RELATIONSHIPS AMONG MEASURES OF COGNITIVE STYLE, VOCATIONAL PREFERENCES, AND VOCATIONAL IDENTIFICATION*

Won-Shik Chung**

George Peabody College for Teachers

Introduction

Since Klein's work (1951) on the conceptualization of consistent stylistic variables in a person's typical mode of perception, three main streams of studies regarding the stylistic dimensions of perceptual and cognitive processes have been generated. These are: (1) the work of Witkin and his group on field-dependence or psychological differentiation (1954; 1962), (2) the studies of Gardner, et al. on cognitive control principles (1959; 1960), and (3) the work of Kagan and his associates on the styles of conceptualization and categorization (1963).

Klein's initial conception of stylistic dimensions of perceptual and cognitive processes and its underlying theory have been described elsewhere, but the following summary made by Holzman and Klein (1954) well describes the point of view.

> The central concern of this point of view is in the organization of personality that is, in consistencies of regulation in a person's thought and action. Its aim is to isolate principles of organization of cognitive behavior, termed "cognitive system-principles" that will account for and predict a person's typical mode of perceiving, remembering and thinking. The hope is that definitions of such generic regulatory principles can provide useful bases for explaining individual differences in cognitive performance. Individual differences in psychophysical response are considered the outcome of "preferred" forms of cognitive regulation — "preferred" in the sense that they are the organism's typical means of resolving adaptive requirements posed by certain types of cognitive problems(though not only such means available to it).
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> Such principles of regulation should be observable throughout a person's cognitive behavior, and the empirical task is to construct adaptive situations that will bring them into relief (p. 105).

On the basis of this theoretical background

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** Presently assistant professor of psychology and chief, Div. of Guidance and Counseling, Student Guidance Center, Seoul National University. The author is indebted to Raymond C. Norris for his supervision of the study.

and evidences obtained from some of his studies, Klein proposed a dimension of cognitive functioning which he termed "leveling-sharpening." According to his definition, levelers tend to ignore changes in the stimulus, to deny differences, and to give a response which was appropriate in the past where it no longer is appropriate. Sharpeners, by contrast, are alert to changes and have a tendency to respond excessively to fine nuances and small differences.

The study of personality and perception by Witkin and his colleagues (1954) revealed wide individual differences in scores on the tasks designed to assess field-dependence. Some people were found to be relying on the visual field, while others were independent of the field reference. The investigators labeled the tendency to rely on the field as "field-dependence;" the inclination to be independent from the field reference and use an analytic approach, was called "field-independece." These two cognitive styles were conceived as representing the extremes of a continuum that reflect a dimension of personality roughly corresponding to activity-passivity in dealing with the environment.

Gardner and his associates carried out a series of studies on the general principles of cognitive organization(1950; 1960 a; 1960 b; 1962) and identified a number of cognitive control principles. One of the variables among their set of cognitive control principles was "equivalence range" or "category width"; a high score resulting when many narrow range categories are used in various sorting tasks, as opposed to use of only a few broad categories. Another variable which they called "constricted-flexible" control, referred to differences in reactions to stimulus fields containing contradictory or intrusive cues. According to the investigators, constricted subjects resorted to counteractive measures in their attempt to overcome the disruptive effect of intrusive cues, while flexible subjects seemed relatively comfortable in situations that involved contradictory or intrusive cues.

A somewhat different aspect of cognitive style has been studied by Kagan, et al.(1963). Using a figure sorting task, they identified distinctive conceptual classes of categorization. The "analytic-descriptive" style of grouping was the tendency to group objects in terms of some selected elements within a stimulus complex. The second conceptual class was the "relational" mode, in which that subject grouped objects in terms of functional relationships. The third class was the "inferential-categorical" style which was not directly based on exclusively objective attributes of the stimulus, but involved a concept inferential about the stimuli grouped together.

With these dimensions of cognitive style identified, there have been a number of studies conducted in the past several years in order to explore the nature and extent of in dividual differences in these perceptual modes. The basic assumption of all the investigations cited was that cognitive styles are an individual's preferred modes of adapting to particular classes of situations and are important determiners of many aspects of behavior such as memory, perception, thinking, and the like. Furthermore, the students of cognitive style assumed that these preferred strategies which exist in the process of cognition are related to nonintellective aspects of the individual's functioning, such as impulsiveness and systems of defense, and to the history of interpersonal relationships during the early sociali-

zation process. Accumulating evidence tends to support the notion that cognitive styles are closely related to a number of personality variables and to intellectual functioning as well.

Three major groups of studies have been carried out in the past decade in an attempt to specify those unique modes of perception which exist in the cognitive process.

The first group of studies includes attempts to relate cognitive style measures to various aspects of intellectual functioning. Loomis and Moskowitz(1958) attempted to determine the differences in methods of coping with stimulus ambiguity by flexible and constricted control subjects and found that flexible subjects were more likely than constricted ones to integrate the competing, overlapping, contradictory elements of a stimulus situation, whereas constricted subjects were more likely to keep apart the intrusive ambiguities, if possible. Goodenough and Karp (1961) obtained data which tended to support the hypothesis that some intellectual and perceptual tests have a common requirement for overcoming embedding contexts, and that relationships obtained between measures of field dependence and standard tests of intelligence are based on this common factor. Jackson (1957) obtained inversely related significant correlations between scores on the Embedded Figures Test and American Council on Education Psychological Examination for both sexes. Bloomberg (1963) found that field independent subjects were more influenced than field dependent ones by additional relevant stimuli, thus suggesting that field independent subjects were less susceptible to external and internal distractions than field dependent subjects. Messick and Damarin (1964) suggested that accuracy of incidental recall can be predicted from cognitive styles. The most extensive study done along this line was that of Gardner, et al. (1960 a). They administered to 63 female college students a large battery of cognitive control tests designed to measure four distinctive cognitive styles including "Field-Articulation" (Field-Dependence), "Constricted-Flexible Control," "Leveling-Sharpening," and "Equivalence Range". The scores were correlated with 13 intellectual measures obtained from the same subjects. The major contribution of the study was that is supported the finding of the previous study of Gardner, et al. (1959), which pointed to the multi-dimensional nature of cognition at the level of organization represented by the control principle constructs. Clear evidence was obtained that intellectual abilities and cognitive controls are not isolated aspects of cognitive organization but are mutually related.

The second group of studies attempted to relate cognitive styles to personality variables. Holzman and Gardner (1959) investigated the leveling-sharpening dimension in relation to preferences for different defense mechanisms. When Rorschach protocols for 10 extreme "levelers" and 10 extreme "Sharpeners" selected from a large group were rated for reliance upon repression as a defense, the six subjects rated high in repression were found to be extreme levelers, suggesting a possible link between adaptive and defensive processes. Hardison and Purcell (1959), classifying subjects in terms of both constricted-flexible control and the need for independence as measured by the Edwards Personal Preference Schedule, noted that

independent, flexible control subjects showed a significant improvement in performance under stress while dependent, constricted subjects showed a deficit. Wilkins (1964) demonstrated that leveling and ego-strength scores were significantly associated with high need achievement scores. One of the findings of Feldman (1965) suggested that, under stress, the more field independent female subjects performed significantly better on a concept task than those who were field dependent. Kipperman (1964) suggested that field independence serves a defense-like function in preserving the tendency toward analytic categorization against the effects of drive arousal.

The third group of research studies dealt with the investigation of individual differences in cognitive style measures. The studies in recent years have demonstrated consistently marked individual differences in cognitive styles even though the number of variables used and the sample sizes were somewhat limited. One of the most striking findings was that there were marked sex differences in both children and adults. Witkin and his associates (1954), using the Rod-Frame Test, Embedded-Figure Test, Tilting-Room, and Rotating-Room found that women were more field dependent than men. The earlier studies, such as those by Sweeney (1953) and Sandstrom, (1953) provided some indirect support for Witkin's finding. Later studies also have confirmed the Witkin finding. Bieri, Bradburn, and Galinsky(1958) obtained data that showed significant sex differences in performance on the Embedded-Figures Test with males more field independent than female subjects. Feldman (1965) also reported that females were more frequently field dependent than males.

Individual differences in variables other than sex have been related to cognitive style. Age differences were reported by Kagan, Moss, and Sigel(1963). Their cross-sectional comparison of age groups suggested that there are significant increases in analytic style with age among children, especially for boys. Broverman (1960) demonstrated that intellectual abilities as measured by Primary Mental Ability Verbal Meaning subtest vary within individuals as a function of their cognitive styles. The intra-individual ability variations were measured through the use of ipsative scores, or scores which reflect deviations in performance on particular tasks from the person's general level of performance on a large battery of tasks. He found significant differences between cognitive style groups as measured by the Stroop Color Word Test with ipsative but not with raw scores. Defares and Van Der Werff (1963) gave the Rod-Frame Test and Maslow's Security-Insecurity Inventory to 80 Dutch students, equally divided between those who received a verbal pre-education and those concentrating on spatial-mathematical subject matter in school. They found that there was no correlation between Rod-Frame and the Security-Insecurity score for the verbal pre-education group; while negative relationships were obtained for the spatial-mathematical group. This finding suggested that for students who had a concentration on courses emphasizing spatial-mathematical skills, admission of insecurity was associated with analytical, field-independence performance. Along the same line, Field (1954) found physical science majors made significantly higher scores than social science majors on the Schematizing

Test; this suggested that physical science majors have a tendency to respond excessively to small differences and to be alert to changes.

These three groups of studies, i.e., those relating cognitive styles to intellectual functioning, those relating cognitive styles to personality variables, and those investigations of individual differences in cognitive styles in relation to sex and age, lead to a question of particular concern to the present study. What are the relationships between cognitive style as measured by cognitive control measures and the major areas of study and the vocational preferences of college students?

The present study was undertaken in an attempt to explore the nature and extent of individual differences in cognitive styles such as "field-dependence," "leveling-sharpening," "constricted-flexible control," "equivalence range" and to investigate the relationships of cognitive styles to the major areas of study and the vocational preferences of college students. It was based on the following assumptions:

1. That major areas of study in college represent stages of preparation for a specific and that there is some relationship between the area of college study and later occupational requirements.

2. That there are differential personality and perceptual patterns exhibited by contrasting occupational groups.

3. That vocational preference is one of the strong determinants of occupational choice.

4. That there are differential patterns of intellectual functioning require for adequate role performance in specific occupational groups.

5. That adjustment to a particular area of study in college requires the same kind of adjustment as the later occupation in terms of personality characteristics and intellectual ability.

The overall strategy of this research included: (1) the selection of appropriate subjects from each major area of study; (2) the investigation of various cognitive styles and vocational preferences of selcted subjects; and (3) an examination of the relationships of the obtained variable measures.

An incidental part of the present study was the determination of the reliabilities of the cognitive style measures used. This need arose from the fact that the present investigation used group-administered cognitive style measures, unlike most of the previous studies in this field. It was assumed that, if reliable, these group measures could meet the need for economical and practical measures of cognitive style.

The following experimental hypotheses were identified for testing in the present study:

1. The patterns of interrelationships among cognitive style measures would differ from one academic area to another so that differential weighting of scores would permit discrimination of students from the several academic areas.

2. The patterns of interrelationships among cognitive style measures would differ from one vocational interest area to another so that differential weighting of scores would permit discrimination of vocational interest groups.

In addition, the following null hypotheses were tested:

1. There is no relationship between scores of cognitive style measures included in the study and interest area scores on the Kuder Preference Record.

2. There is no relationship among four cognitive style measures selected for the study.

Method

Subjects

The subjects for this study were drawn from the total number of students at junior, senior, and first year graduate school level in the Nashville University Center.[1] The sample consisted of 141 college students drawn from eight academic major areas. The major areas of study from which the subjects were sampled and related departments are shown in Table 1. The selection of the eight academic areas was based on the investigator's judgment of representative areas which might prove differentiable. Of the departments which constitute the three institutions in the Nashville University Center, those judged to be most similar in terms of the intellectual abilities and personality characteristics required were grouped into the broader academic areas. This procedure was followed in an attempt to maximize the differences between broad areas and to minimize differences within areas. At the same time, this procedure was expected to produce broad areas roughly parallel with the Kuder preference categories. Among the academic areas identified, the eight major areas shown in Table 1 were available for the testing of May 1966. of Since the present study to sample those committed and successful students in subjects of their own field of studies, it was desirable to select those closest to the termination of their training. For this reason, juniors and seniors were chosen in most instances, and first year graduate students were selected in others.

Table 1. Major Areas, Number of Subjects, Levels, and Departments Involved in the Sample

Major Area	N	Level	Department
(1) Social Science	17	Jr. & Sr.	Political Science, Sociology, History
(2) Natural Science	17	Jr. & Sr.	Physics, Chemistry, Biology
(3) Humanities	17	Jr. & Sr.	English, Fine Arts
(4) Engineering	18	Jr. & Sr.	Civil, Chemical Mechanical, Electrical Engineering
(5) Elementary	19	Jr. & Sr,	Elementary Education
(6) Music	18	Jr., Sr. & 1st Gr.	School of Music
(7) Social Service	17	1st Gr.	Divinity School, Religious Educatian, Christian Education
(8) Library Science	18	1st Gr.	School of Library

As a first step in recruiting subjects, the chairman of each department whose students were to be involved was asked to recommend students who were doing satisfactory work in their own fields. The standard or criterion by which students could be selected was not given; instead, the chairmen were asked to use their own judgment. Upon receiving a recommended list of students from each department, each student was contacted by letter and, when necessary, by telephone to request his participation in the testing

1) Nashville University Center consists of Vanderbilt University, George Peabody College for Teachers, and Scarritt College for Christian Workers.

program.

Although paid $3.00 for participating, the 141 subjects were, of necessity, volunteers who were self-selected from the recommended students. The participants displayed interest in this type of psychological testing and were willing to add three hours of testing to their otherwise busy schedules. Among the recommended students, roughly 65 percent of those contacted accepted the request.

Because of the difficulty in getting subjects and the nature of the departments involved, it was not possible to control such variables as age, sex, and socio-economic back-ground. The age of the subjects ranged from 19 to 39 with a mean age of 22.8. Seventy-one female and seventy male subjects constituted the total sample. None of the subjects had previously participated in a study employing cognitive style measures.

Instruments

Measuring instruments for field-dependence, leveling-sharpening, constricted-flexible control, and equivalence range were drawn from the set of measures employed by Gardner and his colleagues(1960). Other measures were Kuder Preference Record and a personal data blank specially prepared for the study.

Cognitive style measure. Full descriptions of the specific procedures used to measure the cognitive styles, together with scoring procedure for the tests, are presented in Appendix A. In brief, cognitive style variables and tests selected for the presnet study were:

1. Field-Dependence. Group-Administered Embedded-Figures Test (EFT) or Hidden Figures Test published by Educational Testing Service was used. The test consisted of 32 achromatic complex patterns, each containing one of five simple figures which appear at the top of each page. The task was to identify a simple figure from complex patterns. The score consisted of the number correct in 20 minutes. It was assumed that field-dependent subjects would experience more difficulty in isolating sample figures from the field and would consequently, have lower scores. The reliability was estimated by odd-even split half correlation.

2. Leveling-Sharpening. The Schematizing Test (SMT) used by Gardner, et al., was employed. The test required judgments of size of a series of 150 squares which gradually increase in size. The 14 sizes of squares ranged from 1.2 to 13.7 inches on a side. They were projected from a film strip onto a screen approximately 15 feet from the subjects, who were tested in groups of 10. Individual squares were exposed for three seconds, with eight second intervals between exposures. The exposure time and intervals were controlled by a mechanical timer. At the beginning of the test, the five small squares were shown in ascending order, then in two random orders (Series 1). Without interruption, the smallest square was then removed and a suare larger than any previously seen was added. These five squares were then presented in the same order as in Series 1. The presentation of squares proceeded in this fashion through 10 series of 15 judgments. Increment error was used as the score. It was anticipated that the larger increment error would come from the levelers. Odd-even split half correlation was obtained to estimate the reliability of the test.

3. Constricted-Flexible Style. The Color Word Test (CWT) was initially introduced by Stroop (1935) and later modified by

Thurstone (1944). The Color Word Test which was used in the present study was a group-administered version of the Color Word Test used by Messick and Fritzky (1963). The test consisted of (a) a control color discrimination condition, in which the subject wrote as quickly as possible under each of a series of different colored patches the first letter of hecolor name, and (b) an interference condition, in which subjects again wrote the first letter of the color in which conflicting color names were printed. The score was the total number correct in a fixed time limit. It was expected that lower scores on the test would come from constricted subjects who would experience more interference.

Since the CWT was highly loaded with a speed factor, the internal consitency measure was neither meainingful nor appropriate. It was assumed that the CWT items would present no difficulty from retention of particular items, and the practice effects from repetition of the same items would be negligible. For these reasons, the test-retest reliability estimate over a short interval was conducted on a separate group.

A test-retest reliability study was conducted on a separate group of students attending Summer Pre-session Classes of George Peabody College. A total of 63 subjects completed both first and second testing. An exact one-week interval was maintained between testings. There was no control over such variables as sex and age. Their ages ranged from 22 to 46 with average age of 24.6, which was somewhat higher than the main group. However, the difference seemed to be negligible for this purpose of the study.

4. Equivalence Range. Two parallel forms of the Object Sorting Test (OST), modified by Clayton and Jackson (1961) from the work of Gardner, were used as a measure of equivalence range. Each test consisted of the names of 50 familiar objects selected according to the following two criteria: (a) the objects were specific, generally movable ones with a definite location; (b) objects which would not easily permit more than one meaning. The task involved was to group the objects by actually writing down the names of the objects under categories labeled A. B. etc. The score was simply the number of categories used by each subject in grouping all of the objects. It was assumed that those who would take an analytic approach would produce more categories. A parallel form reliability estimate was obtained.

Other measures. The other variables selected for the study were as follows;

1. Vocational Preference. Kuder Preference Record-Vocational Form C was used. Accoroing to the Kuder Preference Record Manual, the test was designed to measure preferences in 10 broad interest areas:

a. Outdoor: Indicates a preference for work that keeps one outside most of the time, usually dealing with animals and growing things.

b. Mechanical: Indicates a preference for work with machines and tools.

c. Scientific: Indicates a preference for discovering new facts and solving problems.

d. Persuasive: Indicates a preference for meeting and dealing with people, and promoting projects or things to sell.

e. Artistic: Indicates a preference for doing creative work with one's hands. It is usually work that has "eye appeal" involving attractive design, color, and materials.

f. Literary: Indicates a preference for reading and writing.

g. Musical: Indicates a preference for going to concerts, playing instruments, singing, or reading about music and musicians.

h. Social Service: Indicates a preference for helping people.

i. Clerical: Indicates a preference for office work that requires precision and accuracy.

Among the 10 categories, nine categories, with the exception of Outdoor, were used.

The stainine scores for each of the interest areas were available. The 141 subjects were divided into the nine Kuder vocational interest groups on the basis of the highest stanine score of each subject.

2. Biographical Data. Biographical data, including the level of satisfaction within major field and career commitment, were collected by means of a questionnaire specially prepared by the investigator. The sample form is included in Appendix B.

Procedure

Each subject was given a battery of four cognitive style tests, the Kuder Preference Record, and a personal data blank. The measures were administered to the subjects in groups of not more than 10 subjects. The test administration was conducted by three trained examiners. Normal and reasonable physical conditions were maintained throughout the testing. An uniform order of presentation of the test battery for all subjects was used. The first session involved the CWT and the SMT; the EFT and OST constituted the second session; and the Kuder Preference Record and Personal Data Blank were given during the third session. Total testing time was three hours; this was divided into two parts of one hour and two hours duration. Some students worked for two hours on their first examination day and one hour on the second while others reversed these time blocks. The choice was left to the individual. All tests were administered between May 11, 1966, and May 23, 1966.

Results

The data from the four cognitive style measures, the Kuder Preference Record, and the personal data blank were analyzed in terms of the following five sections: (1) product moment intercorrelations of the variables including four cognitive style measures and nine vocational preference scale variables; (2) discrimination of eight major area groups on the basis of cognitive style measures; (3) discrimination of nine vocational interest groups on the basis of cognitive style measures; (4) summary of personal data and its relation to cognitive style measures; and (5) estimation of reliabilities of cognitive style measures.

In view of the nature and amount of computation involved in the data analysis, a computer processing for the necessary computation was essential. The data were analyzed at the Computer Center at Vanderbilt University with the aid of IBM 7072 electronic data processing system. The items requested for the necessary computer analysis are given in Appendix D.

The main statistical analysis was the application of the multiple discriminant analysis suggested by Wert, Neidt, and Ahmann (1954) and illustrated by Cooley and Lohnes (1962). The available computer program analyzes multiple discriminant functions as

the vectors associated with the latent roots of the determinantal equation

$$W^{-1}A-I=O$$

where I is an identify matrix and W is the pooled within-groups deviation scores cross-products matrix. In addition,

$$A=T-W$$

here T is the total sample deviation score cross-products matrix. The matrix A thus the between-groups cross-products of deviations of group from grand mean.

The computer program for discriminant analysis produced latent roots of $W^{-1}A$, per cent of trace, and x^2 values. In testing the significance of discriminant functions, Cooley and Lohnes (1962) suggested that either the x^2 approximation or the F approximation would be appropriate, but Lohens (1961) indicated the latter to be a slightly better approximation. For this reason, it was decided to apply both approximations to test the significance of Λ criterion. The Λ criterion was defined by Cooley and Lohnes (1962 p. 61) as follows:

$$\Lambda=|W|/|T|$$

where the elements of the W and T matrices were:

$$W_{ij}=\sum_{k=1}^{g}\left\{\sum_{n=1}^{ng}(x_{ikn}-\bar{x}_{ik})(x_{jkn}-\bar{x}_{jk})\right\}$$

$$t_{ij}=\sum_{n=1}^{n}(x_{in}-\bar{x}_i)(x_{jn}-\bar{x}_j)$$

where g=number of grops, Ng=number of subjects in group g, N=total number of subjects, and i and j run for 1 to p, where p =the number of variables.

Wilks' lamda criterion was computed from the latent roots produced by the computer analysis using the following formula given by Cooley and Lohens(1962, p. 118):

$$\Lambda=\prod_{i=1}^{r}\left[\frac{1}{(1+\lambda_i)}\right]$$

For F transformation of Λ the following formula given by Cooley and Lohnes (1962, p. 62) was used:

$$F_{ms+2}^{2r}=\left(\frac{1-y}{y}\right)\left(\frac{ms+2}{2r}\right)$$

Where

$$S=(P^2Q^2-4)/(p^2+q^2-5)\quad q=g-1$$
$$m=n-(p+q+1)/2,\qquad n=N-1$$
$$\lambda=-(pq-2)/4,\quad r=pq/2,\quad y=\Lambda^{1/s}$$

Intercorrelations of the Variables

Product moment correlations among four cognitive style measures and nine Kuder preference scales were obtained. These correlations for overall subjects are presented in Table 2, and those for each major area are given in Appendix D. As can be seen in Table 2, the intercorrelations of the cognitive measures are generally low, ranging from .175 to −.217. The results clearly indicate that the cognitive style measures employed in the present study are substantially independent of one another.

It also can be seen in Table 2 that the correlations between cognitive style measures and Kuder preference scales are generally low. The correlations between CWT and Kuder Scales ranged from .156 to −.104. The correlations between OST and Kuder Scales were from .221 to −.129, with the correlation between OST and K-Comp being the only one significant at the .05 level. Correlations for EFT and Kuder Scale produced some significant relations — those for FFT and K-Mech, K-Comp, K-Sci being positive while those for EFT and K-Pers, K-Serv were negative. Crrelations between SMT and Kuder Scales ranged from .146 to

Table 2. Intercorrelations Among Four Cognitive Style Measures and Nine Kuder Preference Record Scales

	CWT (1)	OST (2)	EFT (3)	SMT (4)	K-Mech (5)	K-Comp (6)	K-Sci (7)	K-Pers (8)	K-Art (9)	K-Lit (10)	K-Mus (11)	K-Serv (12)	K-Cler (13)
(1)	1.000												
(2)	0.095	1.000											
(3)	0.175	0.078	1.000										
(4)	−0.217	0.036	−0.148	1.000									
(5)	−0.027	−0.057	0.274	−0.139	1.000								
(6)	0.156	0.221	0.220	−0.154	0.334	1.000							
(7)	0.085	0.175	0.239	−0.182	0.509	0.564	1.000						
(8)	0.021	−0.007	−0.211	−0.124	−0.134	−0.083	−0.203	1.000					
(9)	−0.104	−0.080	0.013	0.146	−0.238	−0.527	−0.493	−0.083	1.000				
(10)	−0.081	−0.029	0.014	0.105	−0.248	−0.167	0.163	−0.032	−0.010	1.000			
(11)	−0.040	−0.027	−0.046	0.010	−0.360	−0.292	−0.419	0.044	0.125	0.165	1.000		
(12)	0.055	−0.129	−0.279	0.002	−0.402	−0.336	−0.302	0.106	0.051	−0.131	0.032	1.000	
(13)	0.011	0.080	−0.079	0.061	−0.158	0.294	−0.060	0.093	−0.191	−0.131	−0.088	−0.276	1.000

(1) CWT: The Color Word Test
(2) OST: The Object Sorting Test
(3) EFT: The Embedded Figures Test
(4) SMT: The Schematizing Test
(5) K-Mech: Kuder Mechanical Preference
(6) K-Comp: Kuder Computational Preference
(7) K-Sci: Kuder Scientific Preference
(8) K-Pers: Kuder Persuasive Preference
(9) K-Art: Kuder Artistic Preference
(10) K-Lit: Kuder Literary Preference
(11) K-Mus: Kuder Musical Preference
(12) K-Serv: Kuder Social Service Preference
(13) K-Cler: Kuder Clerical Preference

−.182 and were generally not significant; a tendency toward negative relationships between SMT and those variables as K-Mech, K-Comp, and K-Sci seemed to be present.

Discrimination of Major Area Groups on the Basis of Cognitive Style Measures

Means and Standard Deviations of four cognitive style measures for eight different major areas as well as for the total group are given in Table 3. Table 4 gives analysis of trace components for four discriminant vectors, and Table 5 presents the Λ and F values for each discriminant function.

As can be seen in Table 5, two discriminant functions were significant indiscriminating eight major area groups on the basis of four cognitive style variables. Therefore, the experimental hypothesis that the patterns of inter-relationships among cognitive style measures would differ from one academic area to another so that differential weighting of scores would permit discrimination of students from the several academic areas was supported. Chi-square approximations for the significance of the discriminant functions confirmed the results. Table 6 gives the x^2 values associated with each discriminant function.

Table 3. Means and Standard Deviations of Four Cognitive Style Measures for Different Major Areas

Cognitive Style Measure	Statistic	Social Science N=17	Natural Science N=17	Humanities N=17	Engineering N=18	Elem. Teach. N=19	Music N=18	Social Service N=17	Library Science N=18	Total N=141
CWT	Mean	155.53	141.76	144.41	148.28	152.68	149.00	133.59	130.39	144.53
	sd	27.46	21.90	23.98	22.78	20.88	26.86	25.10	33.46	26.88
OST	Mean	25.53	23.76	23.94	28.61	26.05	25.67	26.94	24.94	25.70
	sd	8.43	6.97	8.23	7.14	6.12	7.50	7.48	8.13	7.66
EFT	Mean	13.18	16.00	11.41	16.78	9.79	12.67	9.06	10.67	12.42
	sd	5.35	7.32	6.91	4.26	4.54	6.27	4.36	6.11	6.30
SMT	Mean	66.24	47.94	80.18	70.11	71.11	77.33	62.76	48.44	65.59
	sd	33.90	21.07	45.84	29.60	29.98	36.43	42.26	24.05	35.54

CWT=Color Word Test
OST=Object Scoring Test
EFT=Embedded Figures Test
SMT=Schematizing Test

Table 4. Analysis of Trace Components for Four Discriminant Vectors Discriminating Eight Major Area Groups

Vector	Latent Root	Per Cent of Trace	x^2	df
1	0.26042722	49.915	28.931	10
2	0.19813409	37.975	22.596	8
3	0.04005299	7.677	4.909	6
4	0.02312957	4.433	2.858	4

Table 5. F Approximations for Discriminating Eight Major Area Groups

Function	df n^1	df n^2	Λ	F	F.95
I	28	470	.6222	2.376*	1.51
II	21	377	.7843	1.602*	1.59
III	—	—	.9397	—	—
IV	—	—	.9774	—	—

*$p<.05$.

Table 6. x^2 Approximations for Discriminating Eight Major Area Groups

Function	df	Λ	x^2	x^2. 95
Ⅰ	28	.5217	59.294*	41.34
Ⅱ	18	.2613	30.363*	28.87
Ⅲ	10	.0632	7.767	18.31
Ⅳ	4	.0231	2.858	9.49

*p<.05.

Examining the scaled vectors given in Table 7, it appeared clear that the large contributors to group separation along the first discriminant were the CWT and SMT, and that EFT was the major contributor to group separation along the second discriminant function. It also appeared that OST played less of a role in seperating major area groups than the other variables in both discriminant functions.

Since the multiple discriminant analysis yielded significant discriminant functions in eight major area groups on the basis of

Table 7. Normalized and Scaled Vectors for Four Discriminant Functions Discrimination of Eight Major Area Groups

Cognitive Style		Normalized Vectors				Scaled Vectors			
		Ⅰ	Ⅱ	Ⅲ	Ⅳ	Ⅰ	Ⅱ	Ⅲ	Ⅳ
1.	CWT	−0.35630	−0.08364	0.11435	−0.30763	−0.644	−0.329	0.358	−0.607
2.	OST	0.03831	−0.02115	−0.98978	−0.78781	0.020	−0.024	−0.911	−0.457
3.	EFT	−0.88950	0.99398	−0.06996	0.47825	−0.360	0.877	−0.049	0.211
4.	SMT	−0.28349	−0.06751	−0.04866	0.23662	−0.675	−0.350	−0.201	−0.615

cognitive style measures, group differences were examined. In testing the significance of mean differences between major area groups, the group centroids for eight major area groups along four discriminant functions and the standard deviations along discriminant axes were obtained. These are presented in Table 8 and Table 9. A total of 28 pairings among eight major area groups were made and the t test was applied to test the significance of differences of paired means, using group centroids as weighted means and standard deviations along discriminant axes. Table 10 and Table 11 give the results.

Table 8 Eight Major Area Group Centroids for Four Discriminants

Major Area Group	Functions			
	Ⅰ	Ⅱ	Ⅲ	Ⅳ
(1) Social Science	−84.9348	−4.9233	−11.6287	−45.9834
(2) Natural Science	−77.4234	0.3069	−10.7634	−43.3372
(3) Humanities	−83.4169	−6.6550	−11.8830	−38.8573
(4) Engineering	−86.5351	−1.0640	−15.9487	−43.5410
(5) Elementary Teaching	−82.2689	−8.3918	−12.4720	−45.9878
(6) Music	−85.2958	−5.6360	−13.0156	−41.7007
(7) Social Service	−72.4165	−6.9765	−15.0781	−43.1364
(8) Library Science	−68.7236	−4.1018	−12.8832	−43.1986

Data in Table 10 reveal that on the first discriminant function a large cluster composed of social science, humanities, engineering, elementary teaching, and music major appears

Table 9 Eight Major Area Group Standard Deviations Along Discriminant Axes

Major Area Group	Function			
	Ⅰ	Ⅱ	Ⅲ	Ⅳ
(1) Social Science	10.2306	6.2944	9.0769	16.3180
(2) Natural Science	13.6123	6.9931	8.2097	9.0233
(3) Humanities	13.8382	8.4899	8.9635	15.6631
(4) Engineering	12.1318	4.4304	7.4736	13.3303
(5) Elementary Teaching	10.9986	5.8987	6.6160	12.3465
(6) Music	13.9296	7.5745	9.3412	12.9634
(7) Social Service	10.9636	4.8093	7.1827	19 8584
(8) Library Science	13.2313	6.2915	9.6989	14.0600

to hold together. Since the first discriminant function placed larger weights on CWT and SMT, it would appear that these five clustered areas did not differ on the constricted-flexible and leveling-sharpening dimensions. The analysis indicated, however, that social service and library science groups tended to deviate sharply from the rest of the groups. The natural science group occurred somewhere in between, and yet it was significantly different from the engineering group.

The results of Table 11 reveal a number of significant group differences along the second discriminant function which indicate that there were two cluster groups. One group was composed of social service, elementary teaching, library science, and humanities; the other group consisted of engineering and natural science majors. Table 11 shows that natural science and engineering

Table 10 Student *t* Values for Group Differences Associated with Discriminant Function Ⅰ

Major Area Groups	Major Area Groups							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1)	0.000							
(2)	1.819	0.000						
(3)	.364	1.273	0.000					
(4)	.423	2.086*	.707	0.000				
(5)	.753	1.166	.272	1.119	0.000			
(6)	.088	1.691	.400	.285	.731	0.000		
(7)	3.442*	1.181	2.569*	3.616	2.688*	3.048*	0.000	
(8)	4.068*	1.916	3.207*	4.209*	3.377*	3.660*	.901	0.000

* Significant at. 05 level.

groups were markedly different from the rest of the six groups. It should be noted, however, that within the first cluster group there was a significant differences between elementary teaching and library science majors. On the other hand, even though social science and music majors stood in between two cluster groups, they were significantly different from natural science and engineering majors. In view of the fact that the major contributor in the second discriminant function was EFT, it may be reasonable to interpret the findings associated with group differences along the second discriminant function in terms of the field-dependent and field-independent continuum.

Table 11. Student *t* Values for Group Differences Associated with Discriminant Function II

Major Area Groups	Major Area Groups							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1)	0.000							
(2)	2.023	0.000						
(3)	.676	2.379*	0.000					
(4)	2.087*	.380	2.421*	0.000				
(5)	1.701	3.726*	.705	4.288*	0.000			
(6)	.303	2.164*	.374	2.211*	1.230	0.000		
(7)	1.443	3.241*	.136	3.778*	.792	.629	0.000	
(8)	.386	1.684	1.006	1.675	2.138*	.660	1.524	0.000

* Significant at .05 level.

It was obvious even in univariate ranking of major area groups in terms of deviations of conditional means from the grand mean that each cognitive style measure yielded a number of significant differences among groups. It was also shown that equivalence range as measured by OST produced less discrimination between groups. Figure through Figure present the deviation of each group mean from the total group mean on each cognitive style continuum.

On the constricted-flexible style continuum (Figure 1) the relative positions of group means as measured by the CWT and expressed in terms of standard scores were marked with extreme deviations to the constricted side by both the library science and social service groups; the social science and elementary teaching groups tended to fall to the flexible side. The other four groups were clustered around the total group mean. In Figure 2, it was shown that two groups, engineering and natural science, took extreme positions to the field-independent side, whereas social service and elementary teaching groups were clustered toward the field-dependent side. It was revealed in Figure 3 that less discrimination was made with regard to equivalence range as measured by OST than by other measures, although the engineering group showed a somewhat analytic approach employing narrow categories in the test. On the leveling-sharpening continuum, it was revealed that natural science and library science groups deviated to the sharpening side, and humanities and music majors took the leveling side.

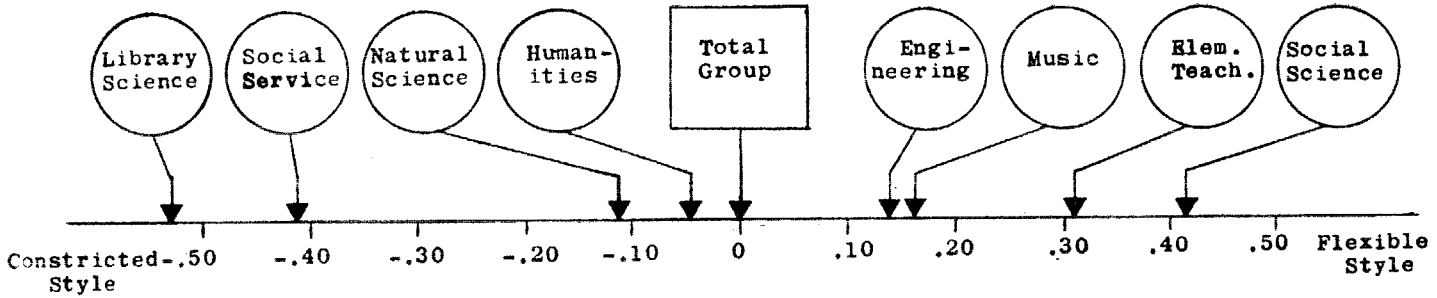

Fig. 1. Relative Positions of Group Means on Constricted-Flexible Style Continuum as Measured by CWT.

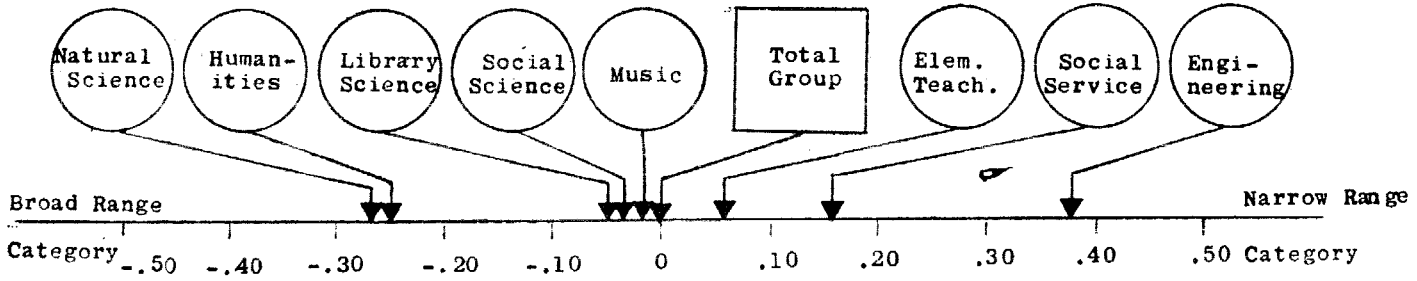

Fig. 2. Relative Positions of Group Means on Category Range Continuum as Measured by OST.

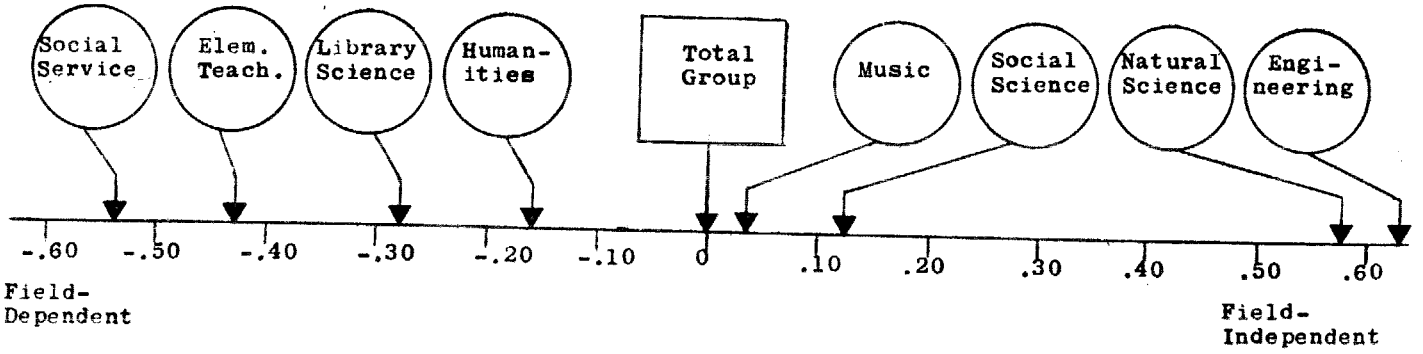

Fig. 3. Relative Positions of Group Means on Field-Dependence-Independence Continuum as Measured by EFT.

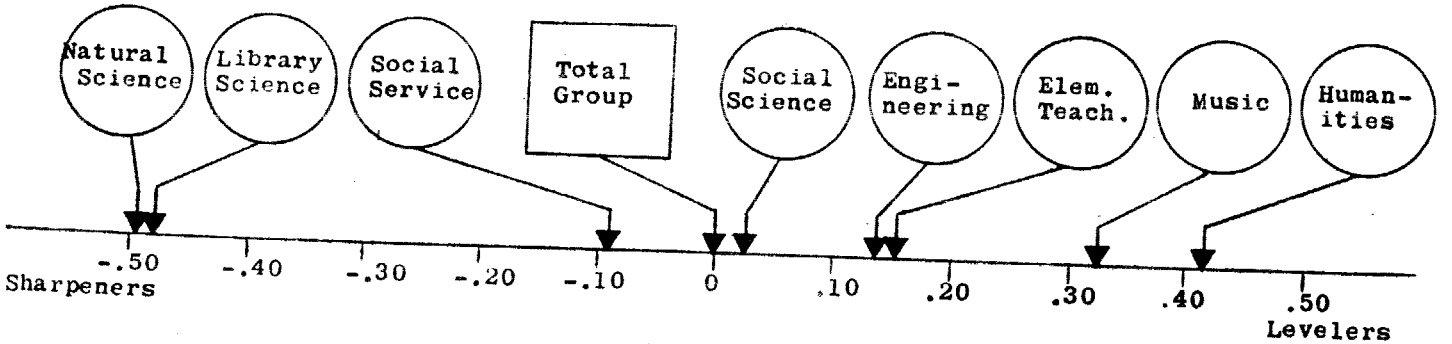

Fig. 4. Relative Positions of Group Means on Leveling-Sharpening Continuum as Measured by SMT.

Discrimination of Vocational Interest Groups on the Basis of Cognitive Style Measures

In order to estimate the similar relationships between cognitive style measures and vocational interest groups, the total subjects were regrouped in terms of nine Kuder Preference Categories taking the highest stanine score of each subject. The data were processed through the same procedures applied to the discrimination of eight major area groups on the basis of cognitive style measures.

Means and standard deviations of each cognitive style measure of the nine different Kuder Preference Categories were obtained. They are presented in Table 12. The analysis of trace components for four discriminant vectors is given in Table 13, and F and x^2 approximations are shown in Table 14 and Table 15 respectively.

It can be seen from Table 14 and Table 15 that none of the discriminant functions extracted from the four cognitive variables were able to discriminate significantly among vocational interest groups. Thus, the multivariate null hypothesis in that nine vocational interest groups had similar cognitive styles was accepted. Therefore, there was no reason to proceed further with analyses of these data. For reference, normalized vectors, scaled vectors, group centroids for four discriminant functions, and standard deviations along four discriminant axes, which were extracted from these deta are given in Appendix D. Covariance matrices in four discriminant space for eight major area groups as well as for nine vocational interest groups also are inserted in Appendix D.

Table 12. Means and Standard Deviations of Four Cognitive Style Measures for Kuder Preference Groups

Cognitive Style Measure	K-Mech N=5	K-Comp N=12	K-Sci N=17	K-Pers N=6	K-Art N=27	K-Lit N=19	K-Mus N=24	K-Serv N=25	K-Cler N=4
					Group Means				
1. CWT	158.600	160.833	143.706	149.000	139.370	141.789	138.708	145.360	149.500
2. OST	22.600	31.833	26.176	23.833	25.370	25.421	24.792	25.640	24.000
3. EFT	19.200	12.917	14.941	7.833	11.889	12.632	12.667	10.320	10.250
4. SMT	60.800	66.333	51.882	81.000	59.667	70.895	73.625	60.280	59.500
					Standard Deviations				
1. CWT	24.460	20.040	25.845	33.221	20.595	24.963	33.155	28.331	24.145
2. OST	4.037	6.617	7.978	7.387	7.894	9.276	7.818	6.588	8.287
3. EFT	3.033	6.721	6.329	6.369	6.320	7.166	5.403	4.931	6.652
4. SMT	41.907	40.900	26.455	8.099	41.304	36.908	32.544	39.799	22.398

Table 13. Analysis of Trace Components for Four Discriminant Vectors Discriminating Nine Kuder Preference Groups

Vector	Latent Root	Per Cent of Trace	x^2	df
1	0.14298327	44.774	16.171	11
2	0.10274126	32.173	11.834	9
3	0.04903188	15.354	5.792	7
4	0.02458788	7.699	2.939	5

Table 14. F Approximations for Discriminating Nine Kuder Preference Groups

Function	df		Λ	F	F.95
	n_1	n_2			
Ⅰ	28	470	.7381	1.476	1.51
Ⅱ	21	377	.8438	1.095	1.59
Ⅲ	—	—	.9304	—	—
Ⅳ	—	—	.9760	—	—

Table 15. x^2 Approximations for Discriminating Nine Kuder Preference Groups

Function	df	Λ	x^2	$x^2.95$
Ⅰ	32	.3193	36.736	43.77
Ⅱ	21	.1764	20.565	32.67
Ⅲ	12	.0736	8.731	21.03
Ⅳ	5	.0246	2.939	11.07

Summary of Personal Data and Its Relation to Cognitive Style Measures

The Personal Data Blank was initially designed to assess the degree of vocational identification or commitment. However, the summary of personal data revealed some additional information with regard to the characteristics of the subjects. The frequencies responded to each item and corresponding percentage values are given in Table 16.

Table 16. Frequencies and Percentages of Personal Data Blank Items

Questions	Frequency	Percentage
1. Do you have a definite goal with regard to your vocation or career?		
Yes	125	88.65
No	12	8.51
No response	4	2.84
2. When did you decide your vocational goal?		
Before entering college	61	43.26
After entering college	64	45.39
No response	16	11.35
3. Has any one helped you plan or choose your vocational carrer?		
No	77	54.61
Yes; Teacher	12	8.51
Yes; Parent	19	13.48
Yes; Friend	23	16.31
Yes; Counselor	5	3.55
Yes; Other	1	.71
No response	4	2.84
4. Do you think that you made the right decision as far as your vocational choice is concerned?		
No	2	1.42
Relatively yes	63	44.68

Absolutely yes	68	48.23
No response	8	5.67
5. What is your academic standing in your department in comparison to your classmates?		
Below average	3	2.13
Average	61	43.26
Above average	76	53.90
No response	1	.71
6. Are you satisfied with what you are studying in college?		
No	9	6.38
Partially	56	39.72
Yes	74	52.48
No response	2	1.42
7. Do you think that the program you have chosen in college is actually preparing yourself for your vocation?		
Doubtful	8	5.67
Specifically	49	34.75
Generally	82	58.16
No response	2	1.42
8. What will be the most important rewards you will gain from your future vocation?		
Economic reward	5	3.55
Academic reward	10	7.09
Social reward	52	36.88
Personal satisfaction	66	46.81
Status and Power	2	1.42
No response	6	4.26
9. In what way will your future vocation contribute to the society?		
Academically	5	3.55
Socially helping people	104	73.76
Material production	2	1.42
Mankind in general	20	14.18
No response	10	7.09
10. Are you planning to commit your carrer to the profession you are studying?		
Doubtful	13	9.22
Possibly	38	26.95
Definitely yes	87	61.70
No response	3	2.13

Examining Table 16, it can be seen that over 88 per cent of the subjects showed consistently throught the items that they had definite vocational goals, were satisfied with what they had chosen, and thought they were preparing for the goal. This revealed that the subjects employed for the present study were, in their own judgment, satisfied, committed, and successful in their own field of studies.

In order to estimate some possible relationships between cognitive style measures and vocational commitment, biserial correlations between each of the cognitive style measures

and a vocational commitment index were obtained. The vocational commitment index was obtained by combining items 1 and 10 of Personal Data Blank. Those answered to "yes" in 1 item and "definitely yes" in item 10 were regarded as committed subjects; other subjects were labeled as non-committed.

Table 17. Biserial Correlations Between Cognitive Style Measures and Vocational Commitment Index

	CWT	OST	EFT	SMT
Vocational Commitment	.032	—.099	.064	—.166	.166

Table 17 gives the results.

Estimation of Reliabilities of Cognitive Style Measures

Reliability coefficients obtained for four cognitive style measures, with the method of estimation used, are presented in Table 18. The correlations in Table 18 show that most of the reliabilities obtained were quite high. It also provided a high reliability estimate for CWT. The reliability estimate for OST was corrected by the Kuder-Brown Prophecy formula because two parallel forms of the OST were added to yield a total score for this measure.

Table 18. Reliabilities of Four Cognitive Style Measures

Cognitive Style Measure	N	Method of Estimation	Reliability Coefficient
CWT	63	Test-retest reliability estimation with one week apart	.854
OST	141	Corrected parallel form reliability	.841
EFT	141	Corrected odd-even split half correlation	.892
SMT	141	Otdd-even split half correlation	.980

Discussion

The experimental hypothesis, that the patterns of inter-relationships among cognitive style measures would differ from one academic area to another so that differential weighting of scores would permit discrimination of students from the several academic areas, was substantiated. This finding, in general terms, tended to lend credence to the assumptions: (1) that academic areas in college represent stages of preparation for a specific occupation; (2) that there is some relationship between the area of study and later occupational requirements; and (3) that there are differential personality and perceptual patterns exhibited by contrasting occupational groups.

Analysis of group mean differences yielded several significant differences among major area groups. A classification of eight academic areas in terms of their characteristic patterns of cognitive style was attempted to aid in the interpretation of obtained group differences. The classification was based on the deviations of group means from the total means for each cognitive style variable as seen in Figures 1 through 4. The deviations were expressed in standard scores and those group means beyond $\pm .20$ were regarded as the extreme groups on each cognitive style continuum. The result of this classification is presented in Table 19.

The patterns of cognitive style shown in Table 19, tend to indicate substantial agreement with the conventional personality

Table 19. Eight Academic Areas Classified by Deviations from the Total Means on Four Cognitive Style Measures

Academic Area	CWT	OST	EFT	SMT
Soc. Science	Flexible	Average	Average	Average
Nat. Science	Average	Broad	Independent	Sharpeners
Humanities	Average	Broad	Average	Levelers
Engineering	Average	Narrow	Independent	Average
Elem. Teaching	Flexible	Average	Dependent	Average
Music	Average	Average	Average	Levelers
Soc. Service	Constricted	Average	Dependent	Average
Lib. Science	Constricted	Average	Dependent	Sharpeners

characteristics and stereotypes ascribed to these academic areas. For example, from the point of view that the differences area function of the nature of works involved in various academic areas, it seems appropriate that natural science and library science majors tend to be sharpeners. The academic requirements of these areas are such that they require more precision and accuracy than the other academic areas.

The group differences exhibited on the cognitive style continuums appear to be confounded with a number of other functions. Sex seems to be one of those functions confounded with the group clusters obtained in the study. The present data paralleled those by Witkin, et al. (1954), and Bieri, Bradburn, and Galinsky, (1958), in which a marked sex difference on field-dependence dimension was reported. Since engineering and natural science groups were constituted largely of male students and elementary teaching and library science female subjects, a reasonable inference is that the group differences on field-dependence style may stem from differences in the sex of students going into those fields.

Age of subjects appears to be another function confounded with the academic group differences. As indicated in Table 43 of Appendix F, the subjects in the social service and library science groups were considerably older than those in the other groups. These age differences suggest the possibility that there are significant relationships between the age variable and consticted-flexible and field-dependence dimensions. Since age was not controlled under the conditions of the study, conclusion cannot be drawn from the present evidence.

A question remains with regard to why equivalence range did not enter into the significant discriminant functions. One explanation is based on the fact that subjects included in the study were from a relatively homogeneous group. It seems quite possible that the levels of conceptions used in the OST are so similar that they may reduce the individual variations in ranges of categories. Although the OST scores did not receive great weight in the two significant discriminant functions, the OST was the major variable in the third discriminant function which failed to attain statistical significance. In a similar study with age and sex controlled, equivalence range may be shown to account for more of

the variability between groups.

The second experimental hypothesis, that the patterns of interrelationships among cognitive style measures would differ from one vocational interest category to another so that differential weighting of scores would permit discrimination of students from the several vocational interest categories, was not substantiated. None of the discriminants extracted from the data analysis was able to discriminate significantly among nine vocational interest groups.

One possible explanation for these results is the gross classification of vocational interest groups afforded by Kuder Preference Record norms. The stanine scores of the norms were not fine enough to offer sufficiently precise categorization. Also, the procedure of defining vocational interest groups on the basis of highest stanine score without regard for the level of that score or the pattern of remaining scores may have resulted in groups more heterogeneous than those based on academic specialization.

In a sample of students as advanced in their training and as committed to their fields of specialization as those in this study, it may not be surprising that area of concentration allows greater differentiation than inventoried vocational interests. One can only speculate on whether the same result would be found among less advanced students who are not yet as committed to their major fields.

Intercorrelations of four cognitive style measures observed in the present study generally paralleled those reported by Gardner, et al. (1960 a). They reported inter-correlations of four cognitive style measures, similar to the dimensions included in the present investigation but measured by individual forms, ranged from .25 to −.27; these intercorrelations for group forms in the present study were very similar. The present findings also confirmed those reported by Lichtenstein(1961) which indicated that three cognitive styles, leveling-sharpening, constricted-flexible, and tolerance for unrealistic experience, were relatively independent of one another. These evidences appear to support the notion of orthogonality of cognitive style.

Intercorrelations between each cognitive style measures and the Kuder preference scores were shown to be generally low, thus supporting the null hypothesis that there is no relationship between scores on measures of cognitive style included in the study and vocational interest scores on the Kuder Preference Record. With the exception of some significant correlations between EFT and few Kuder scales, the intercorrelations obtained in the study were not high enough to suggest any meaningful associations. A careful examination of Table 2 together with Tables 29 through 36 presented in Appendix D reveals that the statistical relationships found between EFT and each of K-Mech and K-Sci markdly vary from one major area to another. Some positive relationships were observed in major area groups such as social science, social service, engineering and library scienece, whereas negative relationships were found in groups of natural science, and music. The exact nature of the relationship is not known, nor does it permit any speculation regarding the observed relationships.

Regarding the reliabilities of cognitive style measures, a number of studies indicated substantially high reliability coefficients of the cognitive style measures. Gardner, et al.

(1959), reported that corrected odd-even reliabillty coefficients of the Schematizing Test were .90 for men and .84 for women. Clayton and Jackson (1961) obtained .90 corrected parallel form reliability of the Object Sorting Test (group form). Jackson, Messick, and Myers (1964) reported Kuder Richardson−21 reliabilities of .71 for the group-administered Embedded Figures Test, Form Ⅲ, and .83 for Form Ⅴ of the same test. No reliability measure for the Color Word Test has been reported, The present study attempted: (1) To confirm the reliability estimates obtained by Clayton and Jackson (1961), and Jackson, Messick and Myers (1964); (2) to obtain a reliability estimate for the SMT administered in a relatively larger group; (3) to establish a similar estimate of reliability for group-administered CWT.

Reliability estimates obtained for four cognitive style measures indicated substantially high reliabilities. These reliabilities are in general agreement with the previous findings reported by Gardner, et al. (1959), Clayton and Jackson (1961), and Jackson, Messick, and Myers (1964). In addition, the present investigation demonstrated high reliability for the group administered CWT through a test-retest reliability study independently conducted.

Research on individual differences requires large samples if any confidence is to be placed in the replicability of results in generalizing to a particular population. To meet this need, it is essential to develop and refine the group measures which can be easily administered to a large sample. The results obtained in the study with respect to the reliabilities of the measures provided substantial degrees of confidence for using the group-administered forms of cognitive style measures. Furthermore, it provided some assurance on the results observed in the present study, for the confidence in the obtained results largely depended on the reliabilities of the measures used.

Although Fisher (1936) had suggested many years ago a method of obtaining a linear combination of variables which would give the best possible discrimination between two groups, it was not until recently that mutiple discriminant analysis was actively employed in the studies intended to discriminate group differences in a combination of variables. Tiedeman and Tatsuoka (1954) made an extensive review of the literature on discriminant analysis, in which it was reported that the development of multiple discriminant analysis had been largely theoretical in nature and consequently some applied works were started in the 1950's. King (1958) applied multiple discriminant analysis in an effort to secure a method which provided effective discrimination of the undergraduate field of concentration in relation to interests and aptitudes. He found significant results which suggested that the method was useful and effective. Cooley and Lohnes (1962) provided an illustration of multiple discriminant analysis with regard to computer programming and presented the advantages of multiple discriminant analysis as compared to the conventional univariate analysis. It is felt that the multivariate analysis which were employed are not only powerful but also very useful, particularly if the career patterns or occupational choices are viewed in terms of multidimensional space rather than unidimensional nature.

The results of the present study pointed to aspects for further research both in cognitive style measures and career fields: First

of all, a study is needed to cross validate the obtained discriminant functions with similar but larger samples, possibly including more academic areas of study in college. Although it was believed that the present sample was large enough for each major area, it might be better to increase the size of groups so as to minimize the chances of possible biases due to peculiar characteristics of the small samples. A further refinement of the measuring devices seems to be essential. Even though the present study has yielded substantially high reliabilities of all the measures used, test-retest reliability estimates with longer time intervals would appear to be desirable instead of reliable instead of relying on internal consistency estimates. Since it was believed that cognitive style measures were fairly stable, test-retest reliability estimate based on more than six months interval might provide more meaningful estimates. Further research relating cognitive styles to those characteristics of various occupational groups seems needed to derive some feasible determinants of occupational success and to maximize the effectiveness of occupational choice. The results of this study suggest that there are differential cognitive style patterns exhibited by various occupational groups, but this should be confirmed by a study of persons already in the fields. A further elaboration of the present study seems to be needed also to control experimentally such confounding variables as sex and age in order to assess more exactly-the nature of cognitive styles which differen-tiate students in serveral academic areas in college. A comparison between successful and unsuccessful college students in each area seems to be needed in order to confirm the predictive value of the cognitive style measures for college success and for success on the jobla ter.

A number of psychological and educational implications emerged from the results of the study. First, it seems possible that the selection of students for such academic areas as social service, natural science, library science, and engineering could be more effective if such cognitive styles as constricted-flexible, field-dependence, and leveling-sharpening are taken into consideration along with the other criterion measures. Second, it may be desirable for counselors and guidance specialists who are in a position to assist students with career choice to recognize cognitive style as one of the variables related to college success in various academic areas. Third, cognitive style measures appear po provide an effective way of predicting appropriate college academic areas if included among the predictor variables and used in conjunction with other variables such as intellectual ability and vocational interest.

Summary

A number of earlier studies provided direct or indirect evidence of relationships between the general principle of cognitive organization conceptualized as cognitive styles and intellectual functioning as well as various personality variables. The present investigation was undertaken in an attempt to explore the nature and extent of relationships between four cognitive style measures and eight academic areas in college, assuming that differences among students in different academic areas would manifest themselves in both cognitive styles and characteristic patterns of personal and intellectual functioning.

Four cognitive styles such as field-depend-

ence, leveling-sharpening, constricted-flexible control, and equivalence range were taken as major variables and were assessed by the measures employed in the previous studies and modified to meet a specific need of the present study. Those measures were the Embedded Figures Test (EFT), the Schematizing Test (SMT), the Color Word Test (CWT), and the Object Sorting Test (OST). The other independent variables selected for the study were vocational prefenence as measured by the Kuder Preference Record, Vocational Form C, and biographical data including vocational identification and the status of satisfaction within academic areas collected by a specially prepared questionnaire.

The sample consisted of 141 college students drawn from the eight academic major areas in Nashville University Center. The academic areas were social science, natural science, humanities, engineering, elementary teaching, music, social service, and library science. Each subject was given a battery of four-cognitive style measures, the Kuder Prefer ence Record, and the personal data blank. The measures were administered in groups of not more than 10 subjects.

Multiple discriminant analysis was applied to explore possible relationships between the cognitive style measures and the eight maior areas and nine Kuder vocational interest categories. An analysis of group mean differences was undertaken on the basis of extracted group centroids and standard deviations along the discriminant axes in order to locate the significant group differences.

Several general observations seemed warranted on the basis of the data from this study. They were:

1. There was a significant relationship between the meansures of cognitive style and academic major areas in college. Both F and x^2 approximations of discriminant analysis yielded significant results, thus indicating that the cognitive style measures were able to discriminate significantly among eight major area groups.

2. Two discriminant functions emerged from the analysis. The first discriminant function placed more weight on CWT and SMT. The second discriminant function placed greatest weight on EFT. The OST, however, did not contribute to either function. The results suggested that OST was not a critical variable among cognitive style measures in discriminating academic major area groups.

3. Multiple discriminant analysis, intended to discriminate nine Kuder vocational interest groups on the basis of cognitive style measures, did not yield the desired significant results. Terefore, a relationship between cognitive styles and the voational interests of college students was not substantiated.

4. Analysis of group mean differences gengrally revealed that students in the humanities, music, and social science exhibited similar cognitive style patterns but those in the other academic areas deviated in one or another from this cluster and from each other.

5. A relationship between cognitive style measures and vocational identification or commitment was not substantiated. The correlation between vocational commitment index and each of the cognitive style measures was not statistically significant.

6. Reliability estimates of four cognitive style measures yielded substantially high reliability coefficients. The estimated reliabilities were .854 for CWT, .841 for OST, .892

for EFT, and .980 for SMT. These results confirmed most of the previous findings and provided a new estimate of reliability for CWT.

The use of the multiple discriminant analysis method was discussed. Implications for psychological and educational practices, such as the selection of college students for specific academic areas on the basis of cognitive style variables along with intellectual ability measures, and the use of cognitive style variables as one of the predictor variables of college success were also considered.

References

Bieri, J., Bradburn, W.M., & Galinsky, M.D. Sex differences in perceptual behavior. *J. Pers.*, 1958, 26, 1—12.

Bloomberg, M.A. An analysis of field dependence-independence with reference to performance on a variety of perceptual, motor and conceptual tasks. Unpublished doctoral dissertation, State Univer. of New York at Buffalo, 1963.

Broverman, D.M. Cognitvie style and intra-individual variations in abilities. J. Pers., 1960, 28, 240—256.

Clayton, M.B., & Jackson, D.N. Equivalence range, acquiescence, and overgeneralization. *Educ. Psychol. Measmt.*, 1961, 21, 371—382.

Colley, W.W., & Lohnes, P.R. *Multivariate procedures for the behavioral sciences.* New York: John Wiley, 1962.

Defares, P.B., & Van Der Werff, J. J. Perception and the security insecurity dimension. *Acta Psychologica*, 1963, 21, 68—73.

Feldman, R.C. A study of cognitive style and some personality variables in relation to the conceptual performance of emotionally disturbed adolescents. Unpublished doctoral dissertation, Temple Univer., 1965.

Field, L.W. Personality correlates of college achievement and major areas of study. Unpublished doctoral dissertation, Univer. of Houston, 1954.

Fisher, Ronald A. The use of multiple measurements in taxonomic problems. *Annals of Eugenics*, 1936, 6, 179—188.

Gardner, R.W., Holzman, P.S., Klein, G.S., Linton, H.B., & Spence, D.P. Cognitive control: a study of individual consistencies in cognitive behavior. *Psychol. Issue*, 1959, 1 (4), 1—186.

Gardner, R.W., Jackson, D.N., & Messick, S.J. Personality organization in cognitive controls and intellectual abilities. *Psychol. Issues.*, 1960, 2 (4).

Gardner, R.W., & Long, R.I. The stability of cognitive controls. *J. abn. soc. Psychol.*, 1960, 61, 485—487.

Gardner, R.W., & others. Tolerance for unrealistic experience. *Brit. J. Psychol.*, 1962, 63, 41—55.

Goodenough, D.R., & Karp, S.A. Field dependence and intellectual functioning. *J. abn. soc. Psychol.*, 1961, 63, 241—246.

Hardison, J., & Purcell, K. The effects of psychological stress as a function of need and cognitive control. *J. Pers.*, 1959, 27, 250—258.

Holzman, P.S., & Klein, G.S. Cognitive system-principles of leveling and sharpening: Individual differences in assimilation effects in visual time-error. *J. Psychol.*, 1954, 37, 105—122.

Jackson, D.N. Intellectual ability and mode of perception. *J. const. Psychol.*, 1957, 21, 458.

Jackson, D.N., Messick, S., & Myers, C.T. Evaluation of group and individual forms of embedded-figures measures of field-independence. *Educ. psychol. Measmt.*, 1964, 24, 177—192.

Kagan, J., Moss, H.A., & Sigel, I.E. Psychological significance of styles of conceptualization. In J.C. Wright and J. Kagan (Eds.). Basic cognitive processes in children. *Mongr. Soc. Res. Child Develpm.*, 1963, 28, Monogr. 86.

King, Richard G. The prediction of choice of undergraduate field of concetion in Harvard College. Unpublished doctoral dissertation, Harvard Univer., 1958.

Kipperman, L.R. Effects of drive arousal on the analytic categorizing style. Unpublished doctoral dissertation, Univer. of Michigan, 1964.

Klein, G.S. The personal world through perception. In R.R. Blake and G.W. Ramsey (Eds.), *Perception: an approach to personality*. New York: Ronald, 1951.

Leichtenstein, E. The relation of three cognitive controls to some perceptual and personality variables. Unpublished doctoral dissertation, Univer. of Michigan, 1961.

Lohnes, P.R. Test space and discriminant space classification models and related significance tests. *Educ. psychol. Measmt.* 1961, 21, 559—574.

Loomis, H.K., & Moskowitz, S. Cognitive style and stimulus ambiguity. *J. Pers.*, 1958, 26, 349—364.

Messick, S., & Fritzky, E.J. Dimensions of analytic attitude in cognition and personality. *J. Pers.*, 1963, 31, 346—370.

Messick, S., & Damarin, F. Cognitive styles and memory for faces. *J. abn. soc. psychol.*, 1964, 69, 313—318.

Sandstrom, C.I. Sex differences in localization and orientation. *Acta Psychologica*, 1953, 9, 82—96.

Sweeney, E.J. Sex differences in problem solving. *Stanford Univer. Technical Report*, 1, Dec 1953.

Tiedeman, D.V., & Tatsuoka, M.M. Discriminant analysis. *Rev. educ. Res.*, 1954, 24, 402—420.

Vert, J.E., Neidt, C.O., & Ahmann, J.S. *Statistical methods in educational and psychological research.* New York: Appleton-Century, 1954.

Witkin, H.A.,& Others. *Personality through perception.* New York: Harper and Row, 1954.

Witkin, H.A., & Others. *Psychological differentiation.* New YorK: Wiley, 1962.

Wilkins, L.G. Some correlates of cogeitive controls, personality trait factors, and n achievement motivation. Unpublished doctoral dissertation, New York Univer. 1964.