feeling (T-F), and judging-perceiving (J-P). A subject is classified as E or I, for instance, on the basis of the difference in "E" items and "I" items marked on the score sheet. A scoring system has been devised to eliminate the problem of equal scores on one dimension. The difference scores are doubled and one point is added in the direction of the least

predominant type in the population. Therefore, a subject might be classified as E 01 or N 11. A system of continuous scores can be developed using this system by adding or subtracting the score from 100. Thus on a continuous scale the "E 01" would become 99 and the "N 11" would become 111. It is on the basis of the continuous scores that the first reliability coefficients are reported.

The manual (Myers, 1962) cites split-half coefficients of the four scales for 200 college males and females in the .80's with the median being .835. They are slightly lower for younger samples. The manual also cites data based on tetrachoric correlation coefficients since the user is more interested in the reliability of the test in categorizing subjects into dichotomies than in continuous scores. These coefficients corrected for test length ranged from .74 to .90 for the college populations cited with the median again at .835.

Concurrent validity is established through correlation with the scales of the Gray-Wheelwright, another less well-known instrument used to assess Jungian typology. Although its reliability is lower than the MBTI, its E-I, S-N, and T-F scales correlate .79, .58, and .60 with corresponding scales on the MBTI. The Gray-Wheelwright has no J-P scale.

The other type of validity reported is construct validity in which scales from other tests which are believed to correlate with Jungian constructs are examined. Data derived from the SVIB have already been reported in Chapter II, and the methodology for comparison on that test is the same as was employed for comparison with the following tests. These tests which are reported as having parts complementing the Jungian constructs are the Allport-Vernon-Lindzey Study of Values (AVL), the Edwards Personal Preference Schedule (EPPS), and the Personality Research

Inventory (PRI). Faculty ratings and findings relative to the MBTI and job stability are reported as further evidence of construct validity.

Scores on MBTI scales were correlated with scales on other tests thought to be measuring at least partial MBTI constructs. In this manner, the AVL Theoretical scale was found to correlate with the INTJ scales of the MBTI. Scales on other tests which correlated highest with a single MBTI scale were also examined. In this manner, a significant correlation of .12 was discovered between the AVL Economic and the J scale on the MBTI and a correlation of .51 between Nurturance on the EPPS and the F scale on the MBTI. The myriad of evidence presented for construct validity is impressive.

The primary criticisms of the MBTI (Mendelsohn, 1965) are that the scales which are claimed to measure dichotomously, in fact, have distributions more normal than bimodal and that the scales do not accurately measure the Jungian concepts. While the criticism regarding the bimodal distribution at this point seems valid, still the MBTI is the best instrument yet devised for assessment of Jungian typology. Therefore, caution seems to be warranted for interpretation of scores near the dividing line between attitudes, functions, and on the J-P scale.

Mention is also made by Sundberg (1965) of the problems in test taking attitude on the part of subjects. The experience of the present author has been that subjects often complain of the ambiguity of the items. To this criticism, it might be mentioned that Stanfiel (1966) developed item weights to correct for motivational and social desirability factors in the results, but that the weights did not appreciably change them. Many items of which subjects complain are those which are not scored. Also intuiters are in the majority in college populations, and

their characteristic orientation of seeing possibilities leads them to complain of myriad possibilities suggested by the items.

Hypotheses

The hypotheses of the present study will now be stated in testable form. The major hypotheses are stated in their null form. The subhypotheses will be stated in the alternate form.

Hypothesis 1 H_o There will be no differences with respect to average performance on five cognitive style variables, grade point average, and American College Test composite score in the degree each contributes to the differentiation among three categories of college major and between the sexes.

H_{1a} Differences will exist in the degree of field-dependence-independence as measured by group mean scores on the Group Embedded Figures Test among humanities, social science, and natural science majors with natural science majors scoring highest (most field-independent) followed by social science, then humanities majors.

Symbolically: $M_1 < M_2 < M_3$

Legend: M_1 = Humanities

M_2 = Social Science

M_3 = Natural Science

H_{1b} Differences will exist in the degree of field-dependence-independence as measured by group mean scores on the Group Embedded Figures Test between males and females with males being higher (more field-independent).

Symbolically: $M_1 > M_2$

Legend: M_1 = Males

M_2 = Females

H_{1c} Differences will exist in reflection-impulsivity as measured by the group mean time score on the Matching Familiar Figures Test among humanities, social science, and natural science majors with natural science majors scoring longer times (more reflective) followed by social science, then humanities majors.

Symbolically: $M_1 < M_2 < M_3$

H_{1d} Differences will exist in reflection-impulsivity as measured by the group mean time score on the Matching Familiar Figures Test between males and females.

Symbolically: $M_1 \neq M_2$

H_{1e} Differences will exist in reflection-impulsivity as measured by the group mean error score on the Matching Familiar Figures Test among humanities, social science, and natural science majors with natural science majors scoring fewer errors (more reflective) followed by social science, then humanities majors.

Symbolically: $M_1 > M_2 > M_3$

H_{1f} Differences will exist in reflection-impulsivity as measured by the group mean error score of the Matching Familiar Figures Test between males and females.

Symbolically: $M_1 \neq M_2$

H_{1g} Differences will exist in the degree of intuitive thinking as measured by the group mean number correct score on the Westcott Intuition Test among humanities, social science, and natural science majors.

Symbolically: $M_1 \neq M_2 \neq M_3$

H_{1h} Differences will exist in the degree of intuitive thinking as measured by the group mean number correct score on the Westcott Intuition Test between males and females.

Symbolically: $M_1 \neq M_2$

H_{1i} Differences will exist in the degree of intuitive thinking as measured by the group mean clue use score on the Westcott Intuition Test among humanities, social science, and natural science majors with natural science majors scoring highest (least intuitive) followed by social science, then humanities majors.

Symbolically: $M_1 < M_2 < M_3$

H_{1j} Differences will exist in the degree of intuitive thinking as measured by the group mean clue use score on the Westcott Intuition Test between males and females.

Symbolically: $M_1 \neq M_2$

Hypothesis 2 H_o Differences will exist among humanities, social science and natural science majors as to the distribution in those major categories of dominant sensors, dominant intuiters, dominant thinkers, and dominant feelers as identified by the Myers-Briggs Type Indicator.

Hypothesis 3 H_o There will be no differences with respect to average performance on five cognitive style variables, grade point average, and American College Test composite score in the degree each contributes to the differentiation between dominant sensors and dominant intuiters as identified by the Myers-Briggs Type Indicator.

H_{3a} Differences will exist in the degree of field-dependence-independence as measured by group mean scores on the Group Embedded Figures Test between dominant sensors and dominant intuiters as identified by the Myers-Briggs Type Indicator.

Symbolically: $M_1 \neq M_2$

Legend: M_1 = Sensors

M_2 = Intuiters

H_{3b} Differences will exist in reflection-impulsivity as measured by the group mean time score of the Matching Familiar Figures Test between dominant sensors and dominant intuiters as identified by the Myers-Briggs Type Indicator.

Symbolically: $M_1 \neq M_2$

H_{3c} Differences will exist in reflection-impulsivity as measured by the group mean error score of the Matching Familiar Figures Test between dominant sensors and dominant intuiters as identified by the Myers-Briggs Type Indicator.

Symbolically: $M_1 \neq M_2$

H_{3d} Differences will exist in the degree of intuitive thinking as measured by the group mean clue use score of the Westcott Intuition Test between dominant sensors and dominant intuiters as identified by the Myers-Briggs Type Indicator.

Symbolically: $M_1 \neq M_2$

H_{3e} Differences will exist in the degree of intuitive thinking as measured by the group mean number correct score of the Westcott Intuition Test between dominant sensors and dominant intuiters as identified by the Myers-Briggs Type Indicator.

Symbolically: $M_1 \neq M_2$

Hypothesis 4 H_o There will be no differences with respect to average performance on five cognitive style variables, grade point average, and American College Test composite score in the degree each contributes to the differentiation between dominant thinkers and dominant feelers as identified by the Myers-Briggs Type Indicator.

H_{4a} Differences will exist in the degree of field-dependence-independence as measured by group mean scores on the Group Embedded Figures Test between dominant thinkers and dominant feelers as identified by the Myers-Briggs Type Indicator.

Symbolically: $M_1 \neq M_2$

Legend: M_1 = Thinkers

M_2 = Feelers

H_{4b} Differences will exist in reflection-impulsivity as measured by the group mean time score on the Matching Familiar Figures Test between dominant thinkers and dominant feelers as identified by the Myers-Briggs Type Indicator.

Symbolically: $M_1 \neq M_2$

H_{4c} Differences will exist in reflection-impulsivity as measured by the group mean error score on the Matching Familiar Figures Test between dominant thinkers and dominant feelers as identified by the Myers-Briggs Type Indicator.

Symbolically: $M_1 \neq M_2$

H_{4d} Differences will exist in the degree of intuitive thinking as measured by the group mean clue use score of the Westcott Intuition Test between dominant thinkers and dominant feelers as identified by the Myers-Briggs Type Indicator.

Symbolically: $M_1 \neq M_2$

H_{4e} Differences will exist in the degree of intuitive thinking as measured by the group mean number correct score on the Westcott Intuition Test between dominant thinkers and dominant feelers as identified by the Myers-Briggs Type Indicator.

Symbolically: $M_1 \neq M_2$

Method of Analysis

Multivariate analysis of variance (MANOVA) met the design requirements of the present study for the test of Hypotheses 1, 3, and 4. MANOVA provided the means by which the five related measures--GEFT, MFF time, MFF errors, WIT correct, and WIT clues--could be tested simultaneously for the ability to discriminate among three categories of major and between the sexes or between dominant types.

In interpreting the MANOVA test, first, the F value for interaction effects was examined for significance at the assigned level. For the present study, the significance level was set at .05. If a significant interaction effect was found, it was interpreted as outlined below and further examination ceased. If no significant interaction effect was found, significant main effects by sex and major or by type were interpreted as outlined below.

When a significant interaction effect or main effect was found, the step-down F test was performed. The five cognitive style measures, ACT-C, and GPA were ranked according to priority of interest. Following the same rationale, separate alpha levels were set for each measure. (The specifics of the ranking are outlined in Chapter IV.) Starting with the variable of least interest, the p value for each variable was compared with its alpha criterion. The examination stopped with the first measure which met the criterion. That measure was seen

as the most important contributor to the differentiation in the significant interaction or in the main effects of major or sex (H_1) or type (H_3, H_4).

The tests via MANOVA were followed by tests of the subhypotheses via two-way analyses of variance (ANOVA). These tests investigated the power of each of the five dependent variables taken separately to discriminate among the categories of college major and between the sexes. Those subhypotheses of H_3 and H_4 were tested via one-way ANOVA since the scores of dominant sensors and dominant intuiters, and dominant thinkers and dominant feelers were not crossed by the two sexes. The significance level for these tests was that assigned for the step-down F tests in the multivariate analysis.

The statistical procedure chosen for evaluating H_2 was chi-square since assessment using Jungian typology involves placing subjects in discrete categories. In this test the three categories of college major were crossed with the four dominant functions. A significance level of .05 was chosen for the test.

These tests were performed at the Michigan State University Computer Center using the program written by Jeremy D. Finn.

Summary

In this chapter the methodology and instrumentation used in the present study were discussed. One hypothesis investigating the relationship of five cognitive style measures to each other in differentiating three categories of college major and the sexes was presented. Another hypothesis investigating the proportion of dominant Jungian types across the three categories of major was proposed, and hypotheses relating

cognitive style variables to dominant type were presented. Two samples of 150 students were tested, the second sample serving as a replication. ACT-C and GPA were added for purposes of comparison with the five cognitive style variables.

The method of soliciting subjects and carrying out the testing was outlined. The strengths and weaknesses of the instruments were discussed. MANOVA, ANOVA, and chi-square were chosen as statistical tools. In Chapter IV, the results will be presented.

CHAPTER IV

RESULTS

In this chapter the results of the statistical tests of the hypotheses derived in Chapter III will be presented. The results of tests of the major hypotheses via MANOVA will be followed by univariate tests of the subhypotheses. Since the review of the literature provided no basis for anticipating interaction effects, and the present author did not have reason to believe they would exist for other reasons, no hypotheses were formulated predicting interactions nor were any found.

The mean scores actually tested in each univariate analysis will be included in tables and graphic representations for clarity of presentation. These mean scores are combinations of mean cell scores, which with their standard deviations are presented in Appendices A, B, C, and D.

The tables reporting the results of the multivariate tests will report them twice for each sample--with and without the ACT-C, which was not available for all subjects. The purpose of dual presentation is to examine the effect, if any, reducing the sample size to include ACT-C might have on the overall F statistic and the step-down F test.

The dependent variables on the step-down F test were ranked to gain maximum benefit from the test according to the priority of interest in the dependent variables (Bock & Haggard, 1968). The GEFT was placed

first, since for both sex and major the literature suggests it would be the most discriminating of the cognitive style variables. The MFF measures were placed next because the literature suggested that they offered more promise of ability to discriminate majors than did the WIT. The alpha level for the GEFT and the MFF was set at .05.

The WIT measures were judged to be of less crucial interest, since the review of the literature had shown that their power to discriminate groups was considerably diminished when scores from an entire sample were used. If the measures did discriminate, safeguards against it being a chance occurrence dictated the choice of an alpha level of .01.

The comparison measures, ACT-C and GPA, were of least crucial interest. The review of the literature suggested that measures of cognitive style were relatively independent of academic ability and mention of the relation of college major to GPA is rarely made. These considerations led to the choice of an .001 alpha level.

The tables reporting the results of the univariate hypotheses will be presented for the full sample size of 150. The alpha level for each univariate hypothesis will be that chosen for the step-down F test.

Test of Hypothesis 1

> H_o There will be no differences with respect to average performance on five cognitive style variables, grade point average, and American College Test composite score in the degree each contributes to the differentiation among three categories of college major and between the sexes.

Table 2 presents the MANOVA table for Hypothesis 1. From Table 2 it can be seen that in Samples 1 and 2 the main effect by sex was significant and in Sample 1 the main effect by major was significant.

TABLE 2

Test of Hypothesis 1: Multivariate Analysis of Variance for Mean Differences on Five Cognitive Style Measures, Grade Point Average, and American College Test Composite Score among Three Groups of College Major and between the Sexes

Sample 1

Source	Without ACT-C df	Without ACT-C F	With ACT-C df	With ACT-C F
Major	12/278	2.9426***	14/152	2.3195**
Sex	6/139	3.5204**	7/76	2.5541*
Interaction	12/278	1.5373	14/152	.4848

Sample 2

Source	Without ACT-C df	Without ACT-C F	With ACT-C df	With ACT-C F
Major	12/278	1.7010	14/210	1.2540
Sex	6/139	2.6264*	7/105	2.6401*
Interaction	12/278	.4352	14/210	.7583

* $p < .05$

** $p < .01$

*** $p < .001$

Table 3 reports the results of the step-down F tests for the main effect by sex in Samples 1 and 2. From Table 3 it can be seen that in Sample 1 without ACT-C, GPA met the alpha criterion and that in Sample 2 without ACT-C, GEFT met the alpha criterion. Since the findings were not upheld in both samples, however, the results are inconclusive.

Also inconclusive is the effect of the reduced sample size and addition of the ACT-C on the step-down F test. The difference in some step-down F's is minimal but on others seems quite large, e.g., on the GEFT. With addition of ACT-C and reduction in sample size in Sample 2, the p value for GEFT was significant.

Table 4 reports the results of the step-down F tests for the main effect by major in Sample 1. It can be seen that only the alpha level for the GEFT met the alpha criterion. It can therefore be concluded that in Sample 1 the GEFT was the measure which was most efficient in differentiating the three groups of college major.

For the sake of completeness, data from the one-way ANOVA's are presented. Table 5 presents the means for the one-way tests of significance by sex for GPA and ACT-C. Table 6 presents the means for the one-way tests of significance by major on the same measures. Figures 1 and 2 are graphic representations of these means and the individual cell means by sex and major. Table 7 presents the one-way ANOVA tests for these measures. From Table 7 it can be seen that only the main effect by sex for GPA was significant in Sample 1.

TABLE 3

Test of Hypothesis 1: Step-down F Test for Ability of Five Cognitive Style Measures, American College Test Composite Score, and Grade Point Average to Discriminate between the Sexes

	Sample 1				Sample 2				
	Without ACT-C		With ACT-C		Without ACT-C		With ACT-C		
Measure	Step-down F	P less than	Step-down F	P less than	Step-down F	P less than	Step-down F	P less than	Alpha criterion
GEFT	.0749	.7848	1.1739	.2818	1.2949	.2571	4.3956	.0384*	.05
MFF time	.9033	.3436	.4256	.5160	.0323	.8577	.1708	.6802	.05
MFF error	2.7570	.0991	2.8323	.0963	1.0686	.3031	.4565	.5007	.05
WIT correct	.9579	.3294	.7118	.4015	2.5591	.1119	3.9009	.0509	.01
WIT clues	1.2249	.2704	1.6791	.1989	.4102	.5230	.0011	.9738	.01
ACT-C			.4681	.4960			.3768	.5407	.001
GPA	14.6092	.0002*	9.7493	.0026	10.0493	.0019	8.5767	.0042	.001

* Significant at prescribed alpha criterion.

TABLE 4

Test of Hypothesis 1: Step-down F Test for Ability of Five Cognitive Style Measures, American College Test Composite Score, and Grade Point Average to Discriminate among Three Categories of College Major in Sample 1

	Without ACT-C		With ACT-C		
Measure	Step-down F	P less than	Step-down F	P less than	Alpha criterion
GEFT	7.8407	.0006*	4.9051	.0098*	.05
MFF time	1.1485	.3201	1.8354	.1662	.05
Mff error	1.0776	.3432	1.1936	.3085	.05
WIT correct	1.9175	.1508	3.8003	.0266	.01
WIT clues	2.9705	.0211	2.3053	.1065	.01
ACT-C			1.5581	.2171	.001
GPA	1.6013	.2054	.4418	.6446	.001

* Significant at specified alpha criterion.

TABLE 5

Mean Grade Point Average and Mean American College Test Composite Score between the Sexes

	Grade Point Average		American College Test Composite Score	
	Males	Females	Males	Females
Sample 1	2.75	3.05	23.10 (N = 42)	23.11 (N = 46)
Sample 2	2.78	3.03	22.98 (N = 54)	22.59 (N = 63)

TABLE 6

Mean Grade Point Average and Mean American College Test Composite Score among Three Categories of College Major

	Humanities	Social Science	Natural Science
Grade Point Average			
Sample 1	2.78	2.87	3.05
Sample 2	2.91	2.95	2.86
American College Test Composite Score			
Sample 1	21.88 (N=26)	22.03 (N=30)	25.09 (N=32)
Sample 2	23.18 (N=40)	21.70 (N=33)	23.20 (N=44)

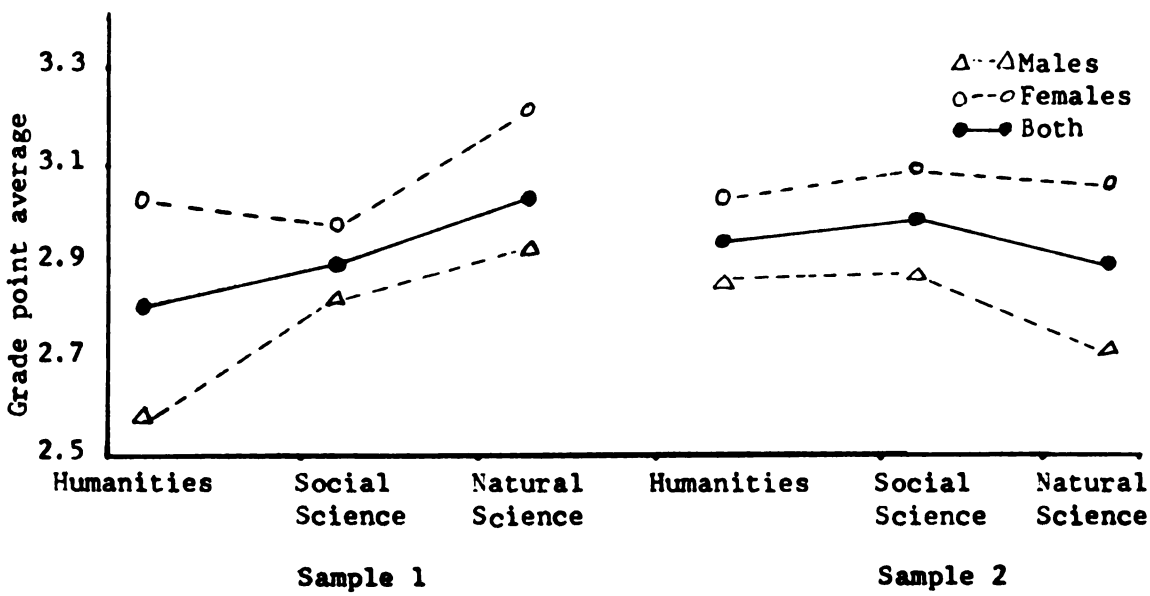

Figure 1. Mean grade point average for three categories of college major.

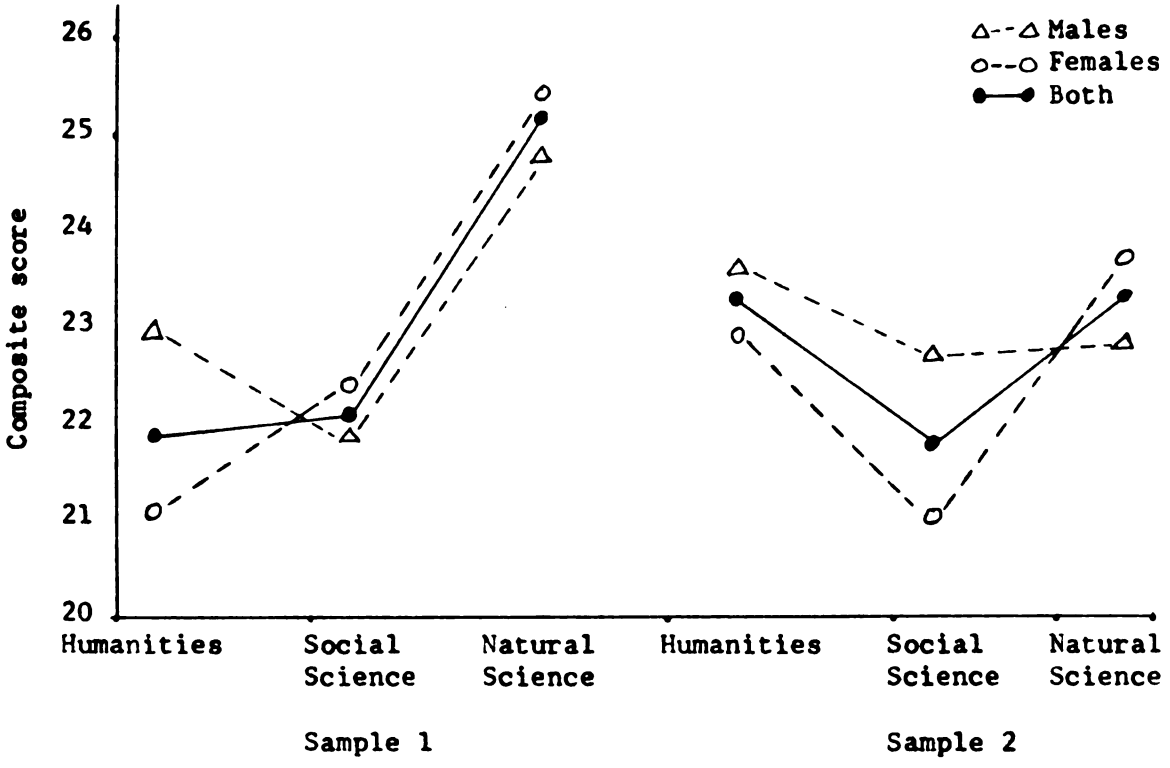

Figure 2. Mean American College Test composite score for three categories of college major.

TABLE 7

Analyses of Variance for Differences between the Sexes and among Three Categories of College Major in Grade Point Average and American College Test Composite Score

Grade Point Average

Source	Sample 1 df	MS	F	Sample 2 df	MS	F
Major	2	.9138	3.5997	2	.0925	.4204
Sex	1	3.5205	13.8689*	1	2.2546	10.2521
Interaction	2	.2919	1.1501	2	.0644	.2928
Within cells	144	.253843		144	.219918	

American College Test Composite Score

Source	Sample 1 (N=88) df	MS	F	Sample 2 (N=117) df	MS	F
Major	2	100.1553	6.8136	2	26.2889	1.5357
Sex	1	.0040	.0003	1	4.5179	.2639
Interaction	2	14.2093	.9667	2	15.7231	.9184
Within cells	82	14.699344		111	17.119147	

* $p < .001$

Test of Hypothesis 1a

H_{1a} Differences will exist in the degree of field-dependence-independence as measured by group mean scores on the Group Embedded Figures Test among humanities, social science, and natural science majors with natural science majors scoring highest (most field-independent) followed by social science, then humanities majors.

Table 8 presents the mean GEFT scores obtained by the three groups of college major and Figure 3 is a graphic representation of these mean scores and the individual cell mean scores by sex and major. Table 9 presents the ANOVA table for Hypotheses 1a and 1b.

Although the specified alpha levels were achieved for both samples on the main effect by major and the null hypothesis was rejected, the alternate could not be accepted. The results were only partially in the predicted direction.

TABLE 8

Mean Scores on the Group Embedded Figures Test for Three Categories of College Major

	Humanities	Social Science	Natural Science
Sample 1	11.3	11.2	14.3
Sample 2	13.8	11.7	13.6

Tukey post hoc comparisons were performed as shown in Table 10. The results indicate that differences exist between natural science majors and both humanities and social science majors in Sample 1 and between social science and both humanities and natural science majors in Sample 2. Therefore, in both samples, a difference between social science and natural science majors was upheld in the predicted direction,

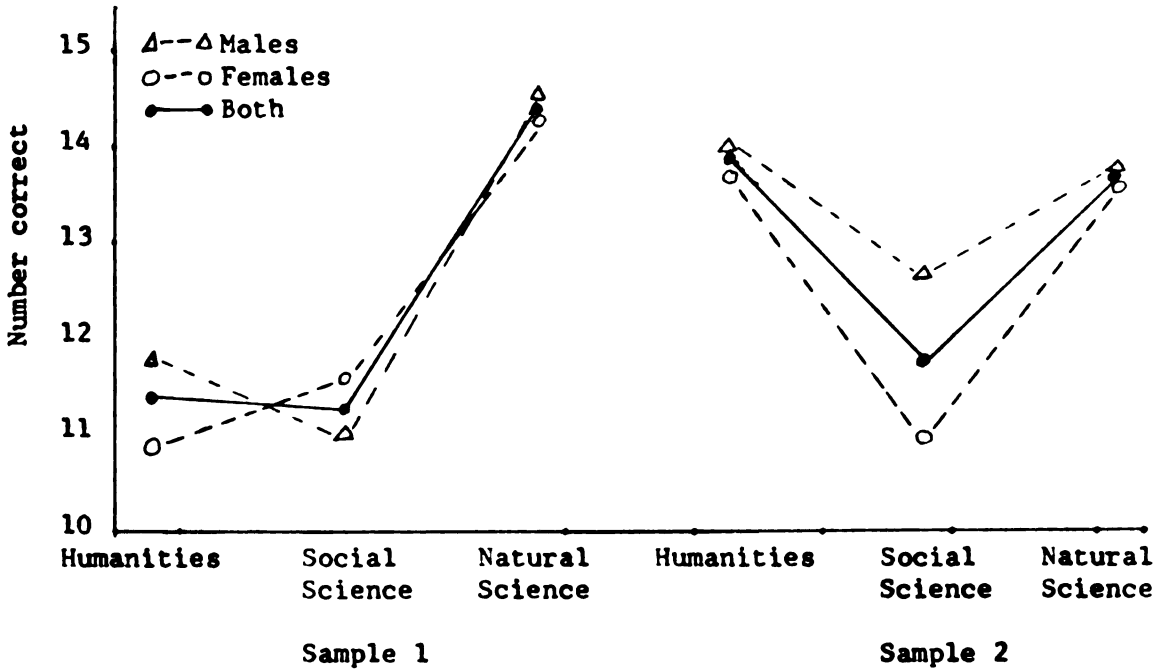

Figure 3. Mean scores on the Group Embedded Figures Test for three categories of college major.

TABLE 9

Test of Hypotheses 1a and 1b: Analyses of Variance for Differences among Three Categories of College Major and between Sexes on the Group Embedded Figures Test

		Sample 1		Sample 2	
Source	df	MS	F	MS	F
Major	2	157.1267	7.8407**	63.2267	4.0598*
Sex	1	1.5	.0749	20.1667	1.2949
Interaction	2	6.14	.3064	7.7867	.5000
Within cells	144	20.04		15.573889	

* $p < .05$

** $p < .01$

natural science majors being more field-independent. However, humanities majors scored higher than social science majors in both samples and significantly so in the second sample contrary to prediction.

TABLE 10

Confidence Intervals Based on Tukey Post Hoc Comparisons for Hypothesis 1a: Differences among Three Categories of College Major on the Group Embedded Figures Test

	Sample 1			Sample 2		
	difference	q	Confidence interval	difference	q	Confidence interval
$\bar{X}_H - \bar{X}_{SS}$ =	.2	± 2.11	(2.31, -1.91)	2.1	± 1.87	(3.97, .23)*
$\bar{X}_H - \bar{X}_{NS}$ =	-2.8	± 2.11	(- .69, -4.91)*	.2	± 1.87	(2.07, -1.67)
$\bar{X}_{SS} - \bar{X}_{NS}$ =	-3.0	± 2.11	(- .89, -5.11)*	-1.9	± 1.87	(- .03, -3.77)*

* $p < .05$

Test of Hypothesis 1b

H_{1b} Differences will exist in the degree of field-dependence-independence as measured by group mean scores on the Group Embedded Figures Test between males and females with males being higher (more field-dependent).

Table 11 presents the mean GEFT scores obtained by the two sexes and Table 9 presents the F values indicating no differences were found between the sexes. It should be noted, however, that the differences observed between males and females are in the predicted direction, the males' scores being higher.

TABLE 11

Mean Scores on the Group Embedded Figures Test for the Two Sexes

	Males	Females
Sample 1	12.4	12.2
Sample 2	13.4	12.7

Test of Hypothesis 1c

H_{1c} Differences will exist in reflection-impulsivity as measured by the group mean time score on the Matching Familiar Figures Test among humanities, social science, and natural science majors with natural science majors scoring longer times (more reflective) followed by social science, then humanities majors.

Table 12 presents the mean MFF time scores in seconds for the three categories of college major and Figure 4 is a graphic representation of these mean scores and the individual cell mean scores by sex and major. Table 13 presents the ANOVA tables for the test of the hypothesis.

TABLE 12

Mean Time Scores (in seconds) on the Matching Familiar Figures Test for Three Categories of College Major

	Humanities	Social Science	Natural Science
Sample 1	581.36	632.74	678.68
Sample 2	563.99	569.47	647.57

Though the differences were in the predicted direction in both samples, in neither sample were they significant.

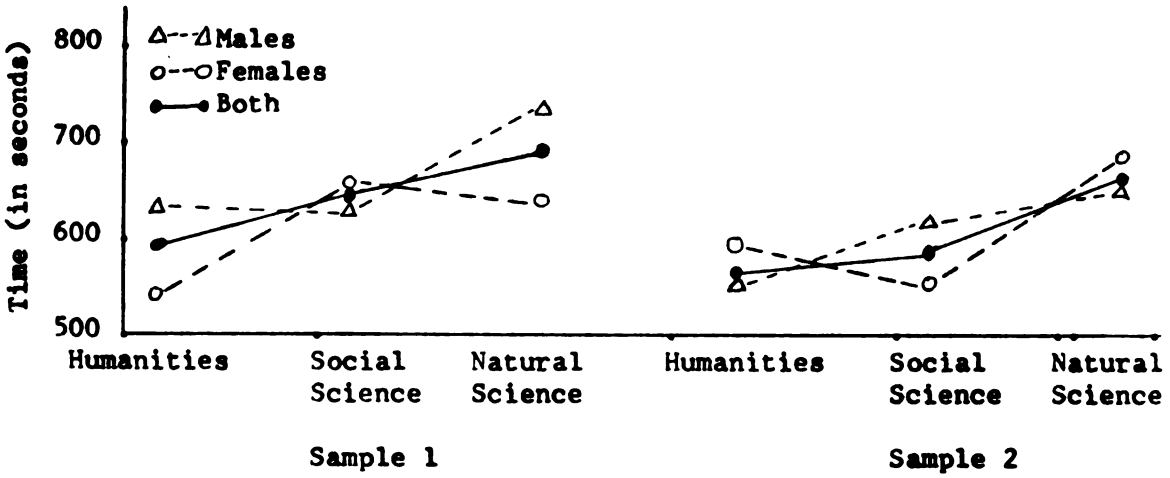

Figure 4. Mean time scores (in seconds) on the Matching Familiar Figures Test for three categories of college major.

TABLE 13

Test of Hypotheses 1c and 1d: Analyses of Variance for Differences among Three Categories of College Major and between the Sexes on the Time Score of the Matching Familiar Figures Test

		Sample 1		Sample 2	
Source	df	MS	F	MS	F
Major	2	118513.0867	1.2990	109293.8067	1.2395
Sex	1	83544.0000	.9157	19.0817	.0002
Interaction	2	54667.3400	.5992	37704.1267	.4276
Within cells	144	91231.769722		88172.664028	

Test of Hypothesis 1d

H_{1d} Differences will exist in reflection-impulsivity as measured by the group mean time score on the Matching Familiar Figures Test between males and females.

TABLE 14

Mean Time Scores (in seconds) on the Matching Familiar Figures Test for the Two Sexes

	Males	Females
Sample 1	654.53	607.33
Sample 2	593.32	594.03

Table 14 presents the MFF mean time scores for both sexes and Table 13 presents the ANOVA table for test of the hypothesis. For sex as for major, the null hypothesis was retained.

Test of Hypothesis 1e

H_{1e} Differences will exist in reflection-impulsivity as measured by the group mean error score on the Matching Familiar Figures Test among humanities, social science, and natural science majors with natural science majors scoring fewer errors (more reflective) followed by social science, then humanities majors.

Table 15 presents the mean MFF error scores for the three majors and Figure 5 is a graphic representation of these mean scores and the individual cell mean scores by sex and major. Table 16 presents the ANOVA table for Hypotheses 1e and 1f.

TABLE 15

Mean Error Scores on the Matching Familiar Figures Test for Three Categories of College Major

	Humanities	Social Science	Natural Science
Sample 1	10.36	8.60	6.92
Sample 2	9.04	9.78	6.74

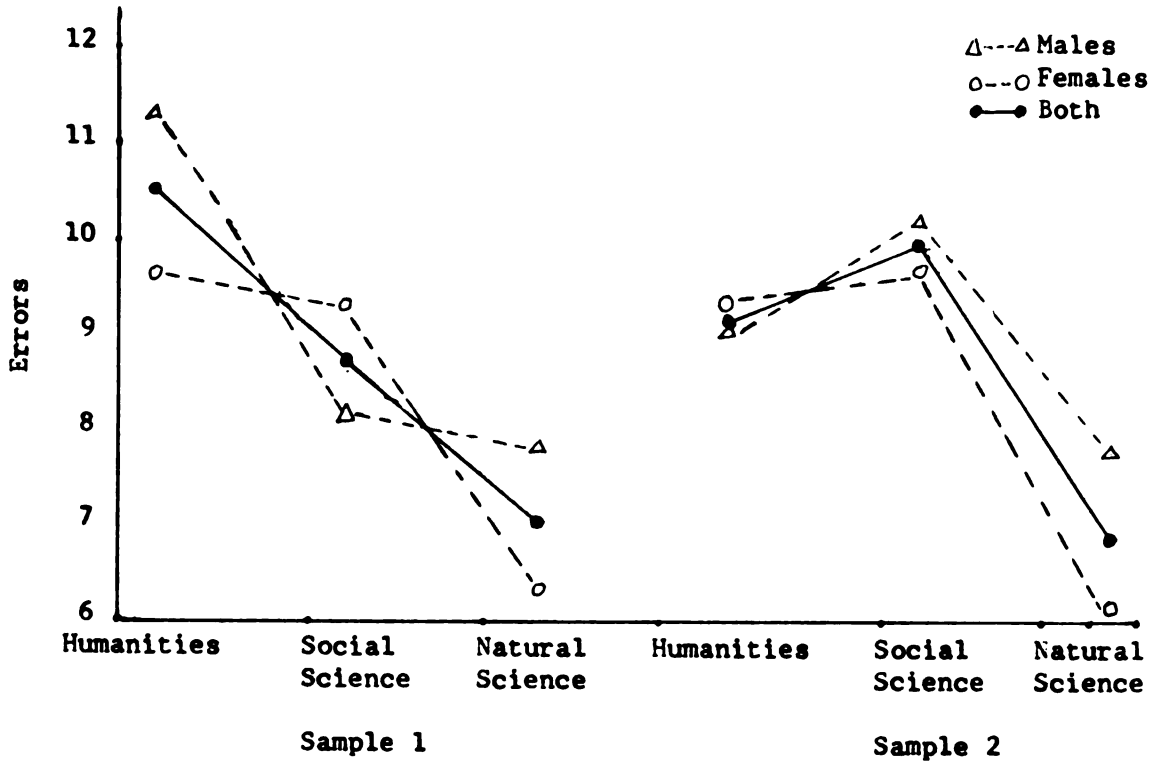

Figure 5. Mean error scores on the Matching Familiar Figures Test for three categories of college major.

TABLE 16

Test of Hypotheses 1e and 1f: Analyses of Variance Differences among Three Categories of College Major and between the Sexes on the Error Score of the Matching Familiar Figures Test

		Sample 1		Sample 2	
Source	df	MS	F	MS	F
Major	2	147.9467	3.8613*	125.6600	3.3895*
Sex	1	18.0267	.4705	15.3600	.4143
Interaction	2	30.9067	.8066	10.1400	.2735
Within cells	144	38.3150		37.072778	

* $p < .05$

From Table 16 it can be seen that the null hypothesis of main effect by major was rejected. Table 17 presents the Tukey post hoc comparisons for this main effect.

TABLE 17

Confidence Intervals Based on Tukey Post Hoc Comparisons for Hypothesis 1e: Differences among Three Categories of College Major on the Error Score of the Matching Familiar Figures Test

	Sample 1			Sample 2		
	difference	q	Confidence Interval	difference	q	Confidence Interval
$\bar{X}_H - \bar{X}_{SS}$ =	1.76	± 2.94	(4.70, -1.18)	- .74	± 2.89	(2.15, -3.63)
$\bar{X}_H - \bar{X}_{NS}$ =	3.44	± 2.94	(6.38, .50)*	2.30	± 2.89	(5.19, - .59)
$\bar{X}_{SS} - \bar{X}_{NS}$ =	1.68	± 2.94	(4.62, -1.26)	3.04	± 2.89	(5.93, .15)*

* $p < .05$

The Tukey post hoc comparisons reveal significant differences between humanities and natural science majors in Sample 1 and social science and natural science majors in Sample 2 on the MFF error score. Since the results were not consistent, the alternate hypothesis was not retained. In the first sample the scores were in the predicted direction, but in Sample 2, the humanities majors made slightly fewer errors than the social science majors.

Test of Hypothesis 1f

H_{1f} Differences will exist in reflection-impulsivity as measured by the group mean error score of the Matching Familiar Figures Test between males and females.

Table 18 presents the mean error scores for the two sexes. Table 16 presents the ANOVA tables for the test of the hypothesis. As can be seen from Table 16, the null hypothesis has been retained.

TABLE 18

Mean Error Scores on the Matching Familiar Figures Test for the Two Sexes

	Males	Females
Sample 1	8.97	8.28
Sample 2	8.84	8.20

Test of Hypothesis 1g

H_{1g} Differences will exist in the degree of intuitive thinking as measured by the group mean number correct score on the Westcott Intuition Test among humanities, social science, and natural science majors.

Table 19 presents the mean WIT number correct scores obtained by three categories of college major and Table 20 presents the ANOVA tables for test of the hypothesis. Figure 6 is a graphic representation of these mean scores and the individual cell mean scores by sex and major. As can be seen from Table 20, the null hypothesis was retained.

TABLE 19

Mean Number Correct Scores on the Westcott Intuition Test for Three Categories of College Major

	Humanities	Social Science	Natural Science
Sample 1	4.20	3.66	6.92
Sample 2	4.46	4.28	4.72

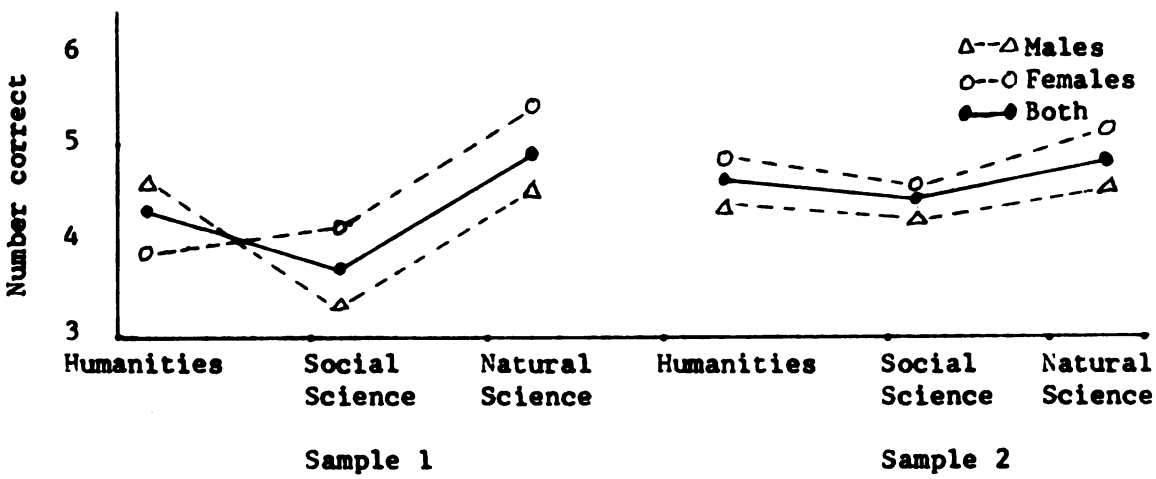

Figure 6. Mean number correct scores on the Westcott Intuition Test for three categories of college major.

TABLE 20

Test of Hypotheses 1g and 1h: Analyses of Variance for Differences among Three Categories of College Major and between the Sexes on the Number Correct Score of the Westcott Intuition Test

		Sample 1		Sample 2	
Source	df	MS	F	MS	F
Major	2	17.4467	4.4394	2.4467	.5274
Sex	1	4.1667	1.0602	8.1667	1.7605
Interaction	2	8.9267	2.2714	.2067	.0446
Within cells	144	3.9300		4.638889	

Test of Hypothesis 1h

H_{1h} Differences will exist in the degree of intuitive thinking as measured by the group mean number correct score on the Westcott Intuition Test among humanities, social science, and natural science majors.

Table 21 presents the mean WIT number correct scores obtained by the two sexes. Table 20 presents the ANOVA tables for test of the hypothesis. As can be seen from Table 20, the null hypothesis has been retained.

TABLE 21

Mean Number Correct Scores on the Westcott Intuition Test for the Two Sexes

	Males	Females
Sample 1	4.07	4.40
Sample 2	4.25	4.72

Test of Hypothesis 1i

H_{1i} Differences will exist in the degree of intuitive thinking as measured by the group mean clue use score on the Westcott Intuition Test among humanities, social science, and natural science majors with natural science majors scoring highest (least intuitive) followed by social science, then humanities majors.

Table 22 presents the mean WIT clue use scores obtained by the three categories of college major and Table 23 presents the ANOVA tables for test of the hypothesis. Figure 7 is a graphic representation of the mean scores and the individual cell mean scores by sex and major.

TABLE 22

Mean Clue Use Scores on the Westcott Intuition Test for Three Categories of College Major

	Humanities	Social Science	Natural Science
Sample 1	31.98	34.46	30.36
Sample 2	31.72	32.84	30.90

From Table 23 it can be seen that the main effect by major was significant in Sample 1, but that it was not upheld in Sample 2. Table 24 contains the Tukey post hoc comparisons for Sample 1. From Table 24, it can be seen that the significant difference was between social science and natural science majors.

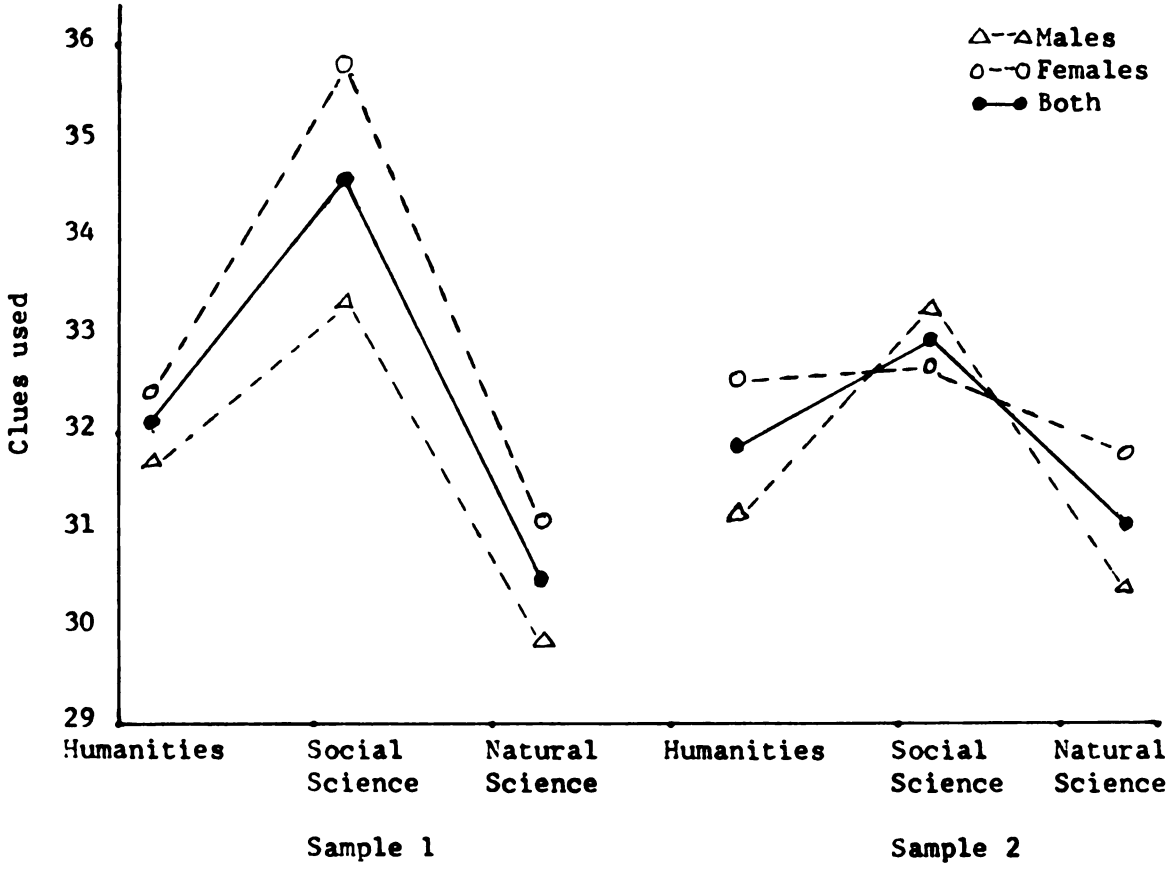

Figure 7. Mean clue use scores on the Westcott Intuition Test for three categories of college major.

TABLE 23

Test of Hypotheses 1i and 1j: Analyses of Variance for Differences among Three Categories of College Major and between the Sexes on the Clue Use Score of the Westcott Intuition Test

		Sample 1		Sample 2	
Source	df	MS	F	MS	F
Major	2	213.2067	5.0095*	47.4200	1.2896
Sex	1	77.7600	1.8270	21.6600	.5891
Interaction	2	10.2200	.2401	16.3400	.4444
Within cells	144	42.560556		36.770556	

* $p < .01$

TABLE 24

Confidence Intervals Based on Tukey Post Hoc Comparisons for Hypothesis 1i: Differences among Three Categories of College Major on the Clue Use Score of the Westcott Intuition Test in Sample 1

	difference	q	Confidence interval
$\bar{X}_H - \bar{X}_{SS}$ =	-2.48	± 3.88	(1.40, -6.36)
$\bar{X}_H - \bar{X}_{NS}$ =	1.62	± 3.88	(5.50, -2.26)
$\bar{X}_{SS} - \bar{X}_{NS}$ =	4.10	± 3.88	(7.98, .22)*

* $p < .01$

Test of Hypothesis 1j

H_{1j} Differences will exist in the degree of intuitive thinking as measured by the group mean clue use score on the Westcott Intuition Test between males and females.

Table 25 presents the mean WIT clue use scores obtained by the two sexes. Table 23 presents the ANOVA tables for test of the hypothesis. As can be seen from Table 23, the null hypothesis has been retained.

TABLE 25

Mean Clue Use Scores on the Westcott Intuition Test for the Two Sexes

	Males	Females
Sample 1	31.55	32.99
Sample 2	31.44	32.20

Test of Hypothesis 2

H_o Differences will exist among humanities, social science, and natural science majors as to the distribution in those major categories of dominant sensors, dominant intuiters, dominant thinkers, and dominant feelers as identified by the Myers-Briggs Type Indicator.

Table 26 presents the chi-square tables for test of the hypothesis. It can be seen that in neither sample was the chi-square value significant. The null hypothesis was retained.

Although not a part of the original hypothesis, an extension of the test of the relation of Jungian typology to college major was made by utilizing the complete Jungian classification system of attitude with dominant function. To provide a large enough N for a valid chi-square test, subjects from both samples were combined. The results are presented in Table 27. As can be seen from Table 27, the chi-square was significant.

Visual inspection of the distribution reveals the areas of greatest differences among majors are with the introverted and extraverted sensing types, and extraverted intuitive and thinking types. Introverted sensing types seem to favor the natural sciences over the humanities, while extraverted sensing types favor natural science over social science. Proportionally fewer extraverted intuitives are attracted to the sciences and extraverted thinking types seem strongly attracted to the humanities as opposed to the social sciences.

Test of Hypothesis 3

H_o There will be no differences with respect to average performance on five cognitive style variables, grade point average, and American College Test composite score in the degree each contributes to the differentiation between dominant sensors and dominant intuiters as identified by the Myers-Briggs Type Indicator.

TABLE 26

Test of Hypothesis 2: Distribution of Dominant Jungian Functions through Three Categories of College Major

Sample 1[a]

	Humanities			Social Science			Natural Science		
	E	O	%	E	O	%	E	O	%
Sensors	6.67	5	3.33	6.67	5	3.33	6.67	10	6.67
Intuiters	20.33	21	14.00	20.33	20	13.33	20.33	20	13.33
Thinkers	6.33	5	3.33	6.33	8	5.33	6.33	6	4.00
Feelers	16.67	19	12.67	16.67	17	11.33	16.67	14	9.33

Sample 2[b]

Sensors	10.67	8	5.33	10.67	8	5.33	10.67	16	10.67
Intuiters	14.67	16	10.67	14.67	18	12.00	14.67	10	6.67
Thinkers	6.00	7	4.67	6.00	3	2.00	6.00	8	5.33
Feelers	18.67	19	12.67	18.67	21	14.00	18.67	16	10.67

[a] Chi-square = 4.030 (not significant).

[b] Chi-square = 9.3556 (not significant).

TABLE 27

Extension of the Test of Hypothesis 2: Distribution of Jungian Types (Attitude with Dominant Function) through Three Categories of College Major for Samples 1 and 2 Combined

	Humanities			Social Science			Natural Science		
	E	O	%	E	O	%	E	O	%
Introverted Sensors	12.33	8	2.67	12.33	11	3.67	12.33	18	6.00
Extraverted Sensors	5.00	5	1.67	5.00	2	.67	5.00	8	2.67
Introverted Intuiters	10.67	11	3.67	10.67	8	2.67	10.67	13	4.33
Extraverted Intuiters	24.33	26	8.67	24.33	30	10.00	24.33	17	5.67
Introverted Thinkers	7.00	3	1.00	7.00	10	3.33	7.00	8	2.67
Extraverted Thinkers	5.33	9	3.00	5.33	1	3.00	5.33	6	2.00
Introverted Feelers	27.00	29	9.67	27.00	30	10.00	27.00	22	7.33
Extraverted Feelers	8.33	9	3.00	8.33	8	2.67	8.33	8	2.67

Note.--Chi-square = 24.0283 (significant).

TABLE 28

Test of Hypothesis 3: Multivariate Analysis of Variance for Mean Differences on Five Cognitive Style Measures, Grade Point Average, and American College Test Composite Score between Dominant Sensors and Dominant Intuiters

		df	F
Sample 1	Without ACT-C	6/74	1.0624
	With ACT-C	7/41	1.1181
Sample 2	Without ACT-C	6/69	1.4780
	With ACT-C	7/55	1.6146

Table 28 presents the MANOVA table for Hypothesis 3. It can be seen that in neither sample was the F value significant. The null hypothesis was retained.

Test of Hypothesis 3a

H_{3a} Differences will exist in the degree of field-dependence-independence as measured by group mean scores on the Group Embedded Figures Test between dominant sensors and dominant intuiters as identified by the Myers-Briggs Type Indicator.

Table 29 presents the mean scores obtained on five cognitive style measures used in the test of this and the next four hypotheses. Means and standard deviations are presented in Appendices E and F. Table 30 presents the ANOVA tables for test of this hypothesis and the next four hypotheses.

As can be seen from Table 30 the null hypothesis was retained. From Table 29 it can be seen that the direction of the difference in both GEFT samples was the same: dominant intuiters tend to be more field-independent than dominant sensors.

TABLE 29

Mean Scores on Five Cognitive Style Measures, Grade Point Average, and American College Test Composite Score Obtained by Dominant Sensors and Dominant Intuiters

	Sample 1		Sample 2	
	Sensors (N=20)	Intuiters (N=61)	Sensors (N=32)	Intuiters (N=44)
GEFT	11.75	11.96	12.44	12.77
MFF time	763.58	657.66	632.92	515.69
MFF errors	5.25	8.25	7.81	9.80
WIT correct	4.10	4.07	4.41	4.89
WIT clues	31.75	31.38	32.44	32.11
ACT-C	21.64[a]	23.47[b]	21.84[c]	22.39[d]
GPA	2.89	2.87	2.83	2.99

[a] N = 11.

[b] N = 38.

[c] N = 25.

[d] N = 38.

Test of Hypothesis 3b

H_{3b} Differences will exist in reflection-impulsivity as measured by the group mean time score of the Matching Familiar Figures Test between dominant sensors and dominant intuiters as identified by the Myers-Briggs Type Indicator.

As can be seen from Table 30 the null hypothesis was retained. From Table 29 it can be seen that the direction of the difference in both samples is the same: intuiters tend to be more impulsive.

TABLE 30

Test of Hypotheses 3a, 3b, 3c, 3d, and 3e: Analyses of Variance for Differences between Dominant Sensors and Dominant Intuiters on Five Cognitive Style Measures, American College Test Composite Score, and Grade Point Average

		Sample 1			Sample 2		
Measure	Source	df	MS	F	df	MS	F
GEFT	Between cells	1	.7106	.0333	1	2.0819	.1206
	Within cells	79	21.3631		74	17.2649	
MFF time	Between cells	1	168795.8760	1.7095	1	254599.1268	2.7786
	Within cells	79	98842.4545		74	7491627.4414	
Mff errors	Between cells	1	135.1854	5.6594*	1	72.8475	1.8588
	Within cells	79	23.8869		74	39.1897	
WIT correct	Between cells	1	.0179	.0037	1	4.2705	.9871
	Within cells	79	4.8043		74	4.3264	
WIT clues	Between cells	1	2.0950	.0460	1	41.9432	.0476
	Within cells	79	45.4947		74	40.8420	
ACT-C	Between cells	1	28.7977	2.2260	1	4.6404	.2577
	Within cells	47[a]	12.9366		61[b]	18.0072	
GPA	Between cells	1	.0070	.0236	1	.4846	2.3790
	Within cells	79	.2964		74	.2037	

[a] Sensors, N = 11; Intuiters, N = 38.
[b] Sensors, N = 25; Intuiters, N = 38.
* $p < .05$

Test of Hypothesis 3c

H_{3c} Differences will exist in reflection-impulsivity as measured by the group mean error score of the Matching Familiar Figures Test between dominant sensors and dominant intuiters as identified by the Myers-Briggs Type Indicator.

As can be seen from Table 30, the null hypothesis was rejected in Sample 1 but retained in Sample 2. From Table 29 it can be seen that the direction of the difference in both samples is the same; intuiters again tend to be more impulsive. This observation is consistent with the observation on the other measure of reflection-impulsivity, the time score.

Test of Hypothesis 3d

H_{3d} Differences will exist in the degree of intuitive thinking as measured by the group mean clue use score of the Westcott Intuition Test between dominant sensors and dominant intuiters as identified by the Myers-Briggs Type Indicator.

As can be seen from Table 30, the null hypothesis was retained, and Table 29 reveals the direction was not the same in both samples.

Test of Hypothesis 3e

H_{3e} Differences will exist in the degree of intuitive thinking as measured by the group mean number correct score of the Westcott Intuition Test between dominant sensors and dominant intuiters as identified by the Myers-Briggs Type Indicator.

As can be seen from Table 30, the null hypothesis was retained. Though the difference is very slight, Table 29 reveals that intuiters used fewer clues in both samples and therefore tend to be more intuitive on this scale of the WIT.

Test of Hypothesis 4

H_o There will be no differences with respect to average performance on five cognitive style variables, grade point average, and American College Test composite score in the degree each contributes to the differentiation between dominant thinkers and dominant feelers as identified by the Myers-Briggs Type Indicator.

Table 31 presents the MANOVA table for Hypothesis 4.

TABLE 31

Test of Hypothesis 4: Multivariate Analysis of Variance for Mean Differences on Five Cognitive Style Measures, Grade Point Average, and American College Test Composite Score between Dominant Thinkers and Dominant Feelers

		df	F
Sample 1	Without ACT-C	6/62	.3476
	With ACT-C	7/33	.2648
Sample 2	Without ACT-C	6/67	1.3300
	With ACT-C	7/46	.8947

From Table 31 it can be seen that in neither sample was the F value significant. The null hypothesis was retained.

Test of Hypothesis 4a

H_{4a} Differences will exist in the degree of field-dependence-independence as measured by group mean scores on the Group Embedded Figures Test between dominant thinkers and dominant feelers as identified by the Myers-Briggs Type Indicator.

Table 32 presents the mean scores obtained on five cognitive style measures used in the test of this and the next four hypotheses.

Means and standard deviations are presented in Appendices E and F. Table 33 presents ANOVA tables for the test of this hypothesis and the next four hypotheses.

TABLE 32

Mean Scores on Five Cognitive Style Measures, Grade Point Average, and American College Test Composite Score Obtained by Dominant Thinkers and Dominant Feelers

	Sample 1		Sample 2	
	Thinkers (N=19)	Feelers (N=50)	Thinkers (N=18)	Feelers (N=56)
GEFT	13.57	12.36	13.17	13.54
MFF time	537.89	580.61	625.64	622.25
MFF errors	9.42	10.14	8.67	7.87
WIT correct	4.32	4.46	4.50	4.21
WIT clues	32.79	33.36	29.89	31.86
ACT-C	23.62[a]	23.07[b]	23.07[c]	23.62[d]
GPA	2.96	2.91	2.70	2.95

[a] N = 13.

[b] N = 28.

[c] N = 15.

[d] N = 39.

As can be seen from Table 33, the null hypothesis was retained. Table 32 reveals that there was no consistency in the direction of scores between samples.

TABLE 33

Test of Hypotheses 4a, 4b, 4c, 4d, and 4e: Analyses of Variance for Differences between Dominant Thinkers and Dominant Feelers on Five Cognitive Style Measures, American College Test Composite Score, and Grade Point Average

		Sample 1			Sample 2		
Measure	Source	df	MS	F	df	MS	F
GEFT	Between cells	1	20.4571	.9248	1	1.8552	.1216
	Within cells	67	22.1217		72	15.2560	
Mff time	Between cells	1	25121.2177	.3318	1	156.4384	.0019
	Within cells	67	75702.4916		72	80964.8667	
Mff errors	Between cells	1	7.1165	.1309	1	8.5372	.2351
	Within cells	67	54.3679		72	36.3073	
WIT correct	Between cells	1	.2863	.0804	1	1.1120	.2288
	Within cells	67	3.5600		72	4.8601	
WIT clues	Between cells	1	4.4815	.1021	1	52.7705	1.6247
	Within cells	67	43.8907		72	32.4810	
ACT-C	Between cells	1	2.6269	.1276	1	3.2618	.2033
	Within cells	39[a]	20.5880		52[b]	16.0416	
GPA	Between cells	1	.0421	.1489	1	.9043	3.6706
	Within cells	67	.2829		72	.2464	

[a] Thinkers, N = 13; Feelers, N = 28.

[b] Thinkers, N = 15; Feelers, N = 39.

Test of Hypothesis 4b

H_{4b} Differences will exist in reflection-impulsivity as measured by the group mean time score on the Matching Familiar Figures Test between dominant thinkers and dominant feelers as identified by the Myers-Briggs Type Indicator.

As can be seen from Table 33, the null hypothesis was retained. Table 32 reveals that there was no consistency in the direction of scores between samples.

Test of Hypothesis 4c

H_{4c} Differences will exist in reflection-impulsivity as measured by the group mean error score on the Matching Familiar Figures Test between dominant thinkers and dominant feelers as identified by the Myers-Briggs Type Indicator.

As can be seen from Table 33, the null hypothesis was retained. Table 32 reveals that there was no consistency in the direction of scores between samples.

Test of Hypothesis 4d

H_{4d} Differences will exist in the degree of intuitive thinking as measured by the group mean clue use score of the Westcott Intuition Test between dominant thinkers and dominant feelers as identified by the Myers-Briggs Type Indicator.

As can be seen from Table 33, the null hypothesis was retained. Table 32 reveals that there was no consistency in the direction of scores between samples.

Test of Hypothesis 4e

H_{4e} Differences will exist in the degree of intuitive thinking as measured by the group mean number correct score on the Westcott Intuition Test between dominant thinkers and dominant feelers as identified by the Myers-Briggs Type Indicator.

As can be seen from Table 33, the null hypothesis was retained. Though the difference is very slight, Table 32 reveals that thinkers used more clues in both samples, and therefore tend to be more intuitive on this scale of the WIT.

Summary

Table 34 presents in summary form the results of the multivariate hypotheses and those univariate hypotheses which dealt with the relationship of cognitive style, GPA, and ACT-C to the three categories of college major. Table 34 reveals that the main effect by sex was significant in both samples, but that in only one sample did a measure--GPA--meet the alpha criterion. This result is complicated by the fact that GEFT met the alpha criterion in the sub-sample with ACT-C. The results are therefore inconclusive as to differentiation between the sexes.

A main effect by major was found in Sample 1 and GEFT was found to differentiate the majors best. Therefore, there is a suggestion that field-dependence-independence is the construct which best differentiates the categories of college major.

Subhypotheses concerning the relation of college major to cognitive style were examined through one-way analyses of variance. Majors were differentiated on three measures but only on two measures did they survive replication. While some measures were not found to be significant, results were in the predicted direction.

TABLE 34

Summary of Results on Multivariate Hypotheses and Univariate Subhypotheses concerning Cognitive Style and Major (Based on the Full Sample Size, N = 150 Each Sample)

Multivariate Hypotheses

Hypotheses	Main effect				Step-down F			
	Major		Sex		Major		Sex	
	Sample 1	2	Sample 1	2	Sample 1	2	Sample 1	2
H_1	yes	no	yes	yes	yes	no	yes	no
H_3	no	no	-	-	-	-	-	-
H_4	no	no	-	-	-	-	-	-

Univariate Subhypotheses

Subhypotheses	Main effect		Direction	
	Sample 1	Sample 2	Sample 1	Sample 2
H_{1a}	yes	yes	no	no
H_{1b}	no	no	yes	yes
H_{1c}	no	no	yes	yes
H_{1d}	no	no	-	-
H_{1e}	yes	yes	yes	no
H_{1f}	no	no	-	-
H_{1g}	no	no	-	-
H_{1h}	no	no	-	-
H_{1i}	yes	no	no	no
H_{1j}	no	no	-	-

Differences between social and natural science majors existed on the GEFT in both samples. Natural science majors were more field-independent. While differences by sex were not significant in either sample, males tended toward field-independence in both. On the MFF time score, natural science majors tended to be reflective followed by social science majors, then humanities majors, though the differences were not significant.

On the MFF error score, majors were differentiated in both samples in the predicted direction in one sample but not the other. Nor were the areas of differentiation consistent. In both samples, natural science majors were differentiated, but in one sample they were differentiated from humanities majors and in the other, from social science majors.

The WIT clue use score differentiated majors in the first sample but not in the second. In that first sample the differentiation was between social science and natural science majors, the natural science majors being more intuitive.

Dominant Jungian functions were not found to be clustered by major. However, when the dominant function was paired with the attitude of extraversion or introversion, some clustering of the types into major categories was observed.

The investigations relating cognitive style to Jungian dominant functions yielded but one difference in one sample. The MFF error score differentiated dominant sensors from dominant intuiters. However, differentiation of dominant sensors and dominant intuiters was in identical and logical directions on four of the five measures in both samples. When the same investigation was carried to dominant thinkers and dominant feelers, results were negative and inconsistent in all but one direction. Dominant thinkers consistently scored lower on the WIT clue use score.

CHAPTER V

SUMMARY AND CONCLUSIONS

Summary

That the campus counseling psychologist's expanding role may well place him in the position of consultant to faculty on the academic dimensions of the collegiate experience provided impetus for the present study. It was proposed that an investigation dealing with the personal ways people approach learning situations--a concept to which the term "cognitive style" is frequently attached--could provide information useful to the counseling psychologist in his new role.

Cognitive style was to be investigated through the medium of college major. Discovering a relationship between the two could be useful for assisting faculty in understanding their students better and it could provide information useful to the counseling psychologist in dealing directly with students' concerns over choice of major. Knowledge of the variation in learning styles could assist the counseling psychologist in understanding and dealing with his clients' styles.

Following a general discussion of cognitive style, the specific cognitive style dimensions utilized in the present study--field-dependence-independence, reflection-impulsivity, intuition, and Jungian typology--were discussed. The review of the literature indicated that field-

dependence-independence, a widely researched construct, provided the most hope for differentiating majors. The dimension of reflection-impulsivity, well established in the realm of educational psychology, provided the second dimension, though research on its relation to college major was scanty. The work of Malcolm Westcott on intuition--less well known but having important implications for instructional practice--was chosen. The Jungian functions of sensation, intuition, thinking, and feeling provided the fourth subject area. Previous research suggested strong links between the functions and college major.

Research pointing to the relation of other cognitive styles to college major was presented.

Multivariate analysis of variance was chosen to analyze mean differences on related measures of cognitive style between three categories of college major--humanities, social science, and natural science--and between the sexes, and chi-square was chosen to analyze the distribution of dominant functions across major categories. Investigation of the relation of the cognitive style measures across the categories of dominant Jungian function was also performed using multivariate analysis of variance.

Two samples of 150 undergraduate students equally divided through the three majors and two sexes were solicited to volunteer as subjects in the study. The first sample was drawn during the spring mini-session and in the summer term of 1973 and the second sample drawn in the first three weeks of the fall term of 1973. Since aptitude and intelligence have been found in some cases to be marginally related to cognitive style, ACT-C and the other most common measure of academic achievement, GPA, were included as comparison measures.

Conclusions

No hypothesis in the study was confirmed as stated across both samples. What results there were suggested the following.

1. The dimension of field-dependence-independence as measured by GEFT (Witkin) best differentiates college majors.
2. College majors can be differentiated on the basis of Jungian typology if type is assessed using both attitude and dominant function.

Discussion

The results of the present study do not give strong support to the thesis that cognitive style is related to college major, but neither do they negate it. The evidence cited in the review of the literature also points to a significant but small factor in the differentiation of college majors. Probably students majoring in different areas do have variations in cognitive style but they are most apparent only in a few individuals or at certain times. It is a characteristic of which the knowledgeable professor should be aware and should utilize when the need arises. Perhaps in assisting an individual student to acquire a difficult concept, another approach more in keeping with that student's learning style might be tried.

The findings of the present study also give support to the hypothesis that field-dependence-independence taps more than acadmic ability. It seems to be a more inclusive variable, consisting of stylistic variations, thus continuation of the designation, "cognitive style," seems warranted. The only evidence to the contrary is that low level, but significant, correlations of .32 and .24 ($p < .01$) between ACT-C and GEFT scores were found. (See Appendix H.) Also ACT-C was found to correlate with more cognitive style variables than any other measure.

As evidence supporting the hypothesis, the results of the step-down F tests show that GEFT discriminates majors at a much higher p value than ACT-C, despite the fact that the pattern by which they differentiate majors is similar, as shown in Figures 2 and 3. Also in support of the hypothesis is the finding that, although ACT-C correlated with more cognitive style variables than any other measure, the variables (MFF errors and WIT correct) were that component of the measure least concerned with differentiation in style of approach to the problem. MFF errors and WIT correct estimate the end product of cognitive effort, not the style by which the end product was achieved.

Goldschmid (1967) proposed that on the continuum from natural science to humanities, social science would stand as a mediating link. Evidence from the present study suggests that it is more often at one of the extremes. A visual inspection of the group means show that the social science majors were the most field-dependent and the least intuitive on both the WIT scales. The finding that social science majors are most field-dependent can be explained when it is recalled that the review of the literature revealed that field dependents were more oriented to their social context. That natural science majors were most intuitive can be explained by the fact that, particularly in the natural sciences, the greatest information must be inferred from the fewest facts.

Limitations

The present study had two primary limitations. First, the impracticality made random selection an impossibility. So that valid inferences may be drawn, the reader must compare samples to see if they could have been drawn from the hypothetical population which samples in the present study represent.

The fact that Sample 1 was drawn from a significantly older group attending shortened spring and summer sessions and that Sample 2 was drawn from a younger group attending a regular term makes more difficult the task of determining whether failure to replicate the experiment in Sample 2 was that the samples represented different hypothesized populations or whether there was in fact no relationship between college major and cognitive style.

Another limitation concerns itself with the intra-discipline variation of the three categories of major, i.e., some disciplines have within themselves science to humanities orientations. Such is the case of speech. At Central Michigan University, theatre, interpersonal and public communication, and speech pathology are all areas in which speech majors may concentrate. The same type of variation may be found in a social science area, psychology, and an area classified as a humanity, journalism.

Implications for Future Research

Should the present study ever be replicated, assurance that the two samples were drawn from the same population would be necessary.

Though the issue is peripheral to the present study, the review of the literature and issues discussed in the previous section suggest that a further clarification of the relation of field-dependence-independence and measures of academic ability would be fruitful.

Most of the research on reflection-impulsivity has shown relevance of the dimension to other intellectual characteristics. Further investigation into other areas such as has been done by workers investigating field-dependence-independence could expand the usefulness of the concept.

Campbell (1967) identified through multivariate procedures a helping people vs. business dimension. Perhaps the relation of cognitive style to this dimension of college major could be investigated with profit.

Perhaps the most fruitful area for further research lies in the area of Jungian typology via the MBTI. The method of analysis using discrete data makes it possible that valuable information was lost. Therefore using continuous MBTI scores, particularly in the area of relating dominant type to cognitive style, may be fruitful. Also as was noted in the discussion of the test of Hypothesis 2, including the total type in the analysis led to significant findings. Perhaps yet more could be learned by including the auxiliary process in the analysis.

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APPENDICES

APPENDIX A

MEANS AND STANDARD DEVIATIONS FOR THE FIVE COGNITIVE STYLE MEASURES, GRADE POINT AVERAGE, AND AGE FOR SAMPLE 1 WITH AMERICAN COLLEGE TEST COMPOSITE SCORE

TABLE A1

Sample 1 Cell Size by Sex and Major

N=88	Humanities	Social Science	Natural Science
Males	12	16	14
Females	14	14	18

TABLE A2

Group Embedded Figures Test

	Humanities		Social Science		Natural Science	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Males	11.0833	3.9648	10.4375	4.9929	14.2143	3.2387
Females	11.8571	3.6973	12.0714	4.7631	14.1111	2.9880

TABLE A3

Matching Familiar Figures Time

	Humanities		Social Science		Natural Science	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Males	563.1250	234.0606	586.8437	233.1506	720.7857	223.2174
Females	510.3929	245.5660	618.2143	313.0689	642.2778	220.9241

TABLE A4

Matching Familiar Figures Errors

	Humanities		Social Science		Natural Science	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Males	13.8333	10.2499	8.2500	3.3566	7.2857	5.1505
Females	9.4286	8.4918	8.7857	5.8989	6.3889	6.0112

TABLE A5

Westcott Intuition Test Correct

	Humanities		Social Science		Natural Science	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Males	4.1667	2.0375	2.9375	1.0626	4.5714	2.1738
Females	4.5000	1.7867	3.7857	2.0821	5.0556	2.2353

TABLE A6

Westcott Intuition Test Clue Use

	Humanities		Social Science		Natural Science	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Males	31.9167	6.2734	32.2500	7.7158	27.7857	5.1914
Females	31.9286	6.3907	35.4286	7.2929	31.4444	6.4828

TABLE A7

American College Test Composite Score

	Humanities		Social Science		Natural Science	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Males	22.9167	4.2310	21.8125	3.4490	24.7143	4.7138
Females	21.0000	4.2245	22.2857	3.6675	25.3889	2.8105

TABLE A8

Grade Point Average

	Humanities		Social Science		Natural Science	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Males	2.6000	.5134	2.6956	.5041	2.8543	.5924
Females	2.9550	.5291	2.9936	.6061	3.2383	.4983

TABLE A9

Age

	Humanities		Social Science		Natural Science	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Males	21.8333	1.7495	22.0625	1.8786	21.2143	1.7177
Females	20.4286	1.2225	20.3571	1.1507	20.2222	.9428

APPENDIX B

MEANS AND STANDARD DEVIATIONS FOR THE FIVE COGNITIVE STYLE MEASURES, GRADE POINT AVERAGE, AND AGE FOR SAMPLE 1 WITHOUT AMERICAN COLLEGE TEST COMPOSITE SCORE

TABLE B1

Sample 1 Cell Size by Sex and Major

N=150	Humanities	Social Science	Natural Science
Males	25	25	25
Females	25	25	25

TABLE B2

Group Embedded Figures Test

	Humanities		Social Science		Natural Science	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Males	11.72	4.6683	10.96	5.0206	14.44	3.2924
Females	10.84	4.9555	11.48	5.4323	14.20	2.8868

TABLE B3

Matching Familiar Figures Time

	Humanities		Social Science		Natural Science	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Males	620.22	349.1914	618.40	372.8969	724.96	285.1040
Females	542.50	251.9368	647.08	308.6467	632.40	215.3711

TABLE B4

Matching Familiar Figures Errors

	Humanities		Social Science		Natural Science	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Males	11.20	8.6603	8.04	3.4578	7.68	4.7233
Females	9.52	7.1770	9.16	6.3815	6.16	5.3282

TABLE B5

Westcott Intuition Test Correct

	Humanities		Social Science		Natural Science	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Males	4.52	2.0232	3.28	1.5684	4.40	2.2174
Females	3.88	1.9858	4.04	2.0800	5.28	2.0314

TABLE B6

Westcott Intuition Test Clue Use

	Humanities		Social Science		Natural Science	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Males	31.64	5.9992	33.24	7.3387	29.76	5.3796
Females	32.32	7.0871	35.68	7.1281	30.96	5.9615

TABLE B7

Grade Point Average

	Humanities		Social Science		Natural Science	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Males	2.5460	.4742	2.7868	.4512	2.9028	.5831
Females	3.0144	.5368	2.9516	.5368	3.1888	.4589

APPENDIX C

MEANS AND STANDARD DEVIATIONS FOR THE FIVE COGNITIVE STYLE MEASURES, GRADE POINT AVERAGE, AND AGE FOR SAMPLE 2 WITH AMERICAN COLLEGE TEST COMPOSITE SCORE

TABLE C1

Sample 2 Cell Size by Sex and Major

N=117	Humanities	Social Science	Natural Science
Males	17	15	22
Females	23	18	22

TABLE C2

Group Embedded Figures Test

	Humanities		Social Science		Natural Science	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Males	14.7059	2.8453	13.9333	3.6345	13.6364	3.6062
Females	13.4348	3.6034	10.6111	4.1036	13.5000	3.7129

TABLE C3

Matching Familiar Figures Time

	Humanities		Social Science		Natural Science	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Males	539.8529	257.6914	634.5333	320.5212	636.1591	321.8926
Females	585.5870	225.3590	542.6667	375.2525	660.0000	315.7025

TABLE C4

Matching Familiar Figures Errors

	Humanities		Social Science		Natural Science	
	$\bar{X}$		$\bar{X}$	SD	$\bar{X}$	SD
Males	8.7647	7.6692	9.2667	6.7978	7.5909	4.2388
Females	8.6522	4.8393	10.3333	6.5530	5.7727	5.0984

TABLE C5

Westcott Intuition Test Correct

	Humanities		Social Science		Natural Science	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Males	4.5882	1.8391	4.0000	1.2536	4.5455	2.0172
Females	4.8696	1.5755	4.7778	2.2375	5.1818	2.7540

TABLE C6

Westcott Intuition Test Clue Use

	Humanities		Social Science		Natural Science	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Males	32.6471	5.3495	34.2667	6.1000	30.5000	5.6967
Females	32.4348	6.8213	32.5556	4.8776	31.9545	6.5282

TABLE C7

American College Test Composite Score

	Humanities		Social Science		Natural Science	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Males	23.5882	4.1391	22.6000	3.9424	22.7727	4.2976
Females	22.8696	3.9347	20.9444	5.1389	23.6364	3.3173

TABLE C8

Grade Point Average

	Humanities		Social Science		Natural Science	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Males	2.8935	.4685	2.8640	.4920	2.6882	.4696
Females	3.0087	.4652	2.9867	.4612	3.0568	.4582

TABLE C9

Age

	Humanities		Social Science		Natural Science	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Males	20.7059	1.2632	20.4667	2.2636	21.3636	1.8138
Females	20.2609	1.1762	20.2778	1.7758	19.5909	1.0980

APPENDIX D

MEANS AND STANDARD DEVIATIONS FOR THE FIVE COGNITIVE STYLE MEASURES, GRADE POINT AVERAGE, AND AGE FOR SAMPLE 2 WITHOUT AMERICAN COLLEGE TEST COMPOSITE SCORE

TABLE D1

Sample 2 Cell Size by Sex and Major

N=150	Humanities	Social Science	Natural Science
Males	25	25	25
Females	25	25	25

TABLE D2

Group Embedded Figures Test

	Humanities		Social Science		Natural Science	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Males	13.96	4.0976	12.56	4.7441	13.68	3.5204
Females	13.60	3.5237	10.92	4.0714	13.48	3.5721

TABLE D3

Matching Familiar Figures Time

	Humanities		Social Science		Natural Science	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Males	543.72	276.1963	600.44	298.9831	635.80	316.1425
Females	584.26	239.3444	538.50	320.7193	659.34	321.3534

TABLE D4

Matching Familiar Figures Errors

	Humanities		Social Science		Natural Science	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Males	8.92	7.3707	10.08	6.2378	7.52	4.6915
Females	9.16	6.2161	9.48	6.2857	5.96	5.3889

TABLE D5

Westcott Intuition Test Correct

	Humanities		Social Science		Natural Science	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Males	4.20	2.1409	4.12	2.0478	4.44	1.9596
Females	4.72	1.8148	4.44	2.2376	5.00	2.6300

TABLE D6

Westcott Intuition Test Clue Use

	Humanities		Social Science		Natural Science	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Males	31.00	6.4356	33.12	5.8189	30.20	5.5151
Females	32.44	6.6588	32.56	5.5308	31.60	6.3246

TABLE D7

Grade Point Average

	Humanities		Social Science		Natural Science	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Males	2.8204	.4428	2.8308	.4996	2.6996	.4588
Females	3.0016	.4594	3.0624	.5037	3.0224	.4456

TABLE D8

Age

	Humanities		Social Science		Natural Science	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Males	20.84	1.2138	20.72	2.8065	21.44	1.8726
Females	20.84	2.7940	20.96	2.6690	19.64	1.1504

APPENDIX E

MEANS AND STANDARD DEVIATIONS FOR THE FIVE COGNITIVE STYLE MEASURES, GRADE POINT AVERAGE, WITH AND WITHOUT AMERICAN COLLEGE TEST COMPOSITE SCORE BETWEEN DOMINANT JUNGIAN TYPES IN SAMPLE 1

TABLE E1

Means and Standard Deviations Between Dominant Sensors and Dominant Intuiters

	Without ACT-C				With ACT-C			
	Sensors N = 20		Intuiters N = 61		Sensors N = 11		Intuiters N = 38	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
GEFT	11.7500	4.3995	11.9672	4.6903	11.4545	3.6977	12.1842	4.0394
MFF time	763.5750	336.8365	657.6557	306.9429	709.8636	209.4307	671.7368	292.3801
MFF errors	5.2500	3.9719	8.2459	5.1435	4.5455	3.4457	7.5263	4.8309
WIT correct	4.1000	2.3598	4.0656	2.1360	4.0000	2.0000	4.1842	2.0646
WIT clues	31.7500	6.7033	31.3770	6.7581	31.0909	8.1542	30.3947	6.8912
ACT-C					21.6364	4.0564	23.4737	3.4620
GPA	2.8945	.4675	2.8730	.5666	2.8664	.5689	2.9411	.5993

TABLE E2

Means and Standard Deviations Between Dominant Thinkers and Dominant Feelers

	Without ACT-C				With ACT-C			
	Thinkers N = 19		Feelers N = 50		Thinkers N = 13		Feelers N = 28	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
GEFT	13.5789	4.2598	12.3600	4.8561	13.8462	3.7826	12.6429	4.6921
MFF time	537.8947	241.7595	580.6100	286.4328	539.5769	246.7629	542.1786	193.6050
MFF errors	9.4211	6.3185	10.1400	7.7249	9.4615	6.7530	11.4286	8.9956
WIT correct	4.3158	1.8575	4.4600	1.8975	4.5385	2.1839	4.1786	1.9447
WIT clues	32.7895	5.5934	33.3600	6.6957	33.3846	6.0764	33.1786	6.0800
ACT-C					23.6154	4.8052	23.0714	4.4132
GPA	2.9621	.5688	2.9068	.5176	2.8515	.5784	2.8946	.5641

APPENDIX F

MEANS AND STANDARD DEVIATIONS FOR THE FIVE COGNITIVE STYLE MEASURES, GRADE POINT AVERAGE, WITH AND WITHOUT AMERICAN COLLEGE TEST COMPOSITE SCORE BETWEEN DOMINANT JUNGIAN TYPES IN SAMPLE 2

TABLE F1

Means and Standard Deviations between Dominant Sensors and Dominant Intuiters

	Without ACT-C				With ACT-C			
	Sensors N = 32		Intuiters N = 44		Sensors N = 25		Intuiters N = 38	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
GEFT	12.4375	4.2573	12.7727	4.0798	13.3600	3.5341	12.7105	3.9723
MFF time	632.9219	323.5892	515.6932	286.6982	641.6800	342.2122	551.0526	288.7651
MFF errors	7.8125	5.3848	9.7955	6.8219	6.8000	4.6368	9.5263	6.7533
WIT correct	4.4063	1.8641	4.8864	2.2227	4.7200	1.8376	4.7105	1.9715
WIT clues	32.4375	4.5361	32.1136	7.4466	32.9200	4.3197	32.4474	7.4424
ACT-C					21.8400	4.2297	22.3947	4.2524
GPA	2.8278	.4384	2.9895	.4605	2.8128	.4659	3.0347	.4476

TABLE F2

Means and Standard Deviations between Dominant Thinkers and Dominant Feelers

	Without ACT-C				With ACT-C			
	Thinkers N = 18		Feelers N = 56		Thinkers N = 15		Feelers N = 39	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
GEFT	13.1667	4.6431	13.5357	3.6480	14.0667	3.8260	13.5385	3.6624
MFF time	625.6389	283.5524	622.2500	284.8488	557.3333	255.0832	643.7308	303.0095
MFF errors	8.6667	7.5069	7.8750	5.4876	9.0000	8.0445	7.6923	4.4672
WIT correct	4.5000	2.3577	4.2143	2.1550	4.9333	2.3442	4.5897	2.1240
WIT clues	29.8889	6.3606	31.8571	.4786	29.5333	6.5232	32.7179	4.8501
ACT-C					23.0667	4.5114	23.6154	3.8018
GPA	2.6956	.4801	2.9532	.5013	2.7767	.4711	2.9285	.4949

APPENDIX G

RAW DATA

Column

1	Major =	1	Humanities
		2	Social Science
		3	Natural Science
2	Sex =	1	Male
		2	Female
3	Type =	1	Dominant Sensor
		2	Dominant Intuiter
		3	Dominant Thinker
		4	Dominant Feeler
4	Group Embedded Figures Test		
5	Matching Familiar Figures Time		
6	Matching Familiar Figures Errors		
7	Westcott Intuition Test Clues Used		
8	Westcott Intuition Test Number Correct		
9	American College Test Composite Score		
10	Grade Point Average		
11	Age		

Column	1	2	3	4	5	6	7	8	9	10	11
Sample 1	1	2	4	07	1024.0	04	05	28		3.64	20
	1	1	2	10	0395.0	17	05	27	22	2.91	21
	3	1	3	17	0522.5	05	05	27		3.47	31
	1	1	2	13	0421.5	06	03	39		2.29	24
	1	1	4	14	0612.5	13	06	30	24	3.62	21
	2	2	1	11	0719.5	05	07	45	24	3.49	20
	1	2	4	15	0509.0	04	05	35	25	2.61	21
	1	1	3	14	0904.5	14	05	32	27	2.04	22
	2	2	2	12	1393.0	01	04	31		3.64	41
	2	2	4	14	0502.5	02	06	31		2.64	23
	3	2	4	15	0745.5	07	04	34	28	3.89	21
	3	2	4	10	0875.0	07	04	23		2.72	21
	2	1	3	12	0597.0	06	05	38	27	3.09	19
	3	2	3	17	0130.5	25	03	34	26	3.69	21
	1	2	2	14	0619.5	03	07	25	22	3.20	19
	2	1	2	07	0595.5	10	01	25		3.14	55
	2	2	4	18	0286.0	19	09	32		3.53	25
	3	2	2	14	0668.0	00	05	32		2.87	22
	3	1	2	06	1200.0	03	04	34		2.51	24
	2	1	1	18	0674.0	08	02	26	22	2.48	25
	3	1	1	15	0675.0	03	04	30		3.58	30
	3	2	1	16	0866.5	02	06	33		2.65	22
	3	2	1	13	0931.0	00	04	39	21	3.13	19
	1	1	3	15	0267.5	12	06	31	25	1.97	25
	3	1	4	17	0623.5	11	05	33	17	3.34	26
	3	2	1	17	0445.0	07	08	30		3.33	20
	2	1	2	18	0759.5	06	03	33	22	3.60	20
	3	1	2	15	0941.5	07	05	20	24	2.88	21
	2	2	3	14	0495.5	08	05	34	21	3.13	21
	2	2	2	13	1048.5	02	06	37		2.95	21
	1	1	2	17	0481.0	07	04	28		2.89	21
	3	1	2	12	0653.5	09	02	38		2.15	27
	2	2	4	17	0580.0	09	02	37		2.63	23
	3	1	1	15	0684.0	04	03	23	23	2.82	20
	2	1	3	17	0222.0	12	03	29		3.34	25
	2	1	1	13	1689.5	03	04	31		2.83	37
	1	2	4	15	0521.0	03	02	49		3.70	26
	3	1	4	15	0537.5	10	03	28	28	3.23	21
	3	1	2	13	1026.0	05	03	24	21	2.90	19
	1	2	4	06	0265.5	21	05	37	19	2.49	22
	3	1	3	09	0413.5	19	01	31	15	2.13	22
	1	2	4	18	0809.5	03	06	36	24	2.79	21
	2	1	4	15	1478.5	05	06	34		2.93	22
	3	2	1	13	0651.5	01	02	36	21	2.75	19
	2	1	2	10	0333.0	10	04	41	25	2.31	22
	2	1	4	17	0207.0	08	04	37		3.12	21
	2	1	3	14	0821.5	05	04	28	28	2.75	22
	2	2	3	03	0820.0	17	04	40		2.23	20
	2	2	2	13	1429.5	04	01	25	26	3.65	21
	1	2	4	11	0808.0	11	04	19		2.23	20

Column	1	2	3	4	5	6	7	8	9	10	11
Sample 1 continued	1	1	4	09	0835.0	04	03	41		2.69	22
	1	2	4	07	0913.5	05	02	38		3.03	23
	3	1	1	07	1159.0	00	02	28	26	2.46	21
	1	1	2	16	0883.0	00	07	31	25	3.24	21
	1	1	4	03	0285.5	20	03	22	27	2.68	22
	1	2	2	12	0166.5	15	03	32	27	3.63	18
	3	1	2	13	0633.5	12	06	30	27	3.39	20
	3	1	4	16	0487.5	12	06	32		3.55	22
	1	2	2	14	0966.5	02	06	34	22	2.45	22
	2	2	4	00	0448.5	17	03	34		2.29	20
	2	2	1	05	0614.0	05	06	31	21	2.26	20
	1	2	2	13	0526.0	06	07	34	21	3.56	20
	3	1	2	16	1107.5	09	07	37		3.16	19
	2	2	4	18	0499.5	10	03	34	23	3.17	22
	2	1	2	05	0874.0	03	02	33	22	3.41	24
	1	1	2	08	0162.5	19	01	30		2.52	21
	2	1	2	07	0845.5	10	02	16	16	2.08	20
	3	1	4	17	0514.0	13	08	28	28	2.19	23
	1	2	3	11	0322.0	14	04	29		3.71	17
	1	1	2	17	0251.5	15	08	35		2.06	21
	3	2	4	12	0330.5	09	05	24		3.16	25
	2	1	4	08	0617.5	09	03	39	23	2.45	21
	1	1	4	14	0560.5	28	02	34	18	3.07	19
	3	1	2	14	0472.0	11	01	41		2.45	26
	2	2	4	01	0266.0	13	03	49	15	2.40	22
	2	1	4	07	0465.0	04	01	35	24	2.42	21
	3	2	2	18	0633.0	07	07	31		3.58	22
	2	2	4	11	0349.0	21	03	28	17	2.45	22
	2	2	2	09	0576.5	06	04	43		3.00	21
	3	2	2	16	0206.0	16	05	25	25	3.54	20
	3	2	4	13	0547.0	07	07	29	28	3.69	21
	1	1	2	15	0609.5	09	06	21		3.69	19
	1	2	1	13	0800.5	07	02	23	24	3.71	19
	2	2	2	16	0453.5	10	04	21		3.00	24
	1	1	2	10	0506.5	12	06	34	28	2.17	22
	2	1	4	06	0393.5	09	07	38		2.99	24
	1	1	4	11	0388.5	03	06	27		2.25	24
	3	1	4	12	0858.0	07	05	30	23	1.86	20
	1	1	4	10	0482.5	09	01	32	23	2.47	20
	3	1	4	16	0791.5	02	05	39	26	2.29	21
	2	2	4	09	0681.0	08	05	30	22	3.08	21
	3	2	2	11	0806.5	04	03	32	23	3.25	21
	3	1	4	18	0167.5	16	06	27		3.32	21
	3	2	3	18	0758.5	03	09	23	28	2.89	20
	3	1	2	17	0611.5	06	04	30		2.10	26
	1	1	4	08	0286.5	35	02	46	13	2.44	22
	1	2	2	03	0534.5	15	02	29		2.76	21
	2	1	2	03	0231.5	13	01	45		2.36	26
	1	1	4	11	1512.5	02	06	24		2.26	24
	1	1	2	17	1164.5	05	07	35		2.55	23

Column	1	2	3	4	5	6	7	8	9	10	11
Sample 1	1	2	4	15	0638.0	09	04	29	27	3.52	20
continued	1	1	1	07	0878.0	08	07	28		2.71	24
	2	1	3	13	0840.5	02	03	32		3.16	22
	1	1	2	00	0515.5	21	03	30		2.13	34
	1	1	2	17	1297.5	02	04	32		1.97	20
	1	2	4	10	0145.5	33	01	29	18	2.65	21
	3	2	2	12	0725.0	06	04	34	29	2.61	21
	2	1	2	10	0787.5	07	03	21	19	2.20	23
	3	2	1	14	0431.0	07	06	35		3.12	20
	1	1	2	18	0230.5	13	05	38		2.44	20
	3	2	4	17	0525.5	04	08	35	27	4.00	18
	1	2	3	04	0358.5	05	03	27	16	3.46	20
	1	2	1	11	0565.0	09	05	42	15	2.21	22
	3	1	1	13	1386.5	04	00	31		2.70	25
	1	1	2	13	0821.0	02	05	39	22	2.33	25
	3	2	2	16	0574.0	07	03	21	22	2.63	21
	2	1	2	03	0818.5	10	03	32	24	3.62	22
	2	2	1	14	0771.0	04	03	44		2.72	22
	2	2	2	10	0226.0	20	00	25	23	2.32	19
	2	2	4	02	0642.5	19	03	46		3.25	35
	3	1	2	18	0821.5	05	09	29	33	3.72	21
	3	2	1	08	0678.5	02	07	27	27	3.75	20
	1	2	1	12	0331.5	09	04	22	14	2.47	21
	2	2	4	18	0709.5	03	03	39	26	3.71	19
	1	2	4	17	0222.5	13	05	44		3.13	27
	3	2	3	14	0585.0	08	07	33	20	3.08	21
	1	1	2	06	0752.5	04	02	25	21	2.26	22
	2	2	2	15	0901.0	11	03	38	24	3.79	20
	3	1	2	18	0662.0	03	05	19	27	3.67	22
	2	2	4	14	0320.5	09	06	36	19	2.66	19
	2	1	4	16	0412.5	07	06	44		2.67	22
	3	2	2	14	0425.5	11	09	31	27	3.98	20
	3	1	2	18	0749.5	12	07	28		3.62	22
	1	2	3	17	0478.5	06	04	32		3.30	20
	1	2	1	00	0320.5	17	00	31		2.72	22
	2	1	2	09	0304.5	09	02	31	22	2.68	21
	3	2	4	15	0667.5	05	05	32	28	2.71	19
	2	2	2	14	0831.0	03	02	43	22	2.15	20
	2	1	2	05	0366.5	14	04	47	16	2.91	23
	3	1	2	14	0425.5	04	04	27	28	3.08	20
	1	2	2	09	0444.0	06	05	42	20	2.62	20
	3	2	2	08	0911.5	04	03	33	25	2.84	20
	1	2	2	02	0459.5	15	00	32		3.21	21
	3	2	4	18	0868.0	02	05	21	26	3.17	21
	2	1	2	07	0676.0	05	04	33	21	2.05	23
	2	1	3	17	0245.5	12	02	37	19	2.50	21
	2	2	3	16	0613.0	03	06	39	29	3.65	19
	2	1	2	17	0204.0	14	03	26	19	2.58	26
	3	2	3	16	0824.0	03	03	47	26	2.69	21
	1	2	4	15	0813.0	03	06	30		2.56	19

Column	1	2	3	4	5	6	7	8	9	10	11
Sample 2	3	1	1	15	0172.0	08	03	26	12	2.02	21
	2	2	4	06	0352.5	12	01	45		2.35	23
	2	1	4	17	0920.0	04	04	31	29	3.48	19
	3	2	4	15	0311.0	17	04	33		2.48	19
	3	1	3	17	0794.0	03	06	32	26	3.54	19
	2	1	4	14	0740.0	04	05	31	24	2.99	22
	2	1	3	07	0893.0	08	02	28		2.05	21
	1	1	2	14	0362.5	07	08	28		2.37	20
	1	1	2	05	0297.0	03	05	27		2.28	20
	1	1	4	09	0542.5	06	00	18		3.24	21
	3	1	1	17	0733.5	03	05	27	19	2.14	20
	2	1	3	16	0259.0	12	03	38	14	2.30	17
	1	2	1	14	0271.5	11	03	37	19	2.79	19
	3	1	4	11	0524.0	09	01	31	21	2.54	21
	1	2	2	11	0736.0	10	07	42	21	2.38	20
	2	2	2	15	0073.0	30	04	37	16	2.92	19
	3	2	4	13	0378.5	11	06	31	26	2.77	21
	2	1	4	14	0993.0	00	05	33	27	3.86	20
	3	2	4	10	1149.0	01	03	24		3.00	19
	1	1	3	18	0705.0	02	09	22	31	3.29	20
	2	1	1	02	0964.5	10	04	25		2.60	20
	1	1	4	16	0531.5	02	03	35		2.39	22
	1	1	3	18	0190.0	32	03	39	28	1.96	22
	3	1	1	17	0204.0	10	05	33	23	3.08	20
	1	1	4	13	0480.5	08	05	33	22	3.80	19
	3	2	2	07	0382.0	18	06	35	26	3.10	19
	2	2	4	17	0653.5	02	06	36		3.27	25
	2	2	2	05	0616.0	06	02	34	18	2.45	18
	3	2	4	12	0489.5	05	00	36	20	2.78	17
	3	1	3	08	1034.5	00	04	38	17	2.55	26
	3	2	4	08	1293.5	03	03	37	25	2.82	20
	2	2	4	12	0464.0	05	03	26		3.91	22
	1	2	4	16	0741.5	05	05	38	16	3.08	19
	3	2	1	12	0387.5	06	06	30	17	3.46	21
	3	1	1	10	0255.0	17	05	24		3.08	20
	3	1	1	13	1134.0	01	07	34	29	3.52	21
	1	2	4	17	0927.5	02	06	37		2.54	22
	2	2	4	12	0670.5	07	04	42	20	2.82	21
	3	2	1	17	0478.0	09	07	36	24	3.27	19
	2	1	1	06	0449.5	20	04	29		2.86	19
	2	2	1	16	0474.5	07	03	31		2.93	30
	3	2	2	14	0646.0	00	09	12	28	3.14	20
	2	2	2	11	0248.0	12	06	37	26	3.79	19
	2	1	3	18	0463.0	06	02	25	21	2.44	27
	2	2	1	07	0386.0	11	02	37	16	2.56	21
	3	2	1	18	1044.5	04	08	32	25	3.08	20
	1	2	3	17	0709.5	03	09	30	25	3.59	23
	2	2	4	11	0865.0	07	04	29	21	2.15	20
	2	2	4	04	0420.5	14	04	36	15	2.76	18
	1	2	2	18	0837.0	00	05	24	29	3.03	20

Column	1	2	3	4	5	6	7	8	9	10	11
Sample 2 continued	3	2	4	16	0638.0	08	08	34	19	2.15	20
	3	2	4	13	0786.5	04	04	32	25	2.92	20
	2	2	2	09	0524.0	08	05	37		3.47	20
	1	1	4	16	0500.5	06	05	22	25	3.00	22
	1	2	1	12	0831.0	04	04	42	23	2.23	22
	1	1	3	03	1122.0	11	03	39		2.55	22
	2	2	2	05	0353.0	05	01	31	21	2.44	21
	1	1	4	14	0244.5	11	04	29	17	3.14	19
	2	1	2	10	0356.0	21	05	27	25	2.29	20
	3	1	3	14	0254.0	12	07	23	24	2.32	21
	3	2	2	15	0457.5	05	03	36	24	3.22	18
	2	2	4	18	0267.0	09	08	28	30	3.62	21
	1	1	4	12	1142.5	01	05	38	28	2.79	21
	3	1	4	13	1171.0	08	03	21	26	2.12	21
	1	2	2	15	0586.5	08	03	23	22	2.65	21
	1	2	2	10	0504.5	09	04	22	23	2.86	21
	1	2	4	14	0210.5	28	00	28		3.30	33
	3	1	4	18	0660.0	09	07	31	25	2.58	22
	2	1	2	18	0258.0	14	09	33		2.45	21
	1	1	2	17	0116.0	25	00	17		2.54	23
	2	1	2	13	0784.0	03	04	34	19	2.73	18
	1	1	2	12	0348.5	14	02	32	20	2.93	19
	3	2	1	05	0603.5	01	03	34	20	2.62	18
	2	1	2	12	0417.5	19	03	45	19	2.80	21
	3	1	3	06	0186.0	16	07	30	27	3.14	22
	2	2	4	08	0274.0	13	08	26	29	3.62	19
	2	2	4	08	0559.5	16	01	23		2.87	20
	2	1	4	14	0532.0	05	04	25		3.82	19
	2	1	4	17	0423.0	05	03	37	19	2.90	20
	2	1	2	06	0913.5	13	02	36	20	3.11	19
	2	2	2	15	0354.0	17	04	28	19	3.32	26
	3	1	1	17	0836.0	02	07	36	22	2.45	27
	1	2	4	16	0290.0	06	03	33	21	3.20	21
	2	1	1	07	0884.5	07	00	36		3.39	21
	3	2	4	15	0503.5	04	04	30		2.83	22
	1	1	4	17	0938.0	09	04	29		2.82	21
	1	1	2	17	0677.0	08	05	32	27	3.44	21
	3	2	2	13	1356.5	01	04	24	25	3.72	19
	1	2	4	15	0526.5	08	05	36	25	3.52	20
	1	1	2	16	0302.5	12	06	35	23	2.81	21
	3	1	1	16	0758.0	02	04	32		3.00	21
	1	2	3	15	0752.0	13	03	19	17	2.60	20
	3	1	1	17	0254.5	11	01	34	25	2.44	22
	1	2	4	18	0408.5	09	06	22	29	3.35	21
	1	1	1	16	0602.0	06	06	33	25	3.36	21
	3	1	1	09	0557.5	06	04	33	24	2.73	21
	3	2	4	17	0653.0	03	04	34	26	3.59	21
	2	2	4	07	1593.0	00	08	35	28	3.33	20
	1	1	2	15	0479.5	05	06	31	28	3.02	21
	1	2	2	12	0449.5	16	05	35	20	3.61	21

Column	1	2	3	4	5	6	7	8	9	10	11
Sample 2 continued	1	1	4	18	0597.0	05	06	41	25	2.45	22
	1	2	2	03	0803.0	09	05	42	17	2.61	22
	2	1	4	18	0414.0	04	06	35		2.47	31
	1	1	4	17	0440.0	20	02	40	23	2.25	22
	2	2	2	14	0328.0	13	07	30	21	3.22	20
	1	1	2	14	0462.0	03	02	35	16	3.18	21
	1	2	1	11	1085.5	02	07	32	26	3.20	19
	3	2	4	15	0389.5	08	00	32	22	2.97	19
	1	1	1	13	1075.5	03	04	32	23	2.66	18
	3	1	2	17	0683.5	10	04	24	27	2.85	21
	3	1	1	12	0753.0	08	04	36	14	2.38	20
	3	1	2	13	0898.0	04	06	43	24	3.77	21
	2	2	4	14	0719.0	09	05	37	24	3.13	21
	2	1	4	10	0479.0	16	02	27		2.75	19
	2	2	4	14	0666.5	01	06	30		4.00	19
	2	1	4	17	0626.5	13	04	33	25	2.19	21
	2	1	2	16	0193.0	12	09	38		3.11	20
	1	2	2	12	0781.0	05	04	31	27	3.36	20
	2	2	2	12	0948.5	02	04	24	22	3.03	21
	2	1	4	08	0607.0	18	06	31	23	2.31	22
	3	2	2	18	0787.0	00	03	24	26	3.86	19
	1	2	4	18	0337.0	15	05	37	24	2.94	20
	1	2	4	17	0520.5	06	06	28	29	3.79	20
	3	2	3	16	0512.5	06	06	25	21	2.70	20
	1	2	2	10	0209.5	15	06	37	23	3.25	18
	3	2	3	12	0772.0	03	03	37	23	3.00	21
	3	2	1	12	1078.5	03	07	27	28	3.28	19
	3	2	4	09	0389.0	12	09	35	26	2.64	20
	1	1	1	07	0363.5	08	03	31	20	2.73	21
	1	1	4	18	0506.0	11	04	27		3.13	20
	2	1	1	14	0541.5	09	04	35	23	3.18	20
	1	2	1	16	0749.5	11	03	36	25	3.47	19
	3	1	2	17	0386.0	09	06	28	27	2.39	21
	3	1	3	16	0886.5	02	02	28		2.27	25
	1	1	4	14	0567.0	05	05	30	20	2.38	22
	1	2	3	10	0563.5	04	03	32	23	2.47	19
	2	1	1	07	0425.5	17	03	38		2.31	20
	3	1	4	09	1028.0	05	02	33	23	2.86	21
	1	2	1	12	0319.5	19	05	38	17	2.13	20
	3	1	4	09	0790.5	07	02	33	19	2.62	21
	2	1	1	15	1348.0	00	04	30	24	3.10	21
	3	1	1	16	0232.0	14	06	22	23	2.44	21
	1	2	3	11	0455.5	11	06	30	25	3.09	21
	2	2	2	07	0330.5	07	02	27	11	2.85	21
	3	2	2	17	0873.0	00	05	44	27	3.85	19
	3	2	2	18	0124.0	17	10	36	17	2.31	21
	2	1	2	18	0126.0	12	06	48	27	3.28	20
	2	2	2	12	1037.5	11	07	33	17	2.51	20
	2	2	2	14	0284.5	13	06	35	23	3.24	19
	3	1	3	15	0709.5	12	03	23	24	2.66	20

APPENDIX H

INTERCORRELATION BETWEEN THE FIVE COGNITIVE STYLE MEASURES AND GRADE POINT AVERAGE WITH AND WITHOUT AMERICAN COLLEGE TEST COMPOSITE SCORE IN SAMPLE 1 AND SAMPLE 2

TABLE H1

Intercorrelations for Sample 1 Without American College Test Composite Score

	GEFT	MFF time	MFF errors	WIT correct	WIT clues	GPA
GEFT	1.000000					
MFF time	.011037	1.000000				
MFF errors	-.226725*	-.587672**	1.000000			
WIT correct	.370255**	.043878	-.223766*	1.000000		
WIT clues	-.050011	-.098558	.017183	-.010761	1.000000	
GPA	.250359*	.007861	-.035924	.217597*	-.087624	1.0000

* $p < .01$

** $p < .001$

TABLE H2

Intercorrelations for Sample 1 With American College Test Composite Score

	GEFT	MFF time	MFF errors	WIT correct	WIT clues	ACT-C	GPA
GEFT	1.000000						
MFF time	.082038	1.000000					
MFF errors	-.131926	-.641986***	1.000000				
WIT correct	.252058*	.028405	-.276667**	1.000000			
WIT clues	-.078894	-.096455	.024510	.084976	1.000000		
ACT-C	.321152**	.230786*	-.346505**	.331718**	-.098241	1.000000	
GPA	.230282*	.086588	-.053169	.200567	-.087178	.359103***	1.00

* $p < .05$

** $p < .01$

*** $p < .001$

TABLE H3

Intercorrelations for Sample 2 Without American College Test Composite Score

	GEFT	MFF time	MFF errors	WIT correct	WIT clues	GPA
GEFT	1.000000					
MFF time	-.169805*	1.000000				
MFF errors	-.053178	-.604047***	1.000000			
WIT correct	.266446**	-.008094	-.090404	1.000000		
WIT clues	-.061161	-.002178	.048391	.031563	1.000000	
GPA	.182546*	.122041	-.266966**	.163943*	-.072572	1.0000

* $p < .05$

** $p < .01$

*** $p < .001$

TABLE H4

Intercorrelations for Sample 2 With American College Test Composite Score

	GEFT	MFF time	MFF errors	WIT correct	WIT clues	ACT-C	GPA
GEFT	1.000000						
MFF time	-.148298	1.000000					
MFF errors	.006485	-.634022***	1.000000				
WIT correct	.226527*	.036622	-.001930	1.000000			
WIT clues	-.148788	-.034735	.150183	-.089896	1.000000		
ACT-C	.247472**	.231922*	-.162301	.400516***	-.201682*	1.000000	
GPA	.175658	.150252	-.306444**	.215942*	-.033968	.453199***	1.00

* $p < .05$

** $p < .01$

*** $p < .001$

APPENDIX I

THE MATCHING FAMILIAR FIGURES TEST (MFF): INSTRUCTIONS, SCORE SHEET, AND SAMPLE ITEMS

INSTRUCTIONS - MFF

E opens test booklet to first item so that S is looking at the practice item with the standard at the top and the variants at the bottom. The standard is nearly at a right angle to the variants.

E, pointing to the variants, then says, "Only one of these is an exact duplicate of this" (pointing next to the standard). "Your task is to find that one. Tell me when you think you have found it. If you are wrong, you keep looking until you have found it. If you are right, then you go on to the next item, but please wait to turn the page until I tell you. The first two are practice items. Ready? Go."

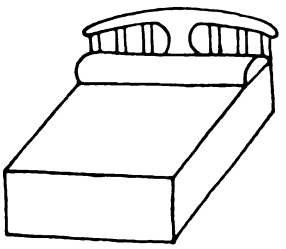
E answers any questions S may have while S solves the practice items. E records latency to the first response for each item to the nearest half-second and the responses S makes in order.

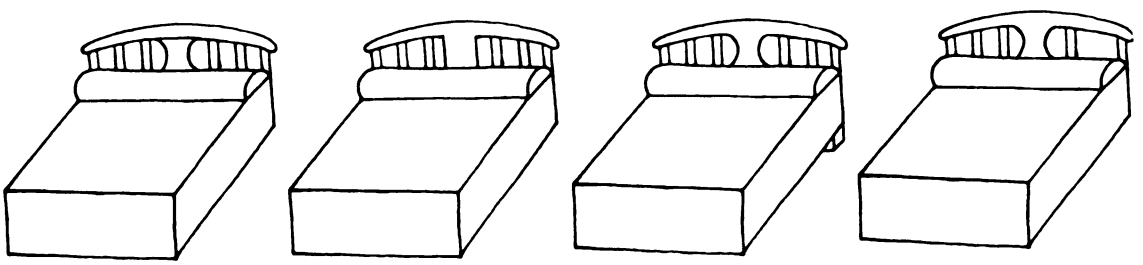
SCORE SHEET - MFF

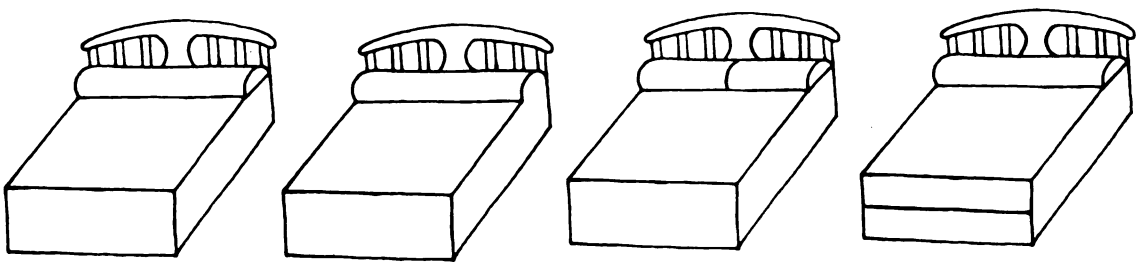
NAME _____ DATE _____

AGE _____ SEX _____ MAJOR _____

Time to first response	Responses
a. boat (2) _____	_____
b. cowboy (4) _____	_____
1. dog (4) _____	_____
2. rose (6) _____	_____
3. soldier (2) _____	_____
4. graph (7) _____	_____
5. baby (4) _____	_____
6. lamp (8) _____	_____
7. dress (1) _____	_____
8. lion (5) _____	_____
9. glasses (7) _____	_____
10. plane (4) _____	_____
11. leaf (2) _____	_____
12. bed (5) _____	_____







APPENDIX J

THE WESTCOTT INTUITION TEST (WIT): INSTRUCTIONS, TEST WITH CLUES UNDEVELOPED, TEST WITH CLUES DEVELOPED

INSTRUCTIONS SHORT FORM WIT B

Place the problem page in front of you and look at it closely. The page contains twelve problems for you to solve with a space at the right to record the answers.

Each row of boxes is a problem and each problem is separate from the others.

In each box in a row there is progressive information about the problem and about what answer is to go on the line at the right. To find the information in a box, brush across the box with a single stroke of the developing pen. For each problem, the correct answer is the one answer which would be right if all boxes were developed and all the information were used.

The task is to solve each problem using as little information as possible.

The first two problems are for practice only, to familiarize you with the task, so work through them as follows:

Problem 1. Note that the answer space for problem 1 is entirely blank (while the answer space for problem 2 already is partly filled). Use your developing pen to develop the first box in problem 1 and see what it says. If you have an idea what would go on the answer sheet if you developed all the rest of the boxes, write it down. You probably don't have any idea yet, so develop the next one. Now the information reads 1-2-blank-blank-blank (answer).

If you develop the next box, you will find that the information then reads 1-2-3-blank-blank (answer). By now you may be willing to guess what is in the boxes that you haven't developed, and you may be willing to write the one answer which would be correct if you went ahead and did develop them.

As you develop the rest of the boxes in the row, one by one in order, you find that the information, when fully revealed, is 1-2-3-4-5 (answer), and the one correct answer is 6. You might have been able to reach this conclusion after developing only one or two boxes, but remember the right answer to this problem would be 6 no matter how few boxes you developed.

Remember, your task is to solve the problems correctly using as little information as possible. When you develop boxes, you must develop them in order from left to right.

Problem 2. Note that the answer space already contains part of an answer. Develop the first box, and see what it says. If you want to complete the answer, try it. If not, develop the next box, and so on, until you find that the one correct answer is High/low.

In these first two problems, you probably developed most or all of the boxes, in order to understand the nature of the two problems. In the next ten problems your aim is to solve them correctly developing as few boxes as possible, in order from left to right.

Only you can decide how many boxes you need to develop and how certain you want to be about your answers. Remember that there is one correct answer for each problem and it must take account of all the information provided in all the boxes, whether you have developed them or not.

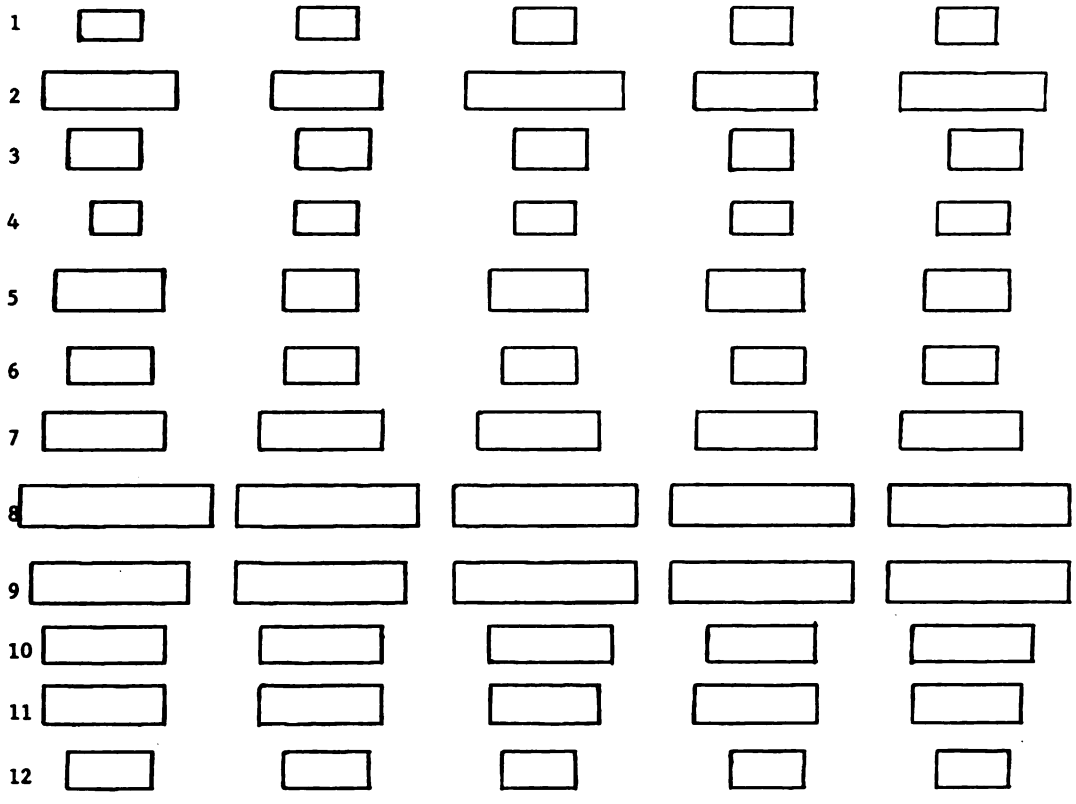
The time limit for the task is fifteen minutes, and it is important that you attempt a solution to each problem during that time.

Remember: develop the boxes in order from left to right, and try to solve each problem, using as little information as possible. Your answer must take account of the information you have seen as well as the information you have not seen.

NAME _____ MAJOR _____ SEX _____

Date of first admission to CMU _____ Are you a transfer student? Yes ____ No ____

Are you on a teaching curriculum? Yes ____ No ____



1 _____

2 HIGH _____

3 _____

4 _____

5 216- _____

6 _____

7 _____

8 PLANK MEALS. _____

9 SIP _____

10 TAR _____

11 6857392 _____

12. 2 _____

NAME _____ MAJOR _____ SEX _____

Date of first admission to CMU _____ Are you a transfer student? Yes ____ No ____

Are you on a teaching curriculum? Yes ____ No ____

1	1	2	3	4	5	1 _____
2	over under	in out	short long	down up	black white	2 HIGH
3	BC	CD	DE	EF	FG	3 _____
4	Z	X	V	T	R	4 _____
5	312-4	8-2	15-4	351-1	242-2	5 216-
6	N	NE	E	SE	S	6 _____
7	326-1957	732-6195	573-2619	957-3261	195-7326	7 _____
8	boat ship send	tar pitch toss	tavern bar rod	fee tip end	thin lean tilt	8 PLANK MEALS
9	stripe 123456	strip 12345	trip 2345	pier 5463	pest 5612	9 SIP
10	DOC DUD	RID ROE	SEW SIX	COD CUE	TAM TEN	10 TAR
11	3692-4	216874-6	31-2	26915-5	9-1	11 6857392
12	9N	8E	6S	4F	7S	12 2