SEX AND MAJOR DIFFERENCES
IN VOCATIONAL PREFERENCES OF STUDENTS
IN A TECHNICAL INSTITUTION

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Dedicated to

My wife, Susan

The hundreds of students who cheerfully cooperated in this study

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SUMMARY

The Holland Vocational Preference Inventory (VPI) was administered to 544 undergraduates at the Georgia Institute of Technology. The purpose was both the evaluation of a theoretical model by Holland of vocational choice and to test the criterion related validity of the VPI. Student choice of area-of-study major curriculum was the criterion used. Investigation of vocational choices of women in previously "masculine" fields of study was a further objective.

Results indicated the VPI was very effective at differentiating between choice of field of study in this sample. Furthermore, the theoretical model of vocational choice was also suitable for the sample used in this thesis.

Another result is that constant differences between the sexes are to be found across the different majors on most of the VPI scales. Interactions of sex with major were found only in two of the four analyses and involved only a few of the VPI scales. This suggests that with few exceptions when constant sex differences are controlled, men and women vary in about the same way in different fields of study.

CHAPTER I

INTRODUCTION

Vocational choices have long been studied by psychologists (Strong, 1943; Holland, 1966; Roe, 1956; Darley, 1938; Super and Crites, 1962; Kuder, 1970). Possibly in no other area has psychology provided so much practical help for the layman (Hobson and Hayes, 1968). Millions have taken the vocational interest inventories that have been developed by these researchers.

Good theories of vocational choice have not developed as extensively as have the inventories of vocational choice. Super and Crites (1962) proposed a theory that interests become more focused as development proceeds. More recently, Roe and Klos (1969) have proposed a theory based on need gratification, involving two types of needs: (1) interpersonal needs -- needs for a certain type or level of interpersonal interaction; (2) level of responsibility needs -- need to have influence over other people. Their expectation is that different occupations will fulfill these needs to varying degrees. Roe's theory has not in general been supported, but Hill (1974) found some evidence for its authenticity.

Over a twenty year period, Holland (1958, 1966) has proposed a theory that vocational preference is a function of one's self-concept. He suggests that people in similar occupations have similar personalities. The Holland theory has generated much research. This is the theory investigated in this thesis.

Purpose

This study is designed to show empirically that the Holland Vocational Preference Inventory (VPI) can differentiate between majors, between sexes, between intracampus colleges, and between majors within colleges having more than one major. It is particularly relevant to the question of whether a population of students at a technical institute is homogeneous in vocational interests. Also to be studied is whether, as measured by the VPI, men differ from women in patterns of vocational interests in fields in which few women have previously enrolled. Contributions by this study include new data supporting the vocational interest-personality theories of Holland as well as possible applications in the guidance of students who are undecided as to choice of major field of study.

Literature Review

Bases of Holland's Theory

Darley (1938) foreshadowed the development of the Vocational Preference Inventory (VPI) when he suggested that measures of personality and vocational interest be studied jointly since both differentiate between members of different occupations. This thinking is expressed in the development of the Holland VPI which is both a personality test and a vocational interest test.

In developing the Vocational Preference Inventory Holland (1958) proposed that a personality test might employ only occupational titles as items. Thus the VPI became a test in which a subject is asked to go through a list of vocations and decide his disposition toward doing the work in each vocation. The VPI differs from other personality tests which may ask for preferences for non-vocationally related activities or for beliefs or attitudes. Holland (1958) noted the ease of administration of the inventory and the fact that the innocuous stimuli reduce the subjects' anxiety and their need to fake.

Kuder (1970) has been critical of the use of occupational titles in a vocational interest inventory. He thinks this is bad because it hinders use of the inventory with children or young adolescents who may not be able to respond properly due to their lack of sophistication about vocations.

Holland (1966) does not see Kuder's criticism as a major concern. He agrees that vocational stereotypes are involved in the VPI:

> Vocational stereotypes have reliable and important psychological and sociological meanings... Our everyday experience has generated a somewhat inaccurate but apparently useful knowledge of what people in various occupations are like...

This aspect of vocational stereotypes bears on the question, "Would I be like the people in that occupation?" which a subject might ask himself in filling out the VPI.

A subject might also ask himself "What do the people in that occupation do?" All of the occupations described by Holland are comprehended easily by an adult. In this research the subjects were frequently asked if they understood the occupations. Very rarely did any subject report lack of understanding. This directly meets Kuder's objections. High reliability of the items also supports the idea of stability of the stereotypes.

In the development of the inventory, part of Holland's rationale was:

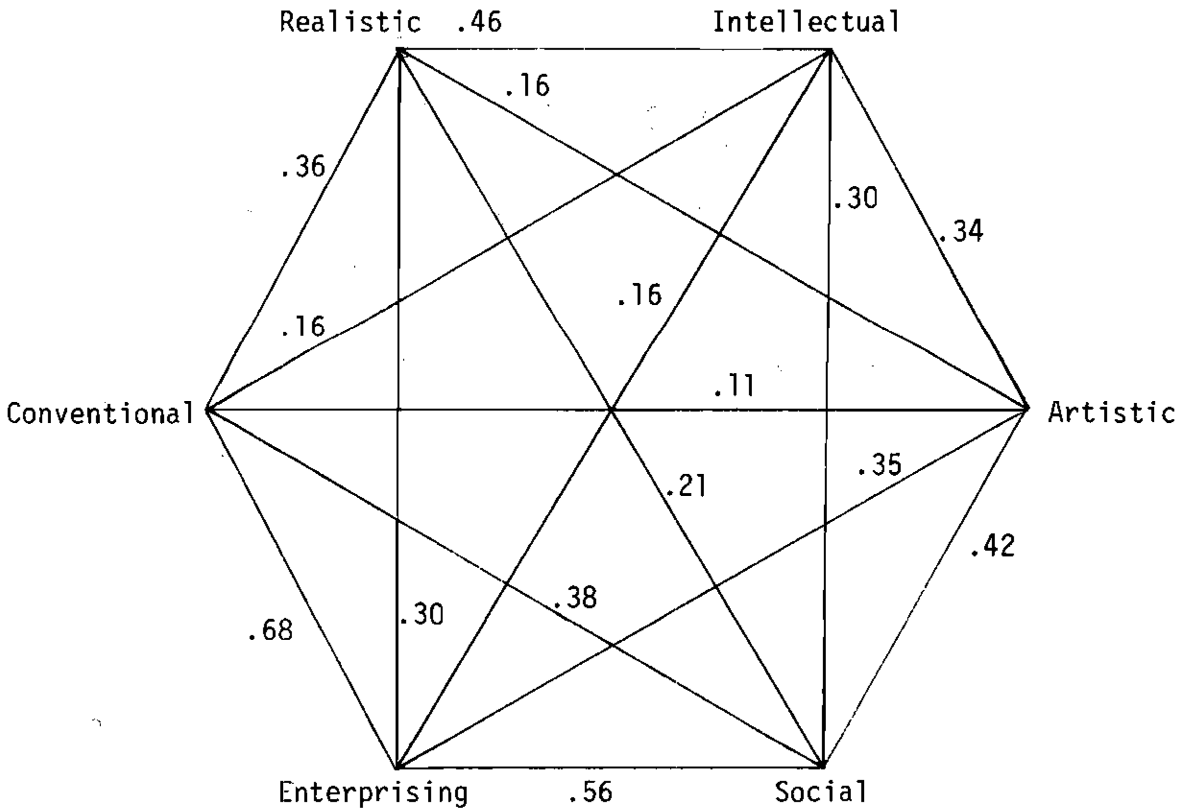
> The choice of an occupation is expressive act which reflects a person's motivation, knowledge, personality, and ability... The interaction of the person and his environment creates a limited number of favorite methods for dealing with the environment... Translated into scale terms, peaks (on the VPI scales) reveal accepted methods of adjustment... The choice of an occupational title is a measure of the subject's insight and understanding as well as a sign of his comprehension of the occupation in question." (Holland, 1958, p. 336-337).

In this same article Holland (1958) discussed the early development of the scales. Originally, items were chosen a priori to represent eight scales: physical activity, intellectuality, responsibility, conformity, verbal activity, emotionality, reality orientation, and acquiescence. Subsequent revisions involved internal consistency analyses of the scales and cluster analysis.

The current version is a scale consisting of six occupational choice scales: realistic, intellectual, social, conventional, enterprising, and artistic; and three typical personality scales: self-control, masculinity, and status; and two response style scales: infrequency and acquiescence. Actually, the VPI is now in its Sixth Revision.

Holland's hexagonal model of types (Figure 1) is helpful in understanding the current version of the VPI. This hexagonal model accounts roughly for distance represented by intercorrelations among the six scales. These correlations were empirically derived on a large sample. The hexagonal model was subsequently tested on nine other samples and found adequate (Holland, Whitney, Cole, and Richards, 1969).

The practical implications of the hexagonal model were shown by Holland and Whitney (1968). They found a student switching majors usually switched to a category adjacent to the category of his original major if



Correlations between variables are printed on lines connecting those variables.

(From Holland, Whitney, Cole, and Richards, 1969)

Figure 1. A Hexagonal Model for Interpreting Inter- and Intra-class Relationships.

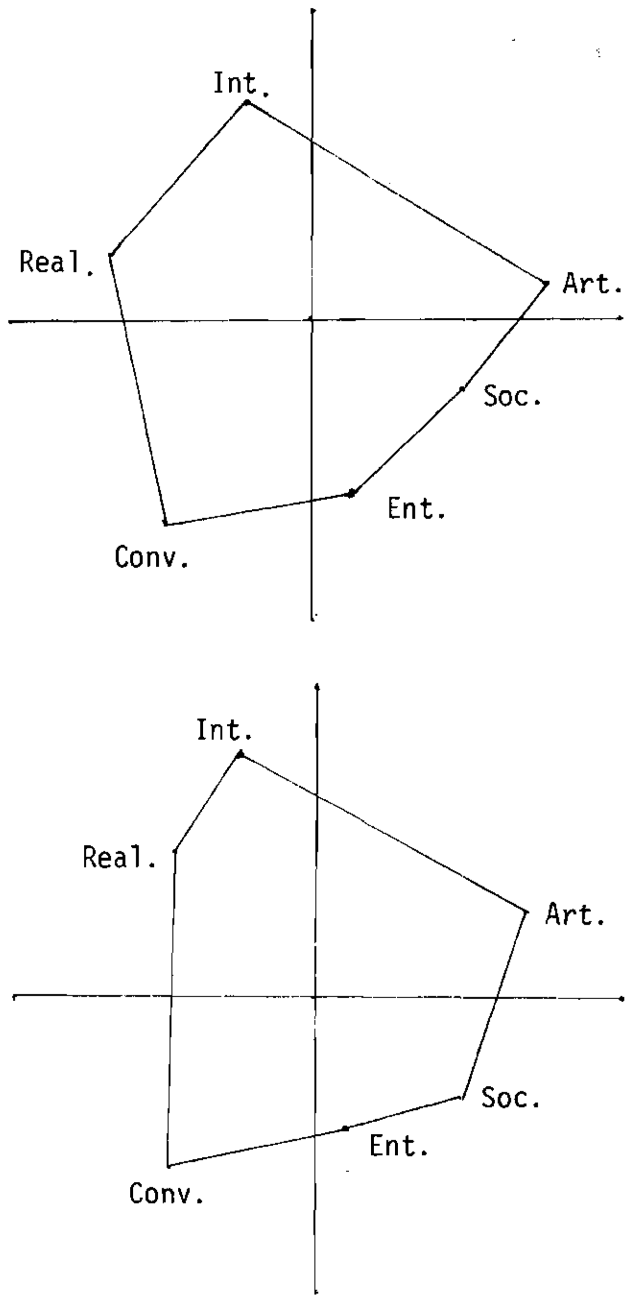
he left the original category at all.

Mathematical aspects of Holland's model are rather interesting. A score on each scale is given by counting the number of items marked a certain way. All six scales are positive or zero, and all correlations between scales are positive. Thus, this model is a partitioning of the cosine in the first quadrant.

Figure 2 represents the results of a pair of principal components factor analyses that Holland, Whitney, Cole, and Richards (1969) cite as a mathematical verification of Holland's model. One analysis was for females and one for males. The first three components accounted for 77% and 79% of the trace respectively so these three components were chosen to represent the model in Euclidean space.

Every variable (six scales) loaded high positive on factor 1. This was used as a kind of elevation parameter in a 3-space along the z (vertical) axis. Loadings from the next two factors were used to locate each variable in an x-y plane above the x-y plane found when $z = 0$. Very similar orderings were found for males and females as is seen in Figure 2. By comparing Figure 1 and Figure 2 exact correspondence of ordering is noted. Holland, et al., mention that this model has been found to roughly fit the data from nine other samples.

A comparison of this model to the circumplex model of Guttman (1954) is fruitful. With regards to the correlations between a set of variables he suggests the possibility of a circular ordering. The basis for this would be the sharing of common elemental units arranged themselves in a circular ordering. The overlap of shared elemental units would account for the correlation between variables being higher, the



Top figure is males and bottom figure is females

(Holland, Whitney, Cole, and Richards, 1969)

Figure 2. Results of Holland's factor analysis by sex, represented in model form.

nearer the variables are in the circle. The correlation matrix for such a relationship among variables should show a characteristic pattern with high values along the main diagonal, lower values toward the edges of the matrix and again higher values at the extreme corners. This pattern is approximated in both matrices in Table 2. Of course, the pattern is not perfect which would be expected by Guttman if the variables were not equidistant from their neighbors around the circle. This could be the real theoretical basis of Holland's model. Guttman suggests this may be analyzed by factor analysis.

Essentially, the Holland theory (Holland, 1958) is based on the idea of an individual's self-concept as discussed by Strong and Feder (1961): "Every evaluative statement a person makes concerning himself can be considered a sample of his self-concept," (p. 170). This is relevant because one sort of evaluative statement is a vocational choice as measured by the Holland VPI. This is because a vocational choice involves evaluation of one's abilities, needs and preferences.

Holland (1960) also provided evidence that responses to the VPI are related to a much used personality questionnaire, the 16 PF of Cattell (1957). The scales of the two tests are shown to be substantially correlated. Also, the earlier scales of the 16 PF which are said to account for more of the variance in the personality domain were more frequently intercorrelated significantly with the VPI scales. Thus, the claim of the VPI to measure personality is much substantiated since it measures much the same domain as a commonly used personality test.

If the VPI is to be considered a comprehensive test of vocational interest, can Holland's theory account for the mass of data from other vocational interest tests? Nafziger and Helms (1974) have shown that Holland's theory accounted well for data from the Strong Vocational Interest Blank (SVIB), The Minnesota Vocational Interest Inventory (MVII), and the Kuder Occupational Interest Survey (OIS). The results supported Holland's theories even though the data were not collected on Holland's instrument. This is important since the six scales based on Holland's theory account for much of the content of the VPI. Nafziger and Helms showed that by cluster analysis Holland's hexagonal model can account for a very broad spectrum of the vocational interest domain. Thus, whatever success the VPI has in prediction has relevance for the construct validity of all major vocational interest tests.

Examples of Research Generated by Holland's Theory

Holland and Nichols (1964) did a study representative of those done on major field of study and showed that choice of major field of study is analogous to vocational choice. It is mentioned here because one contention of this thesis is that choice of major can be studied in the same way as vocational choice. This is because in most cases choice of course of study involves choice of a vocation. It also follows from the general idea that vocational preference follows from self-concept and so does choice of major. Both involve evaluative statements about one's abilities, needs, and preferences.

Elton (1974) found that students who transferred into a field of study became more similar to the people in that field as measured by their interests with the passage of time. This represents an interaction between environment and person in which interests are shaped by the environment. This is important for this study because it suggests that though a person did not begin in a certain major, his scores should nonetheless be characteristic of students in his new major even after switching. Many of the students in my sample had switched majors since coming to the Georgia Institute of Technology.

Differences Between Majors in Terms of Vocational Choice

Holland, Whitney, Cole, and Richards (1969) proposed a scheme for the classification of occupations. In terms of their empirically derived six classes (realistic, intellectual, artistic, social, enterprising, and conventional) they classify many common occupations. Many of the occupations for which students at the Georgia Institute of Technology are preparing are included. For instance, architect, civil engineer, industrial engineer, mechanical engineer, and engineer are classified as "realistic" occupations. Physicist, biologist, physical scientist, natural science teacher, engineering scientist, and mathematician are classified as "intellectual" occupations. Economist and managers are in the "enterprising" group as are lawyer and salesman. Finance worker and accountant are in the "conventional" class. Advertising man is in the "artistic" class and psychologist in the "social" class. It should be noted that these are gross categories and allow for much much variance within the occupational class. They are derived from the highest scores characteristic of the group on the VPI. A four-letter code is also available which indicates the order from high to low of the highest four scales typical of the occupations. Thus, astronomer is IRAS (intellectual, realistic, artistic, social); chemical engineer is IREA (intellectual, realistic, enterprising, artistic). Many of these codes are available for college majors corresponding to those in the present sample.

These codes will be compared to results obtained in this thesis. Of course, many of the majors are not represented by a national sample, particularly for females.

Thus, in summary, a rationale for expecting differences between majors on the VPI scores is that differences are usually found between majors in a broad heterogeneous sample of college students (Abe and Holland, 1965a, b). The question involved is whether a more homogeneous group of majors or between intracampus colleges or even within an on-campus college offering more than one major could be so distinguished. All the vocational choice literature is based on students' having similar occupational choices to those already in a particular field. That is, students studying chemical engineering are expected to have similar vocational choices to those already employed in chemical engineering.

The idea that the VPI could differentiate between majors has been tested at the graduate school level by Frantz and Walsh (1970). They expected differences between six graduate majors (engineering, accounting, chemistry, economics, English, and counseling) to be representative of Holland's six types. Their results, however, were negative in that all majors came out as intellectual. The authors concluded that graduate school pressure forced all the students into an intellectual mode of adaptation. They assumed it was temporary.

Unpublished data (York and Loveland, 1964) reveal differences between majors on the Edwards Personal Preference Survey (EPPS). The senior undergraduates ($N = 437$) were differentiated by the variables of dominance and aggressiveness in terms of their curricula. These findings suggests that a more appropriate test might differentiate among majors at the Georgia Institute of Technology.

Examples of work applying the VPI to choice of major are Abe and Holland's (1965a, b) technical reports. Over 12,000 college freshmen were studied in thirty-one institutions comparing their VPI scores to their choice of major field. For example, physical science majors were found high on the masculine scale and low on the social scale. Sex differences were also significant as will be discussed later in this thesis.

Additionally, a study by Elton and Rose (1971) showed that a student who begins college undecided in his vocational choice and then enters a major or who transfers into that major becomes more similar to students who originally began in that major. This is important in making predictions of differences in vocational interest varying systematically with major because many of the students in this sample have changed majors since coming to Georgia Institute of Technology.

As for specialties within a broad vocational area, such as business administration, there is evidence for expecting differences between specialties. Several empirical studies have been done along this line of inquiry. Hill (1974) studied various functional areas of management within a Master of Business Administration program. The eight functional areas were: accounting, system analysis, finance, small business management, engineering, marketing, manufacturing management, and personal management. This study is based on Roe's idea that interpersonal needs are a determinant of major choice. Interpersonal needs were measured by the Fundamental Interpersonal Relations Orientation (FIRO) instrument (Schutz, 1966). Significant differences were found across the area of the program on dimensions of inclusion, control and affection.

Barnette and McCall (1964) and Silver and Barnette (1970) were able to differentiate between majors of vocational high school students at both ninth and tenth grade levels by means of the Minnesota Vocational Interest Inventory (MVII). Electrical, building trades, and machine shop were very well classified. This is similar to what this study will do at the Georgia Institute of Technology using Holland's VPI.

Four engineering functions (basic research, applied research and development, production and process engineering, sales and technical services engineering) were studied by Dunnette, Wernimont, and Abrahams (1964). They expected that personalities of engineers in each function would be different because of differing demands placed on the incumbents in these four areas. The hypothesis was supported by scores on the SVIB keys for research, development, production, and sales -- each key significantly differentiated the four areas of engineering. The authors point out, however, that the functional areas are not related to areas of study in engineering school. Also, no mention of females was made.

A somewhat analogous study was made by Kreidt (1949) on psychologists. Ninety-two psychologists classified into the areas of experimental, social, guidance, statistical, or industrial psychology filled out the SVIB. The overall psychologist key was found not to embrace all specialties. Subkeys were developed which differentiated the specialties. In some cases the subkeys were radically different. For instance, the guidance psychology key correlated with the experimental psychology key $-.82 \pm .03$. Thus, experimental psychologists differ from guidance psychologists in a very different way than psychologists differ from people in general. This is one of the best demonstrations that what seems homogeneous to an outsider may actually be very heterogeneous.

Sex Differences in Vocational Interest

"No topic in psychology is of more perennial interest than sex differences. Study after study, book after book, testify to the fact that research workers, writers, and readers consider the subject one of paramount importance," (Tyler, 1965, p. 239). There is also reason to believe that recent changes in sex roles in our society may make some of the earlier studies of questionable applicability.

Vocational interest is an area in which sex differences have been studied, but this study has been incomplete. Holland (1966) states: "Unfortunately most of our empirical knowledge about personality and vocational behavior has been obtained in studies of men. Consequently, it is difficult to construct a theory of personality that applies equally to men and to women," (p. 13).

Particularly lacking has been the study of females in technical fields. Thus, there has been no data base and little interest in this area. However, the Georgia Institute of Technology has a large number of female students in technical, managerial, and scientific fields, comprising an excellent data base. Indications of the current lack of data are in Abe and Holland's studies (1965a, b). Their industrial engineering sample of females was 0. Other female samples were: aeronautical engineering = 9, civil engineering = 6, electrical engineering = 4, mechanical engineering = 1, metallurgical engineering = 0, management = 22; computer specialist was not included. Compare this to a total sample of

6,143 women and the lack of data on women in technical and managerial fields becomes obvious.

On the VPI the score most characteristic of engineers is high on the masculinity scale. No characteristic scores are given for females at all so a girl considering matriculating at an engineering school would have no VPI scores to which she could compare herself.

One might conjecture that females in engineering must have similar interest profiles to the males in engineering. There is some literature on this. Seder (1940) in an early study of this area compared SVIB profiles of males and females in medicine and life insurance sales. The conclusion she reached was that interests of women tended to be the same as men in the same occupation. However, she was much handicapped by the fact that no SVIB existed at the time that could be scored for men and women both; thus, only a portion of the items were in common and could be compared. She noted that efficiency would be increased by comparing both sexes on the same blank as the Sixth Revision of the VPI does. She stated that where sex differences were significant a key should be constructed for each sex. This is similar to what is done in this thesis with the VPI. However, note that: (1) Seder did not study women in technical and managerial fields and (2) interests of women may have changed radically since 1940.

A study by Hornaday and Kuder (1961) noted the similarity of interests of men and women in the same occupations in most of the occupations they studied. Separate norms were, however, implicated for the occupation "librarian." The authors note, "... the fact remains that the empirical approach is the only sure way of determining whether a key developed for men is applicable for women. To answer this question for other occupations, further empirical studies should be made..." (p. 863).

An example of the differences that can occur between men and women in the same field is provided by Abe and Holland (1965). In regard to the health professions no VPI scales were characteristic of men especially choosing or rejecting that field. However, the women high on choice of the health professions were characterized by VPI profiles high on realistic, aggressive, acquiescence, and masculine versus other women. Women low on choice of health professions were lower on self-control on the VPI than other women. Thus, a comparison with norms for men would have greatly misled a woman considering choice of a health profession.

A study similar to the one in this thesis is by Perry and Cannon (1968). They studied a sample of 293 female computer programmers on the SVIB. They concluded that in general male and female programmers are similar, but the differences that characterize men and women in general, and other differences also, make the male key inadequate for female programmers. Specifically, women had higher scores in scientific occupations and lower scores in technical supervision and technical occupations. Female programmers who were very dissatisfied or who preferred a different field were excluded from the analysis.

Cole (1974) discusses sex differences on several vocational interest surveys. She points out the serious inadequacies of existing female norms for the present situation in which many occupations are becoming available to females for the first time. She suggests that male norms be used in areas where no female norms are available. She feels the empirical approach (as is used in this thesis) is good but not possible in many areas at this time.

Cole further comments that although pervasive sex differences are found throughout our society, the structure of interests (as in Holland's hexagonal model) is equivalent across sexes.

Actually, as Lunneborg and Lunneborg (1970) found in factor analyzing responses to quite a few commonly used masculinity-feminity scales, interests account for much of the variance in these scales. Their first factor, accounting for much of the variance, was an interest factor. Thus, the understanding by psychologists and laymen alike of masculinity versus feminity is closely intertwined with vocational interests.

Specific Hypotheses

Hypothesis 1: Students in different majors have different profiles on the VPI. Previous research with various interest inventories including the VPI has shown that persons in different professions -- and professional training programs as well -- tend to have relatively homogeneous interest patterns within professions and diverging patterns between professions.

Hypothesis 2: Within colleges that have more than one major students in different majors will show different profiles on the VPI. Students in different majors within colleges should reflect the different patterns of interest in their fields. For example, students in industrial engineering would have a different pattern of interests from those in electrical engineering -- yet both are in the general field of engineering.

The VPI should be sensitive to these differences.

Hypothesis 3: Differences between sexes will be found in each analysis (entire sample of twenty majors, or between colleges, or majors within colleges that have more than one major) on the VPI. There is some disagreement as to whether sexes differ in preference profiles within the professional or typically "masculine" vocational areas (Seder, 1940; Perry and Cannon, 1968).

Hypothesis 4: Differences will be found between intracampus colleges on the VPI profiles. This analysis is necessary to complete the breakdown of traditional areas of the Georgia Institute of Technology. Differences are expected here because majors within an intracampus college are relatively more homogeneous in content and method than majors across such colleges.

Hypothesis 5: Differences found between sexes will vary across colleges, across all majors, or across majors within a college having more than one major on VPI profiles. Some of the differences found by Perry and Cannon (1967) are typical of men and women in general but some are not. As Hornaday and Kuder (1961) point out only empirical studies can determine whether a constant increment to each scale is adequate to account for sex differences. This would not be true in cases where a complex interaction is found.

CHAPTER II

METHODOLOGY

Subjects

A sample of 554 undergraduate students at the Georgia Institute of Technology participated in this study. Initially subjects were obtained from psychology classes. When it was seen that few females were obtained by this method a larger number of female students was obtained by contacting all undergraduate females on campus through their mailboxes. This method of solicitation was very successful as evidenced by the large number of females in the sample. As a result there were 245 male subjects and 299 female subjects.

The collection of data by the two different methods has been criticized. Note that Perry and Cannon (1968) also used two separate surveys to collect their female sample. Their problem also was that they had too few females in their original sample of programmers. Any sample with an appreciable number of females in these fields could only be obtained by making a special appeal to females. Thus, some sampling bias may be unavoidable in this field of study at this time.

The collection of data by two different methods was investigated by comparing female subjects who volunteered through psychology classes with those who volunteered through the mailbox survey. It was further investigated by an analysis of sex differences in the sample collected from psychology classes.

This was done to test the possibility that the vocational interests of those subjects from psychology classes were different from the vocational interests of the mailbox sample.

Characteristics of the sample in terms of college, major, and sex are shown in Table 1. It can be seen that the ratio of males to females in the sample is much smaller than the ratio in the Georgia Institute of Technology population in general. Also, there are two empty cells. There are no male ceramics engineers, and no male engineering science and mechanics majors. These empty cells in the design were filled with dummies (2 each) to allow for a complete factorial design with no empty cells. This is a slight deficiency of this thesis. Of course, the only ideal solution to missing data is not to have any. Although this sample is not perfect and is not representative in a proportionate sense, it is typical of samples reported in the vocational preference literature. Of course, no proof exists that the subjects in this sample are representative of all the students in their majors.

Instruments

The Holland Vocational Preference Inventory (VPI) was administered to each subject in a package which included a request for cooperation and other forms. The VPI is a psychological instrument which has been successively developed by John L. Holland since the 1950's. Its Sixth Revision was used in this study.

The VPI consists of 160 items which are vocational choices. A person is to respond to them as they appeal to him on a corresponding answer sheet by checking Y for yes, N for no, or leaving the item blank for undecided.

Table 1. Enrollment Compared to Sample for this Research by Major

			Enrollment	Sample
Engineering College	Male Female	Aerospace Eng.	154 5	6 2
		Architecture	447 59	31 22
		Building Const.	87 5	7 3
		Ceramic Eng.	16 9	0 3
		Chemical Eng.	630 38	24 21
		Electrical Eng.	809 17	30 9
		Eng. Science and Mechanics	61 5	0 2
		Industrial Design	62 15	4 7
		Industrial Eng. + Health Systems	364 51	26 27
		Mechanical Eng.	484 14	12 10
		Nuclear Eng.	113 7	3 3
		Textiles + Textile Eng. + Text Chem.	69 36	4 11

Table 1 (Continued)

			Enrollment	Sample
General College	Male Female	Biology	174 53	12 19
		Chemistry	101 19	6 6
		Information and Computer Science	116 26	16 11
		Mathematics	82 37	5 25
		Physics	166 9	8 5
		Psychology	14 18	5 16
Management College		Industrial Management	843 110	37 47

N. B. - Each major has two row entries. First row is male and second is female.

The VPI has eleven scales:

1. Realistic - technical and skilled trades
2. Intellectual - scientific occupations
3. Social - teaching and service occupations
4. Conventional - clerical occupations
5. Enterprising - supervisory and sales occupations
6. Artistic - artistic, musical, and literary occupations
7. Self-control - aversion to occupations involving risk of physical injury, adventure, and danger
8. Masculinity-femininity (Mf) - occupations usually chosen especially by one sex
9. Status - prestigeful occupations such as lawyer, doctor, or business executive
10. Infrequency - infrequently chosen occupations
11. Acquiescence - number of preferred occupations

These scales were the dependent variables in these analyses. The first six are based on Holland's theory of types of interests and environments. The last five are typical personality or response bias scales. They provide a comprehensive survey of Holland's theory along with some other useful measures.

The factor structure of the Holland VPI has been investigated by DiScipio (1974). This analysis shows some support for the scales.

Statistical Analysis

First, descriptive data were obtained. These were means and standard deviations on all majors for both sexes. These are what is usually referred to as interest norms or means. These would be used by an individual comparing himself to the scales of any group selected by sex and major.

A principal components factor analysis was performed to replicate an earlier principal components factor analysis by Holland, Whitney, Cole, and Richards (1969). The correlation matrix for this factor analysis was the correlation of the six VPI type scales. A principal components analysis is a factor analysis with 1's placed in the principal diagonal of the correlation matrix and factor extraction by a principal axes method. A principal components analysis produces a set of linearly independent components from which the original variables can be derived. Usually a set of these components smaller in number than the set of original variables is used to summarize the information in the set of variables in a smaller number of orthogonal variables. Of course, no inferences about reliabilities can be made since communalities are not computed. Actually, row sums of squares of the factor pattern matrix of an orthogonal solution were computed as a lower bound estimate of the scale reliabilities, but they were not put in the diagonal of the factor analysis.

No rotation was used since the method was copied from Holland, et al., who felt rotation was irrelevant to the question they were asking. Three components were retained which again served to replicate the factor analysis of Holland, et al.

An analysis was run for each sex to provide for maximum methodological similarity to the Holland, et al., study. Figures were constructed on which the second and third principal loadings were used as abscissa and ordinate values respectively. This method was also taken from the previous study. In line with Guttman's (1954) ideas concerning arrangement of variables in a circumplex, it was decided that a lack of correspondence between models would be evidenced by a breakdown in the circumplical ordering of the variables.

The principal components analysis was done on the program FAMP written by Dr. Stanley A. Mulaik for the Cyber 74-70 computer at the Rich Electronic Computer Center.

Several multivariate factorial analyses were used to test the substantive hypotheses of this study. Factors used were college (referred to as C), major (referred to as M), and sex (referred to as S). Note that in the model equations to follow each of the terms indicates a vector of parameters. Thus, $\underline{Y}_{ij}$ is an n×1 random vector of scores for an observation on n variables in the i,j cell of the design, $\underline{\mu}$ is an n×1 vector of constants, $\underline{M}_i$ is an n×1 vector of constants for the n dependent variables on the ith level of factor M, $\underline{S}_j$ is an n×1 vector of constants on the jth level of S, and $\underline{MS}_{ij}$ is an n×1 vector of constants for the i,j level combination of n variables, and $\underline{e}$ is an n×1 vector of n error random variables (see Timm, 1975, p. 403).

(1) For the all-major analysis the multivariate factorial design was a 2 × 20. That means two sexes were crossed with 20 majors. The complete equation was:

$$\underline{Y}_{ij} = \underline{\mu} + \underline{M}_i + \underline{S}_j + \underline{MS}_{ij} + \underline{e}$$

(2) For the majors within General College analysis, the design was 2 × 6. That means two sexes were crossed with six majors. The complete

model equation was:

$$\underline{Y}_{ij} = \underline{\mu} + \underline{M}_i + \underline{S}_j + \underline{MS}_{ij} + \underline{e}$$

(3) For the majors within Engineering College analysis, a 2×13 design was used. That means two sexes were crossed with thirteen majors. The complete model equation was:

$$\underline{Y}_{ij} = \underline{\mu} + \underline{M}_i + \underline{S}_j + \underline{MS}_{ij} + \underline{e}$$

(4) For the between colleges analysis the design was 2×3. That means two sexes were crossed with three colleges. The complete model equation was:

$$\underline{Y}_{ij} = \underline{\mu} + \underline{C}_i + \underline{S}_j + \underline{CS}_{ij} + \underline{e}$$

The purpose of the multivariate factorial analysis was to determine whether the complete model equation or some modification of it represented the true state of the sample. Each analysis results in an equation depicting the true state of affairs in that sample. For example, in a model with factors of A and B, a state of affairs with significant main effects but a nonsignificant interaction the model is:

$$\underline{Y}_{ij} = \underline{\mu} + \underline{A}_i + \underline{B}_j + \underline{e}$$

Each one of these four MANOVA analyses bears on several hypotheses of the introductory chapter.

The MANOVA factorial, or multivariate factorial design, is a multivariate analysis of variance design (Jones, 1966). This technique involves the derivation of linear combinations of the dependent variables which best differentiate among the independent variables (or in this case levels of the factors of the designs). A number of these linear combinations are derived, and each is tested for significance with tests for each effect.

Then univariate (or single degree of freedom) F tests are performed to give an idea of which of the dependent variables contributes to the differences. A significance value is obtained for each of the dependent variables. This approach of an overall multivariate test followed by univariate tests for each dependent variable is recommended by Hummel and Sligo (1974) because it allows for control of the error rate.

It should be noted that the design used here is nonorthogonal and is analyzed by procedures described by Appelbaum and Cramer (1974). The concept of nonorthogonality is that sex and major or sex and college are not independent, they are correlated. These designs necessitate special analysis as described by Appelbaum and Cramer. Each design is analyzed twice. For example, in a design involving factors A and B the first analysis for factors A and B would test factor A ignoring B and factor B eliminating A (by covariance). The second analysis would test factor B ignoring A and factor A eliminating B (again by covariance). The AB interaction is also tested each time but should be the same in either case. This is because the order in which A and B are removed is irrelevant to the AB term which follows.

All of these analyses are necessary because of the unequal cell frequency problem. However, when the test, for instance, of A eliminating B, is significant then the test of A ignoring B is irrelevant to the interpretation. Only cases of A eliminating B were reported in this thesis since they were significant in all cases.

In collecting subjects for the sample used in this study an extraneous variable -- method of sampling -- was inadvertently confounded with the independent variable, sex of subject, used in this study. Because the course of introductory psychology is an elective and possibly attracts students interested in psychology as a subject, student volunteers obtained from psychology courses may have interest patterns different from those who would be selected in other ways. All male subjects were volunteers from introductory psychology classes. Although a relatively small number of female subjects were also obtained as student volunteers from psychology classes, by far the greatest number of female subjects were obtained by soliciting their participation in the study by a letter sent to their campus mail boxes. Thus, in this study differences between male versus females might represent differences in methods of sampling used to obtain males versus females and not true sex effects. To rule out this possible alternative explanation for sex effects, if found in the other analyses, two additional multivariate analyses of variance were performed. The first analysis involved a two-way factorial multivariate analysis of variance with method-of-sampling as one of the factors was performed. The first analysis involved a two-way factorial multivariate analysis of variance with method of sampling as one of the factors and academic college enrolled-in as the other factor in the design. The same dependent variables were studied as in the other analyses already described in this chapter. Only the female subjects were studied in this analysis. If in this analysis a difference between the two female samples were found, this would provide strong support for the existence of a method-of-sampling effect confounded with the sex effects in the other analysis. Otherwise if no method-of-sampling effect is found, such an effect could be regarded as an unlikely explanation for sex effects found in these other analyses.

The second analysis investigated sex differences within the sample of subjects collected from psychology classes. The model used for this analysis was a two-way multivariate analysis of variance with sex and academic college of subject as independent variables of the design. The same dependent variables as studied in the other multivariate analyses were used. The important analysis here was of the factor of sex with the effect of college of subject eliminated from the estimate of the sex effect. A significant sex effect, if found in this analysis, would support the contention that sex differences, if found in the other analyses, are not due to sampling methods.

Analysis of these factorial designs was by the program MANOVA written by Dr. Elliot M. Cramer of the University of North Carolina Psychometric Laboratory (Cramer, 1973). It does any kind of univariate or multivariate analysis of variance and was thus very appropriate for this thesis. Dr. Cramer was also consulted concerning the technical aspects of the use of MANOVA in this study. The Univac U1108 at the Rich Electronic Computer Center was used in this analysis.

A discriminant analysis was computed using standard discriminant functions for majors with sex taken out which were obtained by MANOVA. These discriminant functions are linear combinations of the dependent variables which best discriminate among the majors. These discriminant functions are then pre-multiplied by the means of each major for each variable to obtain discriminant functions scores. These can be plotted on orthogonal axes since the discriminant functions are orthogonal to one another. In this plot distances separating majors are representative of degree of similarity along the dimensions. This technique is explained by Timm (1975, pp. 379-381).

The meaning of each dimension was then investigated by pre-multiplying the discriminant function weights by the within-cells-correlation matrix as described by Timm (1975, pp. 414-415). This technique produces a matrix of correlations of each dependent variable with each discriminant function. A positive correlation means that a high score on that variable contributes to a high score on the dimension. A negative correlation means that a high score on that variable contributes to a low score on that dimension. A near-zero correlation indicates that variable contributes little to the dimension.

This analysis allows for a separation of the majors in a Euclidean space and an interpretation of the meaning of the relevant dimensions.

CHAPTER III

RESULTS

Descriptive Statistics

The first descriptive statistics are the means and standard deviations for each major for both sexes and are included in Appendix A. This descriptive data is known as vocational interest norms. Examples of these norms are in Figures 3, 4, and 5, plotted in profile format. Note the different impressions given by plotting males on male norms, females on female norms, or both sexes on neutral norms.

Test of Hexagonal Model

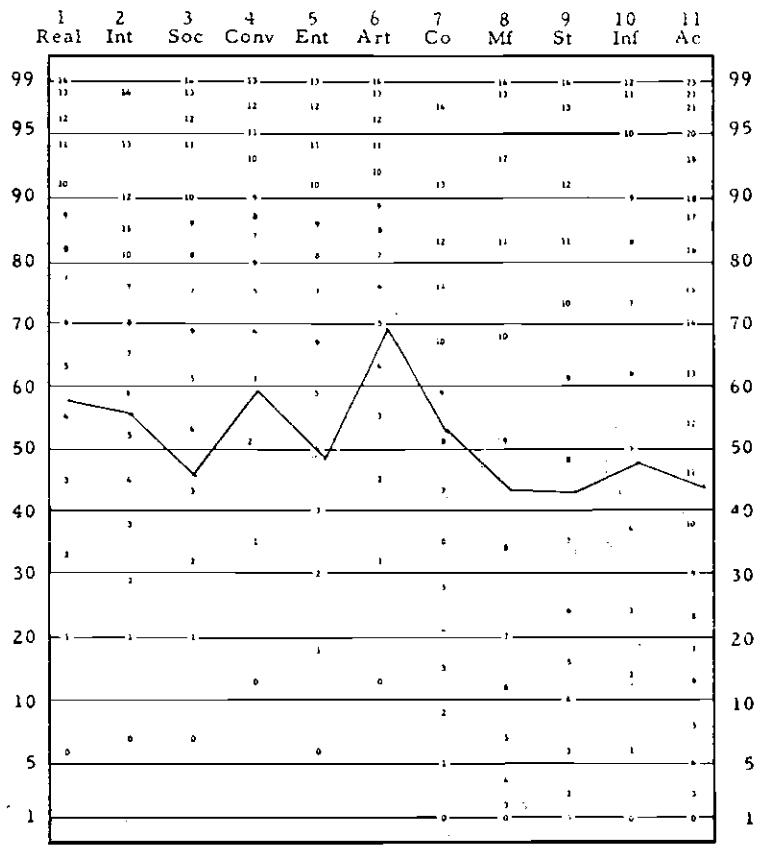
Analysis of the data gathered for this thesis was done to provide for comparison to the data of Holland, Whitney, Cole, and Richards (1969). First note the comparison of the overall correlation matrices in Table 2. A rough correspondence is immediately obvious. Also, both fit an unequally spaced circumplex model as previously discussed.

The model in Figure 6 is Holland's model with the correlations obtained in this thesis drawn in. Note the correspondence to Holland's model. As previously decided, this correspondence is in terms of an identical circumplicial ordering. This observation was mathematically confirmed by two factor analyses whose results are shown in Figure 7. For each sex the circumplicial ordering is shown to be identical. The model holds up very well, and the basic conception of the variable set as a circumplex (or hexagon) is well confirmed.

VOCATIONAL PREFERENCE INVENTORY *by John L. Holland*

MALE PROFILE
(College Freshmen, N = 6270)

Name ____________ Age ______ Date ____________



VPI Code ____________

Vocation ____________

Major ____________

Other Data ____________

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Figure 3. Average Scores of Males in this Sample on Male Norms.

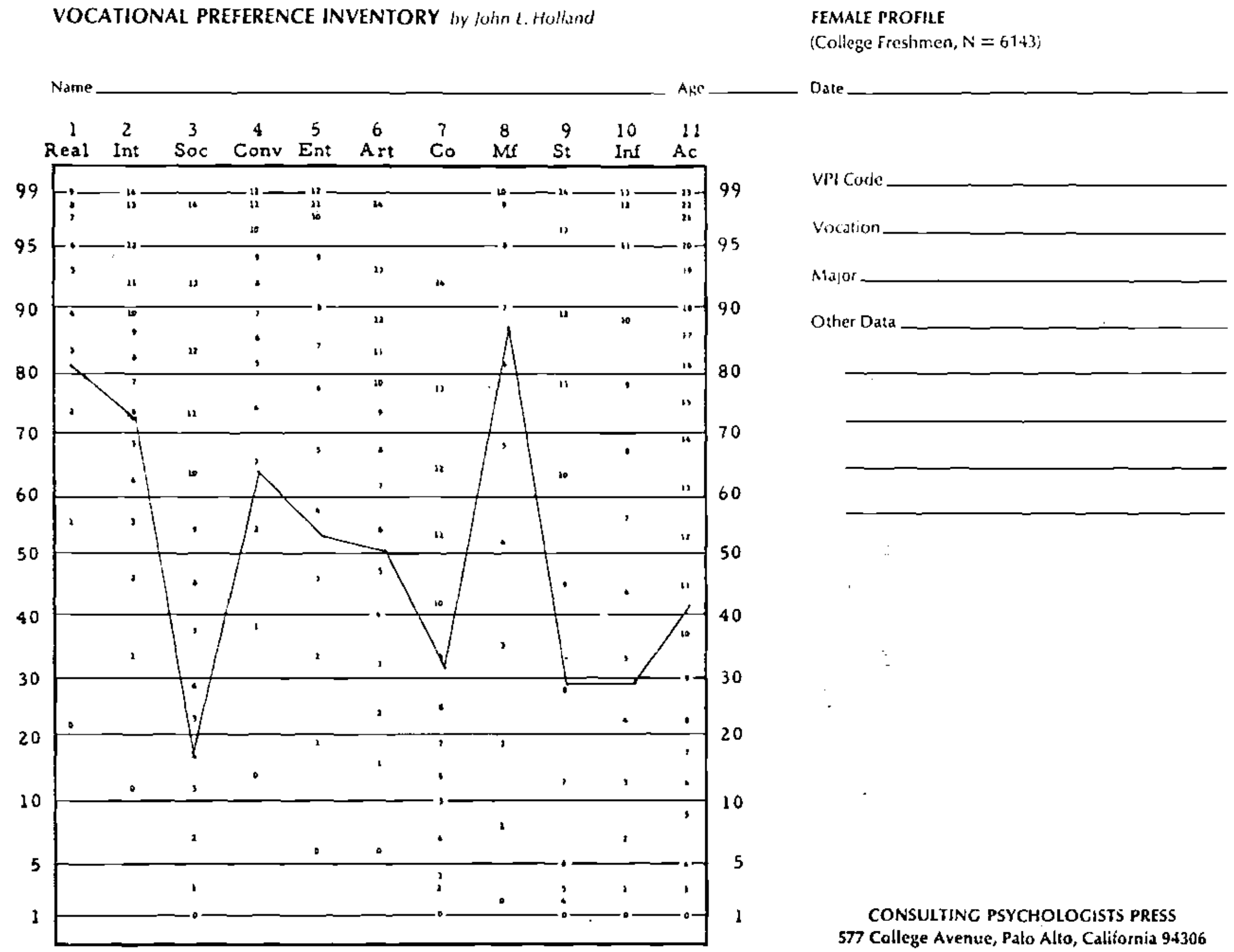


Figure 4. Average Scores of Females in this Sample on Female Norms.

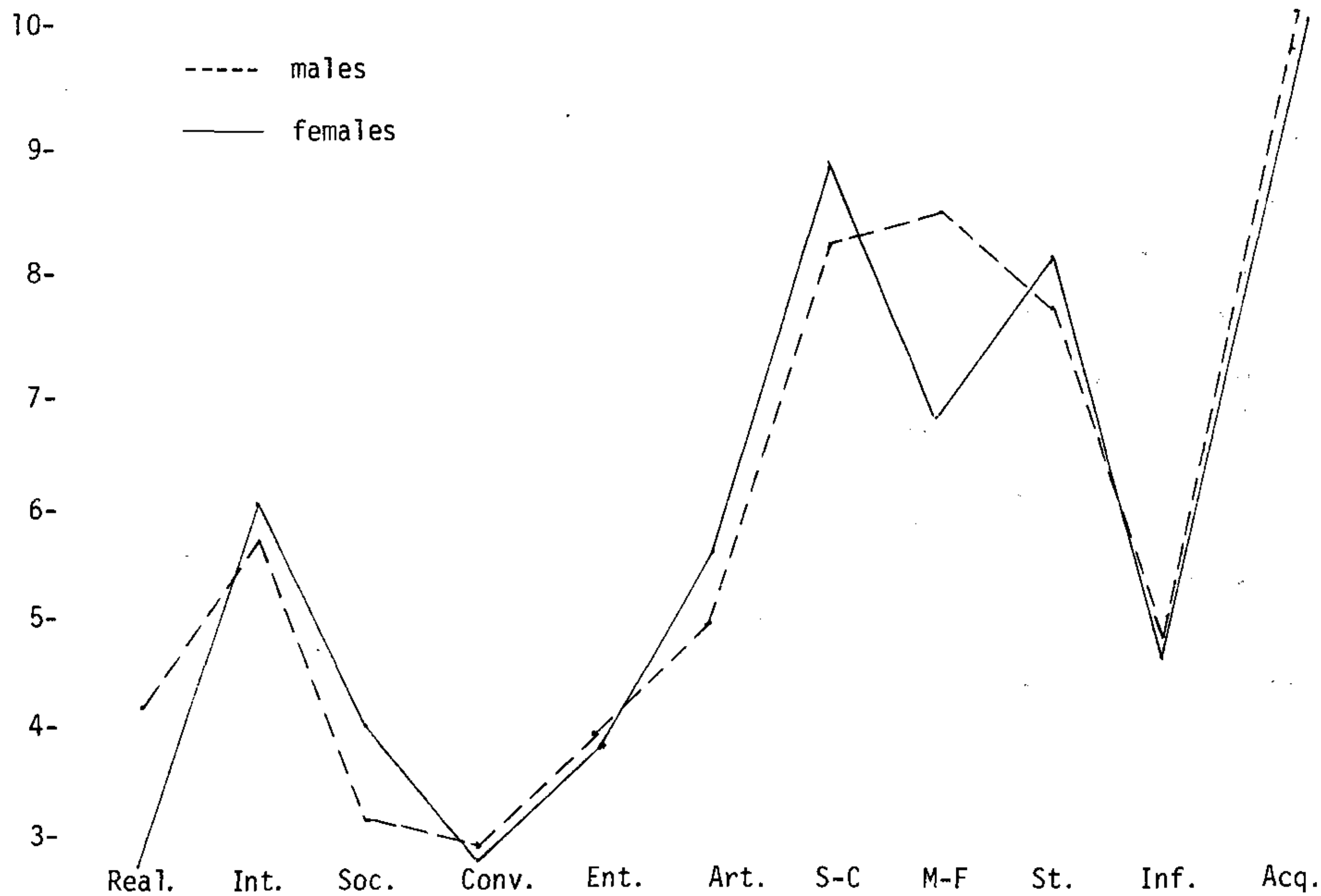
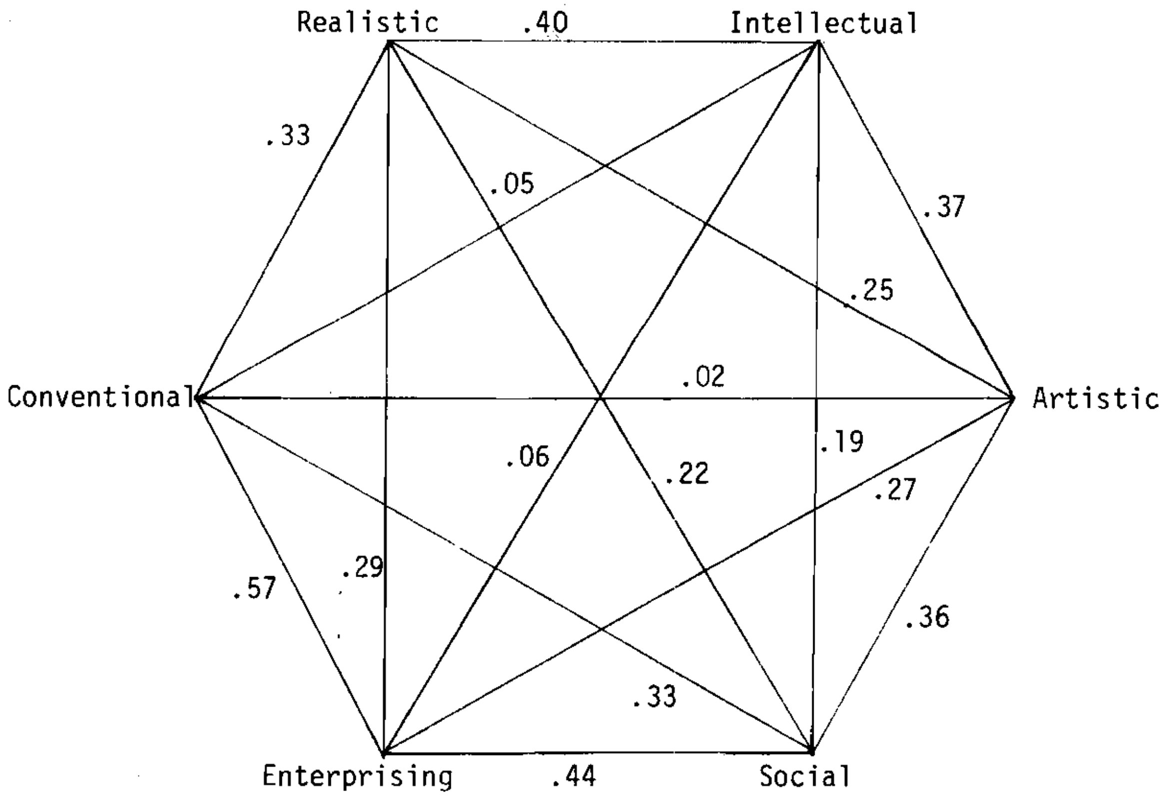
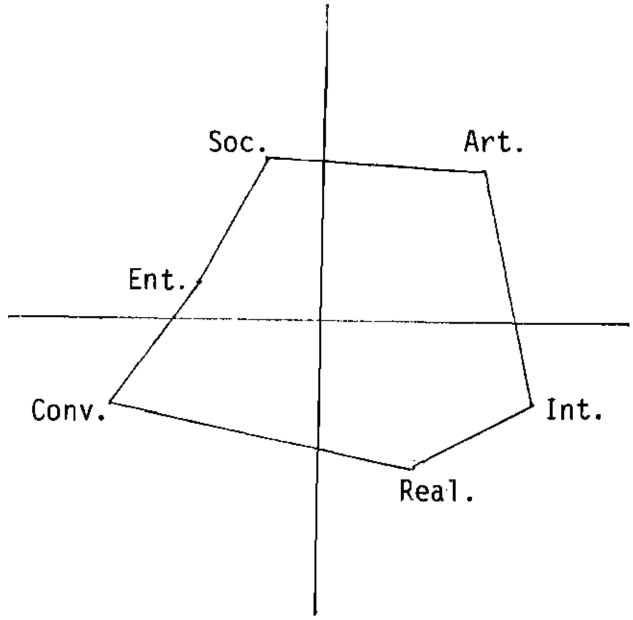


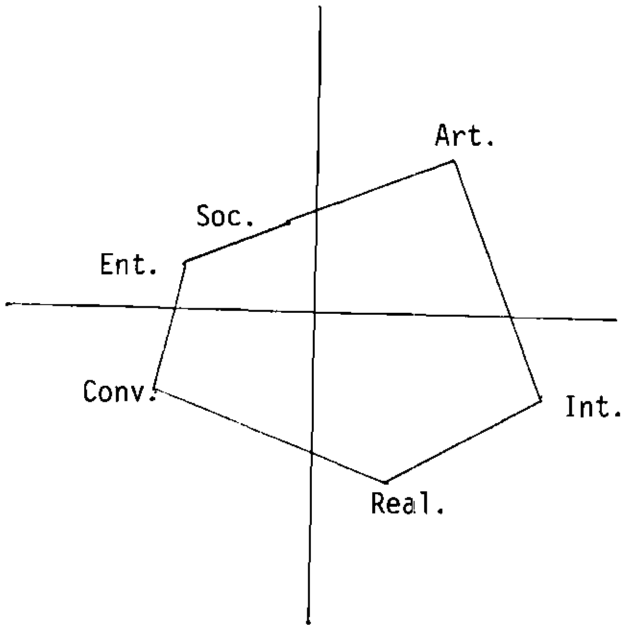
Figure 5. Comparison of Average Scores of Males and Females in this Sample on Neutral Norms.



Correlations are printed on lines connecting variables

Figure 6. Sample Used in this Thesis Represented in Holland's Hexagonal Mode.





Top Figure is Males, Bottom is Females

Figure 7. Results of the Factor Analyses by Sex Done in this Thesis Represented in Model Form.

Table 2. Correlation Matrices for Holland's Sample and the Sample Used in this Thesis

1					
2	.46				
3	.21	.30			
4	.36	.16	.38		
5	.30	.16	.56	.68	
6	.16	.34	.42	.11	.35

(Taken from Holland, Whitney, Cole and Richards, 1969)

1					
2	.40				
3	.22	.19			
4	.33	.05	.33		
5	.29	.06	.44	.57	
6	.25	.37	.36	.02	.27

(Taken from sample gathered in this thesis)

Multivariate Analysis of Variance Results

Between-All-Majors Analysis

The factorial design involving factors of sex (S) and major (M) was performed first with all majors. This analysis is summarized in Appendix B. The sex by major interaction (SXM) was significant at the .001 level with univariate tests significant on the variables of artistic and masculinity (P less than .05). The effect of sex with major eliminated was significant at the .001 level with univariate tests for the scales of realistic and masculinity significant (P less than .001); for self-control (P less than .005); and for social, artistic, and status (P less than .05). The test of major (M) with sex (S) eliminated was significant at the .001 level on the first five of eleven canonical vectors associated with the scales. Univariate tests which were significant were realistic, intellectual, social, conventional, enterprising, artistic, masculinity, and status (P less than .001); self-control (P less than .01); and infrequency (P less than .05).

Thus, this test differentiates very well among majors and sexes in the present sample. The significant MXS interaction indicates that there are differences across the majors in the way the sexes differ on the test. Therefore, there is a more complex relationship than is given by the main effects in the sample at large. This interaction is significant only on the variables of artistic and masculinity.

Since all the effects of the model are significant, the true model is found to be:

$$\underline{Y}_{ij} = \underline{\mu} + \underline{S}_i + \underline{M}_j + \underline{SM}_{ij} + \underline{e}$$

Thus, the hypotheses relevant here are:

Hypothesis 1. Students in different majors have different profile on the VPI. This hypothesis was accepted in this analysis.

Hypothesis 3. Differences between sexes will be found in each analysis (entire sample of twenty majors, or between colleges, or majors within colleges that have more than one major.) This hypothesis was accepted in this analysis.

Hypothesis 5. Differences found between sexes will vary across colleges, across all majors, or across majors within colleges having more than one major on VPI profiles. This hypothesis was accepted in this analysis.

Between-College Analysis

This analysis was a multivariate factorial design with factors of College (C) and Sex (S). The results are reported in Appendix C. The CXS interaction was not significant. However, the main effects were both significant at the .001 level with significant univariate *F* tests on the scales of realistic, intellectual, social, conventional, enterprising, status, and infrequency (P less than .001); and self-control (P less than .01). The S effect was significant at the .001 level with significant univariate *F* tests on the scales realistic and masculinity (P less than .001); and social and self-control (P less than .005).

The significance of the main effects indicated differences varying systematically with sex and college. The absence of an interaction indicates that the differences between the sexes are constant across the colleges.

Thus, the true model in this case is found to be:

$$\underline{Y}_{ij} = \underline{\mu} + \underline{C}_i + \underline{S}_j + \underline{e}$$

Note the absence of an interaction term. It was excluded because it lacked significance. The thesis hypotheses relevant here are:

Hypothesis 4. Differences will be found between intracampus colleges on the VPI profiles. This hypothesis was accepted in this analysis.

Hypothesis 3. Differences between sexes will be found in each analysis (entire sample of twenty majors, or between colleges, or majors within colleges that have more than one major.) This hypothesis was accepted in this analysis.

Hypothesis 5. Differences found between sexes will vary across colleges, across all majors, or across majors within colleges having more than one major on VPI profiles. This hypothesis was not accepted in this analysis.

Between-Majors-Within-Engineering-College Analysis

The results of the analysis between majors within the Engineering College indicates significant differentiation for sexes and majors. The SXM interaction is significant at the .001 level with univariate significant tests on variables of artistic (P less than .01); and intellectual (P less than .05). The test of S with M eliminated was significant at the .01 level with univariate tests significant on masculinity (P less than .05). The test of M with S eliminated was significant at the .001 level with significant univariate tests on realistic, conventional, artistic, masculinity, and status (P less than .01); and enterprising (P less than .05). See Appendix D. Thus, the true model here was found to be:

$$\underline{Y}_{ij} = \underline{\mu} + \underline{M}_i + \underline{S}_j + \underline{MS}_{ij} + \underline{e}$$

The thesis hypotheses relevant here are:

Hypothesis 2. Within colleges that have more than one major students in different majors will show different profiles on the VPI. This hypothesis was accepted in this study.

Hypothesis 3. Differences between sexes will be found in each analysis (entire sample of twenty majors, or between colleges, or majors within colleges that have more than one major.) This hypothesis was accepted in this analysis.

Hypothesis 5. Differences found between sexes will vary across colleges, across all majors, or across majors within colleges having more than one major on VPI profiles. This hypothesis was accepted in this analysis.

Between-Majors-Within-General-College Analysis

The between-majors-within-General-College analysis was similar to the other analyses with the exception that the SXM interaction was not significant. The effect of S with M eliminated was significant at the .005 level with univariate significance tests on the scales of masculinity (P less than .001). The M effect with S eliminated was significant at the .001 level with significant univariate tests on the scales conventional (P less than .0010); social (P less than .005); self-control (P less than .05); and intellectual (P less than .05).

The lack of a significant interaction in the case of the majors within the General College is an indication that the differences between sexes are constant across majors within the General College. See Appendix E for results. Thus, the true model here was found to be:

$$\underline{Y}_{ij} = \underline{\mu} + \underline{M}_i + \underline{S}_j + \underline{e}$$

Note the absence of an interaction term. The specific thesis hypotheses relevant here are:

Hypothesis 2. Within colleges that have more than one major students in different majors will show different profiles in the VPI. This hypothesis was accepted in this analysis.

Hypothesis 3. Differences between sexes will be found in each analysis (entire sample of twenty majors, or between colleges, or majors within colleges that have more than one major). This hypothesis was accepted in this analysis

Hypothesis 5. Differences found between sexes will vary across colleges, across all majors, or across majors within colleges having more than one major on VPI profiles. This hypothesis was not accepted in this analysis.

Results of Methods-of-Sampling Analysis

The multivariate analysis comparing the two methods of data collection for the female sample showed no differences in the two methods. The results of this analysis are in Appendix F. The factor of method with college eliminated was not significant. Because of this result sex differences in the other analyses seems less likely to be attributable to sampling-method differences. This lends support to the other analyses which found sex differences.

The analysis of sex differences within the sample collected from psychology classes showed sex with college taken out was significant at the P less than .001 level. The results of this analysis are in Appendix G. This lends further support to the assertion that sex differences in the other analyses are not attributable to sampling method differences.

Results in Terms of Holland's Four Letter Code

In Table 3 are shown several of Holland's four letter codes (in order of highest scale on VPI) for both a national sample and this sample. Some correspondence is found across the same majors but interpretations should be very guarded because of the small numbers of subjects in many of the cells.

Where disagreements occur between the two samples, the one with the larger N should be considered most representative of the whole group.

Note the deficiency of national female samples in technical and scientific fields. Some national sample sizes are very small and some are non-existent, such as female chemical engineers, electrical engineers,

Table 3. National Sample vs. This Study's Sample on Relevant Empirical Codes

Holland National Sample (Holland, Whitney, Cole and Richards, 1969)			Sample in this thesis	
Title	N	Code	N	Code
		MALES		
Architect	83	RIAE	31	AIRS
Civil Eng.	185	RIEC	24	IRAE
Indust. Eng.	37	RIEC	25	IEAC
Mech. Eng.	152	RIEC	12	IRAC
Biologist	55	ISRE	11	IARS
Math. Teacher	138	ISRC	4	AIRS (Math)
Chemist	87	IRAS	6	IASR
Physicist	61	IRAS	8	IARS
Chem. Eng.	94	IREA	7	IARS
Elec. Eng.	259	IREA	28	IREA
Aero. Eng.	77	IREC	6	IARE
Math/Stat	80	IRCE	4	AIRS
Indust. Psy.	17	SEAI	5	ISAR
Manager	360	ECSR	37	ECAS (IM)
		FEMALES		
Architect	8	IASE	28	AISR
Physicist	7	IARS	5	IARS
Biologist	40	ISAE	19	IASR

Table 3. (Continued)

Title	N	Code	N	Code
Chemist	25	ISAR	8	IASE
Math./Stat.	54	ISCA	25	ISAC (math.)
Indust. Psy.	8	ASEI	16	ASIR
Civil Eng.	6	ASIC	21	IRAC
Manager	22	SEAC	54	ESAC
Math. Teacher	114	SIAC	25	ISAC (math.)
Aero. Eng.	9	SAIE	2	IRCE

N.B. -- Major was put in parentheses where it was not obvious which major the national norms were being compared to.

and industrial engineers. This thesis thus makes a contribution by increasing the pool of normative information.

Results of Discriminant Function Analysis

The results of the discriminant function analysis for males is shown in Figure 9, the results for females in Figure 8. The proximity between majors on the graph indicates their similarity on the first two discriminant functions which were found to maximally separate the majors. For instance, for females mechanical engineering and aerospace engineering are very close together. For males building construction and mathematics are very far apart. Sex differences on variable means are reflected in differences between positions of the same majors on the two graphs. Naturally, ESM and CER for the males are equal since they are filled with equal "dummies."

In Table 4 are shown the correlations of each dependent variable with the two discriminant functions. These are used to show which variables are most important to discrimination along the two dimensions. For instance, on discriminant function 1 enterprising and status both contribute importantly but in opposite directions. Thus, a person would be high on this function if he were high on status or low on enterprising. The second discriminant function is characterized by a negative correlation with realistic and a positive correlation with intellectual and social.

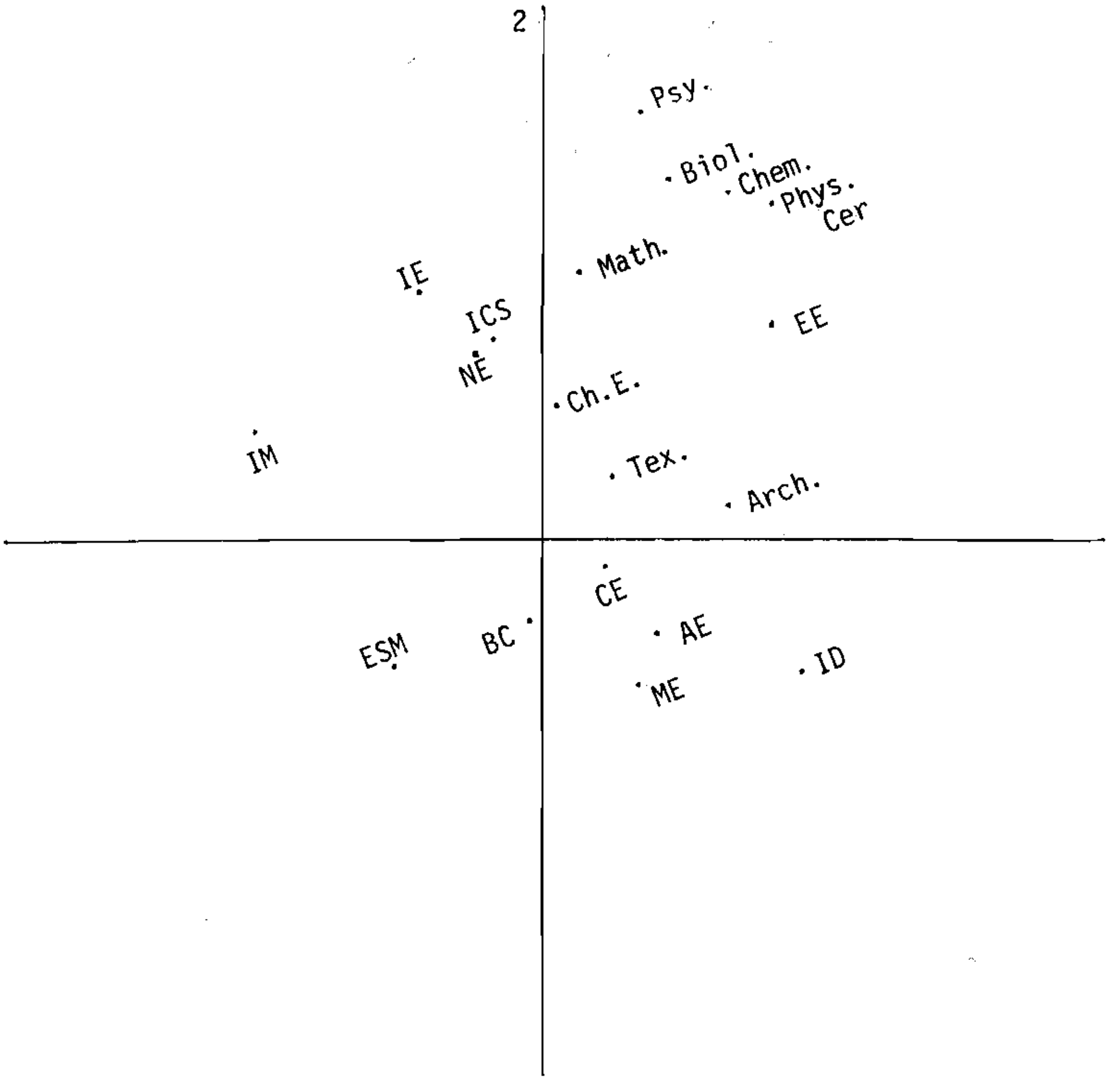


Figure 8. Discriminant Scores for Females by Major.

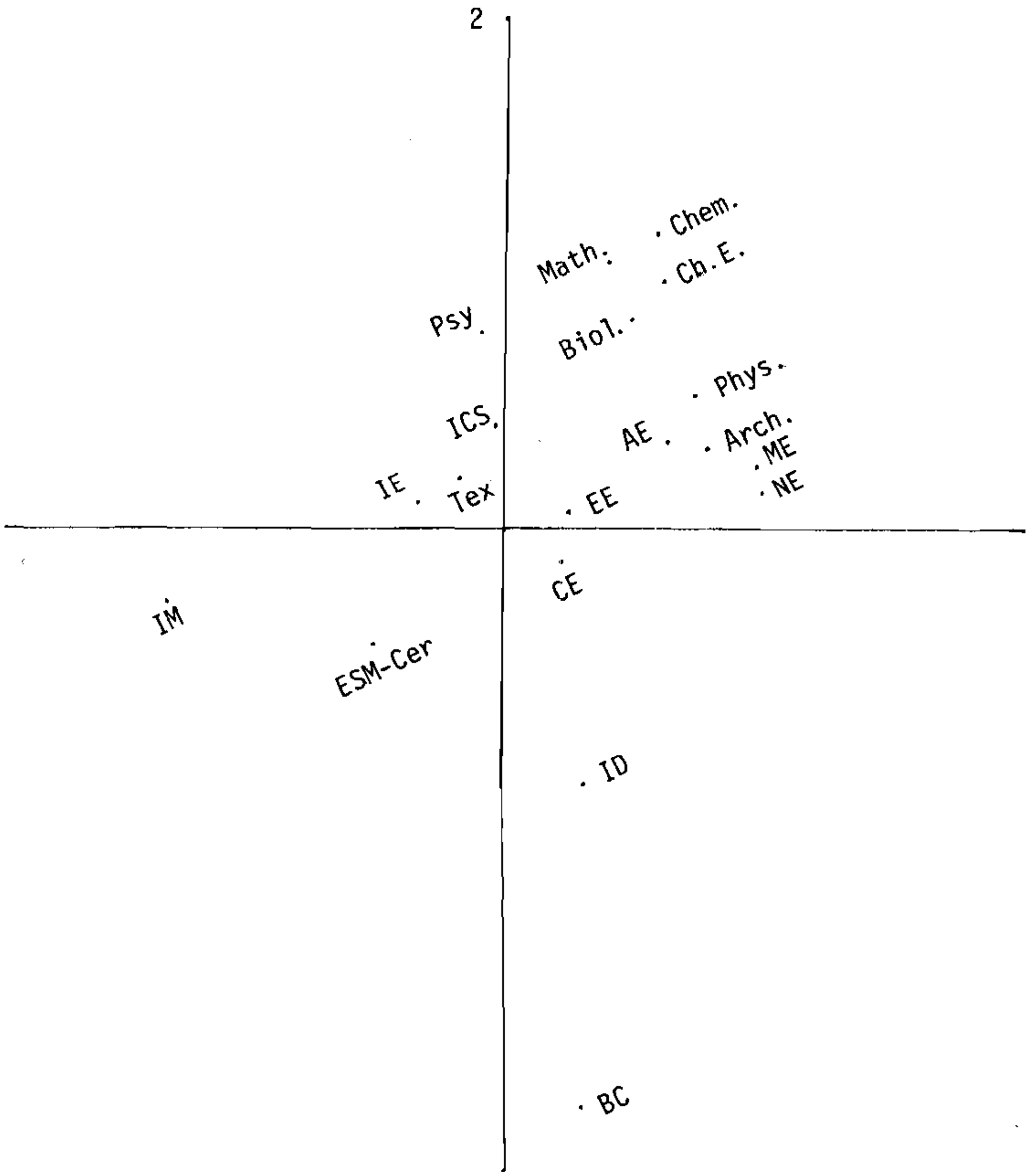


Figure 9. Discriminant Scores for Males by Major.

Table 4. Correlation of Each Variable with Discriminant Functions 1 and 2

		1	2
1.	Realistic	.26	-.52
2.	Intellectual	.39	.33
3.	Social	-.25	.26
4.	Conventional	-.48	-.22
5.	Enterprising	-.59	-.24
6.	Artistic	.16	-.03
7.	Self-control	-.14	.04
8.	Mf	.00	.06
9.	Status	.50	.30
10.	Infrequency	.26	.06

CHAPTER IV

DISCUSSION

Limitations of This Study

This thesis makes a contribution to some areas of the vocational interest literature. It is in order, however, to point out that sweeping generalizations should not be drawn from the results. Because of the small sample sizes in many cells it is possible that the samples obtained are not representative of all students in those majors. Also, the lack of demographic diversity of the sample makes regional differences a possibility. One should also not reify such scale names as "intellectual" or "conventional," etc. These are operationally defined as scores on certain sets of items which may not match most people's concept of "intellectuality" or "conventionality," etc.

Test of Hexagonal Model

Holland, Whitney, Cole, and Richards (1969) state the hexagonal model has been tried on ten different samples successfully. They do not specify their criterion of success, but correct ordering of the variables around the hexagon would be the most global and obvious criteria for such a model. Because this criterion has never been disconfirmed in a published study the model must be considered roughly appropriate. The demonstrations of Nafziger and Helms (1974) show that it accounts for much of the vocational interest domain and make it even more important. The results of this thesis also confirm this circumplical ordering for these variables.

Between-All-Majors Analysis

The relevant MANOVA results for the all-majors analysis were supportive of the hypotheses of the thesis. The effect of majors (M) definitely reaches a level of significance that indicates diversity in what might be considered a homogeneous population. Not only diversity is suggested, but also that diversity varies systematically with major.

Sex (S) factor differences also reach a high level of significance. These indicate separate norms are needed for females for these fields. In some areas they are not available. The statement of Hornaday and Kuder (1961) that only empirical study can determine whether a key developed for men is applicable for women is brought to mind.

The fact that the SXM interaction is significant is also important since sex differences can be more serious for the establishment of norms if sex differences vary across majors. This means such differences cannot be adjusted for by additive constants, associated with an effect. Now, the number of significant univariate $\underline{F}$ tests is a measure of an effect's importance. In this instance, the univariate tests of interaction were significant only on the variables <u>artistic</u> and <u>masculinity</u>. so interactions are of minor importance with most of the variables only differing by an additive constant if they differ at all.

Between-Colleges Analysis

The between-college analysis differed in an important way from the previous analysis. No interaction effect was found between sex and college. Thus, the differences between cells in this sample can be attributed to the separate effects of college and sex rather than to nonlinear effects as would be indicated by an interaction.

Between-Majors-Within-Engineering-College Analysis

There are reasons for expecting the engineering college sample to be more homogeneous than the sample at large. Many required courses are shared by all majors in this college and an Ortgeist of engineering methodology is also shared. On the other hand, there are reasons for expecting diversity. One of these reasons is Holland's four letter type classification which is sensitive to differences among different kinds of engineers on some samples (Abe and Holland, 1969). The results of this analysis bear on the question of diversity of vocational preference profiles across engineering majors. Another value of this analysis lies in the fact that the engineering area is one in which so few women have previously enrolled. Thus, both the major and sex effects were of special interest here. The fact that both effects are significant indicates a great deal of diversity which varies systematically with major and sex. The significant sex by major interaction indicates sex differences are different across the majors. However, this is only true for the scales artistic and intellectual. For those two scales a constant increment would not account for sex differences across these majors.

Between-Majors-Within-General-College Analysis

In the General College both sex (S) effect and major (M) effect are significant. The M effect and S effect are of interest as within the Engineering College because of the homogeneity-heterogeneity issue raised in this thesis. Actually, a great deal of diversity varying systematically with sex and major is indicated.

The SXM interaction does not reach significance, however. This is in contrast to both of the MANOVA analyses with the factor of major. Thus, in this subgroup a constant increment can account for sex differences.

Methods-of-Sampling Analysis

The lack of a significant methods-of-sampling effect in the study of female subjects suggests differences in methods of sampling need not be seriously considered in interpreting sex differences in the other analyses. This was especially important since interests of the type measured by the Holland VPI were a plausible explanation for the subjects in the psychology classes having signed up for psychology as an elective.

The presence of a significant sex effect in the analysis of data collected from psychology classes shows that sex effects found in the other analyses were likely not due to sampling methods.

Discriminant Analysis

The discriminant analysis provided additional results by pointing out similarities between majors in different colleges. Thus, the results showed that for females, nuclear engineering and information and computer science were very close together although they are in different intracampus colleges. These graphical representations also clearly show sex differences. Note that only two of the significant discriminant functions are plotted, whereas in the all-major analysis several more were available.

Sex Differences in Majors Traditionally Chosen by Men

This thesis sheds light on sex differences in majors usually chosen by men. Seder (1940) concluded from a limited study that in medicine and life insurance sales, sex differences were small. Perry and Cannon (1967) found substantial agreement with male norms for female computer programmers. Some scales showed a difference, however. Cole (1973) found that interests of both sexes within an occupation were similar as compared to a non-occupationally-related reference group, but that sex differences did still exist.

This recapitulation of other's results shows a pattern that may be applied to the interpretation of the present results. This pattern is: substantial agreement across sexes with significant differences on several scales. Men and women in technical, managerial, and scientific fields may be roughly similar as compared to groups not connected with these fields, but within these professional fields there are sex differences. Females would be shortchanged if separate norms were not provided for them.

The importance of reference groups should be noted especially. Usually separate male and female norms are used. Thus, females in this sample are in the eighty-second percentile on female norms on the scale realistic yet the male norm would place them at the forty-second percentile. This type of reference-group analysis shows that differences in the present sample are smaller than in the norm sample $N = 6{,}270$ (Abe and Holland, 1965). This is probably due to the fact that the national norms do not contain men and women drawn from equivalent fields. So the question, "Different from which reference group?" must always be considered.

Summary of Hypotheses Accepted and Rejected

In summary, the following hypotheses were accepted or rejected in this thesis:

Hypothesis 1. Students in different majors have different profiles on the VPI. This hypothesis was accepted in this study on the basis of the MANOVA results in the Between-All-Majors analysis.

Hypothesis 2. Within colleges that have more than one major students in different majors will show different profiles on the VPI. This hypothesis was accepted in this study on the basis on the MANOVA results

Hypothesis 3. Differences between sexes will be found in each analysis (entire sample of twenty majors, or between colleges, or majors within colleges that have more than one major.) This hypothesis was accepted in this study on the basis of the MANOVA results in every analysis. In every case the sex differences were significant.

Hypothesis 4. Differences will be found between intracampus colleges on the VPI profiles. This hypothesis was accepted in this study on the basis of the MANOVA results in the Between-Colleges Analysis.

Hypothesis 5. Differences found between sexes will vary across colleges, across all majors, or across majors within colleges having more than one major on VPI profiles. The results in this area were not as clear as with the other hypotheses. This hypothesis would be accepted only if a significant SXM interaction were present in each of the MANOVA analyses. Actually, the interaction was only significant in the Between-All-Majors Analysis, and in the Between-Majors-Within-General College Analysis. Thus, there is some doubt about the existence of non-constant or non-linear sex differences in this sample.

Conclusion and Recommendation

Guidance Uses

Vocational interest inventories are often used for guidance purposes. They work on the principle that a person should be guided into groups whose members' interests maximally resemble his own. Since the majors are different on VPI profiles, it is possible that the VPI could be used for guidance in the population. However, a larger sample would be desirable to assure the most accurate possible representation of the reference population. A periodic update is also in order since the population at the Georgia Institute of Technology is changing so rapidly with regard to its sex composition. Future work on this subject should utilize a new Seventh Revision of the VPI in which efforts are being made to minimize sex differences.*

Culture and Personality Interpretations

This thesis does not deal with the genesis of the vocational choice behavior. This question should certainly be systematically investigated, as it may be of great importance to our society.

The interplay of cultural restraints versus individual needs in the genesis of vocational choice is clearly evident in a retrospective look at the Crissy and Daniel (1939) study of women's vocational interest. In this factor analysis the factor accounting for most of the variance was called "Interest in Male Association." It included typical feminine roles like nurse, secretary, and housewife. Their factor naming implies a value judgement that authors today would be less likely to make. For instance, an environmental press theory would call these "Occupations Easily Available to Women." In any event both the samples available and likely interpretations of results have changed since Crissy and Daniel's pioneering work.

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*Refers to personal communication of John L. Holland.

Relevance to Psychological Theory

There are several aspects of psychological theory dealt with here. For one thing criterion-related validity has been demonstrated in making fine discriminations with the Holland VPI. As Kuder (1970) stated, without criterion validity, no vocational interest test is worthwhile. Since Nafziger and Helms (1974) have shown Holland's theory to be generalizable to other vocational interest tests, construct validity for the whole area of vocational interest is also gained.

As Holland (1966) was quoted in the introduction of this thesis, more data for women is needed to allow for a personality theory for women -- perhaps parallel to that usually derived for men. Some of that data has been provided by this thesis.

Finally, Holland's hexagonal model (Holland, Whitney, Cole, and Richards, 1969) has been found roughly to fit yet another set of data.

Suggestions for Future Research

There are several directions that future research could take. One direction would be to investigate the effect of acquiescence on VPI responses. Holland, Whitney, Cole, and Richards (1969) attributed the first component of their principal components analysis of the six scales to,"a general tendency to respond." If acquiescence were individually measured and partialled among the scales, perhaps components analysis would yield a more meaningful picture of the model.

Another line of research would be to answer Kuder's (1970) criticism of the use of occupational titles by a study of people of different ages to see how young a person the VPI can be effective with.

A further attempt at the test of the hexagonal model by components analysis might involve an analysis of the error correlation matrix as suggested by Lohnes (1966). This means that to test the structure of the six scales' interrelationships, the effects of irrelevant variables such as sex, age, or level of education would first be removed from the intercorrelation matrix by partial correlation. Relevant variables like choice of major would not be removed.

Because of the large numbers of females in this sample in fields of study not usually chosen by females, the data gathered could be used to extend other research findings like those of Cole (1973).

APPENDIX A

MEAN AND STANDARD DEVIATION OF EACH SEX AND ALL MAJORS ON THE VPI SCALES

MEANS AND STANDARD DEVIATIONS

FACTOR S	FACTOR M	OBS		REALISTIC	INTELLECT	SOCIAL	CONVENTION	ENTERPRISI	ARTISTIC	SELF CONTR
1	1	6 OBS	M	5.333	9.667	2.667	3.500	4.833	8.167	7.167
			SD	4.719	2.251	3.204	2.881	3.545	3.710	4.021
1	2	31 OBS	M	4.323	5.290	3.581	1.645	3.323	5.677	6.806
			SD	3.534	3.926	3.594	1.907	3.059	3.591	3.728
1	3	11 OBS	M	3.000	7.636	2.909	.727	2.727	4.909	8.182
			SD	2.828	4.178	1.868	1.009	2.724	3.859	4.143
1	4	7 OBS	M	8.714	3.571	1.714	2.857	3.571	6.000	5.429
			SD	4.309	1.512	2.628	2.478	3.505	4.761	3.047
1	5	6 OBS	M	3.833	8.667	4.500	2.833	2.500	6.167	6.333
			SD	3.371	4.676	4.764	3.764	3.391	4.579	5.125
1	6	24 OBS	M	5.125	5.708	2.917	2.792	3.542	4.667	7.583
			SD	3.069	4.389	3.229	2.604	2.536	4.752	3.513
1	7	7 OBS	M	2.571	8.000	1.714	1.286	1.714	5.286	5.857
			SD	1.902	4.761	1.380	1.380	2.215	5.648	3.761
1	8	28 OBS	M	3.893	5.143	1.536	1.750	2.286	2.500	7.857
			SD	3.119	3.135	1.551	2.048	2.016	2.938	3.699
1	9	16 OBS	M	1.875	4.875	2.108	3.312	2.375	4.375	9.312
			SD	2.187	4.410	2.762	3.321	2.500	4.129	3.260
1	10	4 OBS	M	2.750	1.250	1.250	.250	2.750	8.250	8.500
			SD	1.500	.957	1.500	.500	2.630	4.573	2.082
1	11	25 OBS	M	4.240	5.360	2.800	3.960	4.640	3.880	8.000
			SD	3.010	4.319	2.630	3.482	3.161	3.940	3.969
1	12	37 OBS	M	2.919	2.560	3.919	4.811	6.892	4.297	8.108
			SD	3.068	3.693	3.677	3.821	3.406	3.542	4.526
1	13	4 OBS	M	4.750	6.500	3.000	1.250	1.500	7.750	7.250
			SD	2.363	4.435	1.414	1.893	1.000	4.646	3.775
1	14	3 OBS	M	1.333	6.333	1.667	.667	.667	.667	11.333
			SD	1.528	4.933	2.082	.577	1.155	1.155	2.082
1	15	8 OBS	M	3.500	7.750	2.125	1.500	1.875	5.375	9.250
			SD	2.619	5.312	3.227	1.690	1.642	3.852	1.832
1	16	5 OBS	M	2.600	6.000	6.000	.800	2.200	5.000	5.400
			SD	2.510	5.244	5.339	1.304	2.588	4.528	3.362
1	17	5 OBS	M	3.200	4.200	2.200	1.000	1.800	.800	9.800
			SD	3.564	2.588	2.588	1.000	1.483	.837	3.768
1	18	12 OBS								

		M	6.083	7.667	1.833	1.917	2.167	3.667	8.083
		SD	3.579	4.119	2.167	2.746	2.980	3.750	4.100
1 19	2 OBS	M	7.000	7.000	7.000	7.000	7.000	7.000	7.000
		SD	.000	.000	.000	.000	.000	.000	.000
1 20	2 OBS	M	7.000	7.000	7.000	7.000	7.000	7.000	7.000
		SD	.000	.000	.000	.000	.000	.000	.000
2 1	2 OBS	M	5.500	9.000	1.500	5.500	5.500	3.000	9.000
		SD	.707	5.657	2.121	4.950	7.778	1.414	4.243
2 2	28 OBS	M	3.357	5.714	3.464	1.214	2.679	8.679	8.179
		SD	2.231	3.630	3.097	1.873	2.161	3.762	3.175
2 3	19 OBS	M	2.105	8.000	4.000	.737	2.105	5.474	8.263
		SD	1.049	3.018	2.789	.872	2.233	3.949	3.998
2 4	3 OBS	M	4.333	2.000	3.333	2.000	2.333	.333	9.667
		SD	2.082	2.000	1.528	1.000	2.309	.577	5.859
2 5	8 OBS	M	2.125	9.000	3.000	1.750	2.250	6.125	8.500
		SD	.991	2.777	2.507	1.909	2.712	4.016	2.726
2 6	21 OBS	M	5.143	7.000	2.524	4.000	3.619	5.000	7.952
		SD	3.732	4.690	3.683	4.626	3.853	4.950	3.653
2 7	23 OBS	M	2.348	5.696	2.870	1.783	3.522	5.130	8.522
		SD	1.968	3.747	2.361	2.066	2.661	3.415	3.175
2 8	9 OBS	M	4.556	10.556	3.000	2.778	3.667	7.444	6.333
		SD	2.603	3.321	2.646	2.906	4.416	4.851	3.536
2 9	11 OBS	M	2.909	6.273	4.455	4.727	3.091	4.364	10.091
		SD	2.468	3.319	4.525	3.580	2.508	3.931	3.048
2 10	7 OBS	M	3.857	5.000	1.857	.857	2.571	9.571	9.571
		SD	3.848	3.367	1.574	1.574	2.070	2.936	2.507
2 11	27 OBS	M	1.815	4.889	5.259	3.222	3.963	4.000	8.630
		SD	1.981	3.945	3.537	3.130	2.244	4.243	3.410
2 12	54 OBS	M	1.852	3.759	4.852	4.389	5.426	4.611	10.074
		SD	2.260	3.325	3.683	3.542	2.826	4.227	3.375
2 13	25 OBS	M	2.520	5.320	4.360	4.080	3.080	4.240	9.160
		SD	2.931	3.705	4.172	3.673	2.999	4.003	3.313
2 14	3 OBS	M	3.667	7.667	4.667	3.333	2.667	3.000	8.000
		SD	2.309	6.658	3.512	4.933	2.082	5.196	3.000
2 15	5 OBS	M	2.200	9.400	1.800	1.400	1.600	4.400	10.800
		SD	1.789	3.209	1.643	1.140	1.817	2.074	3.114
2 16	16 OBS	M	2.437	7.062	7.375	1.187	2.500	7.625	7.625
		SD	1.999	4.358	3.074	1.471	1.789	4.843	3.222
2 17	9 OBS								

		M	1.111	4.778	1.444	1.222	2.667	5.667	9.778
		SD	1.269	4.738	1.667	1.563	2.000	5.454	3.563
2 18	10 OBS								
		M	5.000	5.300	1.900	4.000	3.300	6.800	8.500
		SD	3.496	4.111	2.885	3.771	2.359	5.181	4.353
2 19	3 OBS								
		M	4.000	10.333	3.667	1.000	2.000	5.000	5.000
		SD	2.000	1.155	4.619	.000	2.000	1.000	2.646
2 20	3 OBS								
		M	5.333	4.000	4.667	2.000	5.667	1.667	2.667
		SD	4.933	2.000	4.726	2.646	2.517	2.887	3.055

MEANS AND STANDARD DEVIATIONS

FACTOR S	FACTOR M	OBS		MASCULINIT	STATUS	INFREQUE	ACQUIESEN
1	1	6 OBS	M	8.833	7.500	4.167	14.000
			SD	2.639	2.665	3.061	4.733
1	2	31 OBS	M	6.968	7.065	3.742	10.742
			SD	2.652	2.394	2.294	5.341
1	3	11 OBS	M	8.909	8.545	3.182	11.455
			SD	1.514	2.296	2.442	3.804
1	4	7 OBS	M	9.571	4.000	4.000	10.857
			SD	2.149	2.582	3.162	4.018
1	5	6 OBS	M	7.333	6.000	5.000	12.167
			SD	2.805	2.280	3.950	7.223
1	6	24 OBS	M	9.167	7.167	4.375	12.167
			SD	1.857	2.531	2.163	4.669
1	7	7 OBS	M	8.714	6.571	4.000	9.714
			SD	1.799	2.699	1.915	3.352
1	8	28 OBS	M	9.107	6.714	4.071	9.321
			SD	1.618	1.960	2.124	3.811
1	9	16 OBS	M	7.750	7.312	4.625	8.375
			SD	2.017	2.387	2.778	3.649
1	10	4 OBS	M	7.750	6.500	5.250	7.750
			SD	1.500	1.291	1.258	1.258
1	11	25 OBS	M	9.160	7.760	5.480	11.200
			SD	2.897	2.437	3.057	5.000
1	12	37 OBS	M	8.459	9.351	5.892	11.189
			SD	1.643	2.474	2.923	5.773
1	13	4 OBS	M	7.750	7.500	3.750	11.250
			SD	2.872	3.512	2.363	4.349
1	14	3 OBS	M	9.333	7.333	5.000	7.000
			SD	.577	1.155	2.646	3.000
1	15	8 OBS	M	7.875	8.375	4.000	9.875
			SD	2.167	1.685	2.070	3.834
1	16	5 OBS	M	9.600	7.800	6.400	9.600
			SD	2.608	1.304	3.130	5.505
1	17	5 OBS	M	9.400	5.800	5.800	8.400
			SD	2.074	2.387	3.033	3.782
1	18	12 OBS					

		M	8.333	5.833	4.333	9.167
		SD	2.270	2.623	2.348	5.340
1 19	2 OBS					
		M	7.000	7.000	7.000	7.000
		SD	.000	.000	.000	.000
1 20	2 OBS					
		M	7.000	7.000	7.000	7.000
		SD	.000	.000	.000	.000
2 1	2 OBS					
		M	10.500	11.000	8.000	14.000
		SD	.707	2.828	8.485	1.414
2 2	28 OBS					
		M	5.464	7.321	3.893	10.286
		SD	2.349	2.342	1.969	3.989
2 3	19 OBS					
		M	6.474	8.263	4.684	11.368
		SD	1.712	1.284	2.709	2.910
2 4	3 OBS					
		M	7.000	4.667	5.000	10.000
		SD	2.646	3.055	4.583	2.646
2 5	8 OBS					
		M	7.750	8.000	3.625	10.625
		SD	1.581	2.507	1.506	2.722
2 6	21 OBS					
		M	8.190	7.524	5.286	10.762
		SD	1.940	2.926	3.036	6.503
2 7	23 OBS					
		M	7.870	8.043	4.522	10.391
		SD	2.668	2.383	2.428	2.996
2 8	9 OBS					
		M	7.556	7.000	2.333	13.111
		SD	2.007	3.041	1.936	3.551
2 9	11 OBS					
		M	7.818	8.091	4.455	11.818
		SD	2.089	1.640	2.252	4.070
2 10	7 OBS					
		M	5.714	6.857	4.286	9.571
		SD	.951	2.268	2.498	2.225
2 11	27 OBS					
		M	6.185	8.000	4.222	10.074
		SD	2.481	2.617	2.665	3.452
2 12	54 OBS					
		M	6.519	9.944	5.667	10.130
		SD	2.081	2.218	2.828	4.762
2 13	25 OBS					
		M	5.960	8.120	5.000	9.720
		SD	2.541	2.522	2.799	5.296
2 14	3 OBS					
		M	7.333	8.667	2.333	10.667
		SD	2.517	2.887	.577	4.041
2 15	5 OBS					
		M	7.600	7.000	5.800	10.000
		SD	1.140	2.345	2.588	3.391
2 16	16 OBS					
		M	4.562	8.562	3.937	13.125
		SD	3.054	1.999	2.407	4.241
2 17	9 OBS					

		M	7.111	6.556	4.778	7.333
		SD	4.045	2.789	4.024	4.472
2 18	10 OBS					
		M	6.600	6.900	5.500	10.500
		SD	2.171	2.132	2.677	4.089
2 19	3 OBS					
		M	6.000	3.667	2.667	9.667
		SD	1.000	4.041	3.786	3.055
2 20	3 OBS					
		M	9.000	5.333	4.333	11.333
		SD	2.646	2.517	2.082	3.512

APPENDIX B

RESULTS OF BETWEEN-ALL-MAJORS ANALYSIS

TEST OF SM

TESTS OF SIGNIFICANCE USING WILKS LAMBDA CRITERION AND CANONICAL CORRELATIONS

TEST OF ROOTS	F	DFHYP	DFERR	P LESS THAN	R
1 THROUGH 11	1.339	209.000	4609.240	.001	.346
2 THROUGH 11	1.198	180.000	4554.809	.039	.329
3 THROUGH 11	1.036	153.000	4491.308	.365	.278
4 THROUGH 11	.927	128.000	4417.172	.710	.245
5 THROUGH 11	.839	105.000	4330.919	.880	.231
6 THROUGH 11	.728	84.000	4230.721	.970	.190
7 THROUGH 11	.662	65.000	4114.448	.983	.170
8 THROUGH 11	.600	48.000	3979.637	.987	.152
9 THROUGH 11	.528	33.000	3823.485	.988	.146
10 THROUGH 11	.344	20.000	3642.858	.997	.095
11 THROUGH 11	.274	9.000	3434.359	.982	.071

	UNIVARIATE F TESTS			STANDARDIZED DISCRIMINANT FUNCTION COEFFICIENTS	
VARIABLE	F(19, 489)	MEAN SQ	P LESS THAN	1	2
REALISTIC	1.091	8.338	.356	.317	.512
INTELLECT	1.293	19.034	.182	.402	-.504
SOCIAL	.855	8.639	.641	-.185	-.651
CONVENTION	1.252	10.349	.211	.470	.089
ENTERPRISI	1.047	8.019	.404	.085	.058
ARTISTIC	1.880	30.687	.014	.873	.057
SELF CONTR	.846	10.985	.651	-.236	-.264
MASCULINIT	1.647	8.319	.042	-.219	.374
STATUS	.663	3.735	.856	.251	.444
INFREQUE	1.426	10.044	.109	-.001	.558
ACQUIESEN	.980	[illegible].011	.483	-1.312	.541

TEST OF S

TESTS OF SIGNIFICANCE USING WILKS LAMBDA CRITERION AND CANONICAL CORRELATIONS

TEST OF ROOTS	F	DFHYP	DFERR	P LESS THAN	R
1 THROUGH 1	9.641	11.000	479.000	.001	.426

	UNIVARIATE F TESTS			STANDARDIZED DISCRIMINANT FUNCTION COEFFICIENTS
VARIABLE	F(1, 489)	MEAN SQ	P LESS THAN	1
REALISTIC	11.918	91.097	.001	.520
INTELLECT	3.626	53.368	.057	-.546
SOCIAL	6.359	64.287	.012	-.109
CONVENTION	.413	3.411	.521	-.293
ENTERPRISI	.578	4.424	.448	.104
ARTISTIC	5.039	82.263	.025	-.057
SELF CONTR	8.779	113.983	.003	-.273
MASCULINIT	64.839	327.415	.001	.769
STATUS	4.737	26.681	.030	.054
INFREQUE	.333	2.346	.564	.103
ACQUIESEN	.090	1.840	.764	.128

TEST OF M

TESTS OF SIGNIFICANCE USING WILKS LAMBDA CRITERION AND CANONICAL CORRELATIONS

TEST OF ROOTS	F	DFHYP	DFERR	P LESS THAN	R
1 THROUGH 11	3.598	209.000	4609.240	.001	.610
2 THROUGH 11	2.669	180.000	4554.889	.001	.499
3 THROUGH 11	2.169	153.000	4491.308	.001	.416
4 THROUGH 11	1.822	128.000	4417.172	.001	.338
5 THROUGH 11	1.639	105.000	4330.919	.001	.317
6 THROUGH 11	1.421	84.000	4230.721	.007	.290
7 THROUGH 11	1.166	65.000	4114.448	.172	.269
8 THROUGH 11	.810	48.000	3979.637	.822	.208
9 THROUGH 11	.526	33.000	3823.465	.988	.138
10 THROUGH 11	.401	20.000	3642.858	.992	.102
11 THROUGH 11	.329	9.000	3434.359	.966	.078

	UNIVARIATE F TESTS			STANDARDIZED DISCRIMINANT FUNCTION COEFFICIENTS					
VARIABLE	F(19, 480)	MEAN SQ	P LESS THAN	1	2	3	4	5	6
REALISTIC	4.795	36.647	.001	.382	-1.029	-.111	-.093	-.556	.723
INTELLECT	4.061	71.556	.001	.348	.682	.319	-.418	.060	.230
SOCIAL	3.547	35.863	.001	-.140	.560	-.546	-.729	-.127	-.111
CONVENTION	5.639	46.690	.001	-.331	-.006	.395	-.227	.719	.553
ENTERPRISE	6.392	48.946	.001	-.559	-.327	-.154	-.203	-.039	-.643
ARTISTIC	2.600	42.445	.001	.293	-.256	-.455	.431	.373	-.117
SELF CONTR	1.906	24.743	.012	.230	-.166	.269	.383	.506	-.091
MASCULINIT	3.229	16.303	.001	-.014	-.001	.413	-.091	-.212	-.622
STATUS	6.247	35.184	.001	-.323	-.009	.020	.370	-.537	.794
INFREQUE	1.684	11.861	.035	-.182	.113	-.016	.135	-.515	.078
ACQUIESEN	1.200	24.500	.252	.011	.222	.618	.998	-.467	-.227

APPENDIX C

RESULTS OF BETWEEN-COLLEGE ANALYSIS

TEST OF CS

TESTS OF SIGNIFICANCE USING WILKS LAMBDA CRITERION AND CANONICAL CORRELATIONS

TEST OF ROOTS	F	DFHYP	DFERR	P LESS THAN	R
1 THROUGH 2	1.195	22.000	1026.000	.243	.176
2 THROUGH 2	.986	10.000	513.500	.454	.137

	UNIVARIATE F TESTS			STANDARDIZED DISCRIMINANT FUNCTION COEFFICIENTS
VARIABLE	F(2, 523)	MEAN SQ	P LESS THAN	1
REALISTIC	.690	5.717	.502	.631
INTELLECT	.433	6.781	.649	.442
SOCIAL	.773	8.261	.462	.482
CONVENTION	.605	5.503	.546	-.053
ENTERPRISI	3.097	23.979	.046	-.708
ARTISTIC	1.181	20.978	.308	-.307
SELF CONTR	1.157	15.206	.315	.480
MASCULINIT	.142	.791	.868	-.168
STATUS	.011	.063	.989	.350
INFREQUE	.216	1.542	.805	-.358
ACQUIESEN	1.393	28.658	.249	-.549

TEST OF S

TESTS OF SIGNIFICANCE USING WILKS LAMBDA CRITERION AND CANONICAL CORRELATIONS

TEST OF ROOTS	F	DFHYP	DFERR	P LESS THAN	R
1 THROUGH 1	10.118	11.000	513.000	.001	.422

	UNIVARIATE F TESTS			STANDARDIZED DISCRIMINANT FUNCTION COEFFICIENTS
VARIABLE	F(1, 523)	MEAN SQ	P LESS THAN	1
REALISTIC	16.562	137.158	.001	.553
INTELLECT	1.868	29.243	.172	-.494
SOCIAL	10.154	108.465	.002	-.146
CONVENTION	.094	.855	.759	-.266
ENTERPRISI	.291	2.254	.590	.075
ARTISTIC	5.982	106.232	.015	-.047
SELF CONTR	7.857	103.233	.005	-.198
MASCULINIT	71.439	397.828	.001	.775
STATUS	6.419	37.305	.012	.028
INFREQUE	.048	.341	.827	.008
ACQUIESEN	.007	.140	.934	.095

TEST OF C

TESTS OF SIGNIFICANCE USING WILKS LAMBDA CRITERION AND CANONICAL CORRELATIONS

TEST OF ROOTS	F	DFHYP	DFERR	P LESS THAN	R
1 THROUGH 2	12.331	22.000	1026.000	.001	.536
2 THROUGH 2	7.190	10.000	513.500	.001	.350

VARIABLE	UNIVARIATE F TESTS F(2, 523)	MEAN SQ	P LESS THAN	STANDARDIZED DISCRIMINANT FUNCTION COEFFICIENTS 1	2
REALISTIC	15.082	124.903	.001	.162	.858
INTELLECT	22.864	358.015	.001	.440	-.449
SOCIAL	8.720	93.150	.001	.058	-.484
CONVENTION	19.546	177.722	.001	-.174	-.319
ENTERPRISI	47.037	364.256	.001	-.677	.595
ARTISTIC	1.208	21.445	.300	.169	.145
SELF CONTR	4.786	62.881	.009	.154	.076
MASCULINIT	2.071	11.532	.127	.055	.129
STATUS	39.070	227.046	.001	-.396	-.193
INFREQUE	9.203	65.583	.001	-.171	-.213
ACQUIESEN	.263	5.403	.769	.047	-.337

APPENDIX D

RESULTS OF BETWEEN-MAJORS-WITHIN-ENGINEERING-COLLEGE ANALYSIS

TEST OF SM

TESTS OF SIGNIFICANCE USING WILKS LAMBDA CRITERION AND CANONICAL CORRELATIONS

TEST OF ROOTS	F	DFHYP	DFERR	P LESS THAN	R
1 THROUGH 11	1.480	132.000	2218.713	.001	.433
2 THROUGH 11	1.231	110.000	2134.654	.056	.388
3 THROUGH 11	.989	90.000	2036.361	.511	.334
4 THROUGH 11	.776	72.000	1921.935	.917	.271
5 THROUGH 11	.618	56.000	1789.410	.988	.196
6 THROUGH 11	.568	42.000	1636.904	.989	.185
7 THROUGH 11	.476	30.000	1462.834	.993	.162
8 THROUGH 11	.348	20.000	1266.227	.997	.114
9 THROUGH 11	.280	12.000	1047.081	.992	.090
10 THROUGH 11	.188	6.000	806.727	.980	.063
11 THROUGH 11	.019	2.000	548.000	.981	.012

	UNIVARIATE F TESTS			STANDARDIZED DISCRIMINANT FUNCTION COEFFICIENTS	
VARIABLE	F(12, 279)	MEAN SQ	P LESS THAN	1	2
REALISTIC	1.129	9.985	.336	.409	.325
INTELLECT	1.845	27.750	.041	.289	-.732
SOCIAL	1.227	10.216	.264	-.444	-.740
CONVENTION	1.707	12.473	.065	.489	-.025
ENTERPRISI	1.061	8.368	.393	.106	-.017
ARTISTIC	2.389	38.727	.006	.894	-.214
SELF CONTR	1.015	12.973	.435	-.177	-.055
MASCULINIT	1.049	5.720	.404	-.050	.234
STATUS	.654	4.068	.795	.237	.376
INFREQUE	1.618	10.937	.086	.219	.509
ACQUIESENC	.922	17.639	.526	-.970	1.056

TEST OF S

TESTS OF SIGNIFICANCE USING WILKS LAMBDA CRITERION AND CANONICAL CORRELATIONS

TEST OF ROOTS	F	DFHYP	DFERR	P LESS THAN	R
1 THROUGH 1	4.667	11.000	269.000	.001	.400

	UNIVARIATE F TESTS			STANDARDIZED DISCRIMINANT FUNCTION COEFFICIENTS
VARIABLE	F(1, 279)	MEAN SQ	P LESS THAN	1
REALISTIC	6.310	55.811	.013	.513
INTELLECT	1.247	18.758	.265	-.422
SOCIAL	2.933	24.425	.088	-.061
CONVENTION	.290	2.119	.591	-.364
ENTERPRISI	.000	.000	.997	.046
ARTISTIC	7.683	124.546	.006	-.230
SELF CONTR	1.613	20.628	.205	-.174
MASCULINIT	34.140	186.072	.001	.751
STATUS	2.057	12.798	.153	.043
INFREQUE	.762	5.152	.383	.148
ACQUIESENC	.142	2.714	.707	.207

TEST OF M

TESTS OF SIGNIFICANCE USING WILKS LAMBDA CRITERION AND CANONICAL CORRELATIONS

TEST OF ROOTS	F	DFHYP	DFERR	P LESS THAN	R
1 THROUGH 11	2.563	132.000	2218.713	.001	.550
2 THROUGH 11	2.085	110.000	2134.654	.001	.459
3 THROUGH 11	1.777	90.000	2036.361	.001	.393
4 THROUGH 11	1.549	72.000	1921.935	.002	.350
5 THROUGH 11	1.328	56.000	1789.410	.054	.315
6 THROUGH 11	1.069	42.000	1636.904	.354	.284
7 THROUGH 11	.718	30.000	1462.834	.869	.218
8 THROUGH 11	.406	20.000	1266.227	.991	.117
9 THROUGH 11	.363	12.000	1047.081	.976	.089
10 THROUGH 11	.364	6.000	806.727	.902	.072
11 THROUGH 11	.380	2.000	548.000	.684	.053

	UNIVARIATE F TESTS			STANDARDIZED DISCRIMINANT FUNCTION COEFFICIENTS				
VARIABLE	F(12, 279)	MEAN SQ	P LESS THAN	1	2	3	4	5
REALISTIC	4.057	35.085	.001	.722	-.382	-.825	.332	-.325
INTELLECT	2.249	33.833	.010	-.403	.343	-.101	1.108	.089
SOCIAL	2.539	21.148	.003	-.342	.804	-.307	-.119	.165
CONVENTION	3.301	24.707	.001	-.400	-.234	-.131	.088	-.347
ENTERPRISI	2.151	16.960	.014	-.124	.435	-.298	-.374	.146
ARTISTIC	3.405	55.196	.001	.064	.091	.220	-.113	-.094
SELF CONTR	1.372	17.544	.179	.244	-.245	.283	-.068	.150
MASCULINIT	3.787	20.641	.001	-.202	-.356	.001	-.292	.578
STATUS	2.766	17.210	.001	-.217	-.214	.047	.375	-.772
INFREQUE	1.120	7.569	.343	.016	-.176	-.091	-.149	-.239
ACQUIESENC	1.458	27.903	.140	-.186	-1.080	.812	-.776	-.242

APPENDIX E

RESULTS OF BETWEEN-MAJOR-WITHIN-GENERAL-COLLEGE ANALYSIS

TEST OF SM

TESTS OF SIGNIFICANCE USING WILKS LAMBDA CRITERION AND CANONICAL CORRELATIONS

TEST OF ROOTS	F	DFHYP	DFERR	P LESS THAN	R
1 THROUGH 5	1.257	55.000	522.009	.110	.444
2 THROUGH 5	1.053	40.000	432.439	.387	.385
3 THROUGH 5	.846	27.000	333.677	.689	.287
4 THROUGH 5	.794	16.000	227.000	.691	.243
5 THROUGH 5	.806	7.000	114.000	.584	.217

	UNIVARIATE F TESTS			STANDARDIZED DISCRIMINANT FUNCTION COEFFICIENTS
VARIABLE	F(5, 122)	MEAN SQ	P LESS THAN	1
REALISTIC	1.231	6.712	.299	.924
INTELLECT	.251	3.966	.938	-.567
SOCIAL	.660	7.658	.654	-.409
CONVENTION	1.060	7.060	.386	-.449
ENTERPRISI	.466	2.887	.801	-.082
ARTISTIC	.874	14.763	.501	.332
SELF CONTR	.320	3.839	.900	.715
MASCULINIT	3.424	17.459	.006	.197
STATUS	1.010	4.663	.415	.393
INFREQUE	1.740	11.979	.130	-.816
ACQUIESENC	1.281	23.565	.277	.384

TEST OF S

TESTS OF SIGNIFICANCE USING WILKS LAMBDA CRITERION AND CANONICAL CORRELATIONS

TEST OF ROOTS	F	DFHYP	DFERR	P LESS THAN	R
1 THROUGH 1	2.628	11.000	112.000	.005	.453

	UNIVARIATE F TESTS			STANDARDIZED DISCRIMINANT FUNCTION COEFFICIENTS
VARIABLE	F(1, 122)	MEAN SQ	P LESS THAN	1
REALISTIC	2.094	11.444	.150	.797
INTELLECT	.746	11.684	.391	-.659
SOCIAL	2.166	25.120	.144	.034
CONVENTION	1.500	9.993	.223	-.381
ENTERPRISI	.162	1.000	.688	-.031
ARTISTIC	.004	.071	.949	.356
SELF CONTR	3.310	39.726	.071	-.195
MASCULINIT	12.279	62.606	.001	.774
STATUS	.924	4.262	.338	.210
INFREQUE	.139	.958	.710	-.308
ACQUIESENC	1.256	23.114	.265	-.420

TEST OF W

TESTS OF SIGNIFICANCE USING WILKS LAMBDA CRITERION AND CANONICAL CORRELATIONS

TEST OF ROOTS	F	DFHYP	DFERR	P LESS THAN	R
1 THROUGH 5	2.118	55.000	522.009	.001	.617
2 THROUGH 5	1.362	40.000	432.439	.075	.485
3 THROUGH 5	.806	27.000	333.677	.744	.325
4 THROUGH 5	.540	16.000	227.000	.924	.226
5 THROUGH 5	.364	7.000	114.000	.921	.148

	UNIVARIATE F TESTS			STANDARDIZED DISCRIMINANT FUNCTION COEFFICIENTS	
VARIABLE	F(5, 122)	MEAN SQ	P LESS THAN	1	2
REALISTIC	.414	2.255	.839	-.031	-.091
INTELLECT	2.962	46.750	.015	.022	.538
SOCIAL	3.935	45.637	.002	.637	-.778
CONVENTION	7.198	47.958	.001	-.915	-.436
ENTERPRISI	.360	2.227	.875	-.155	.361
ARTISTIC	1.230	20.792	.299	-.090	.020
SELF CONTR	2.379	28.557	.043	-.409	.613
MASCULINIT	1.558	7.942	.177	.047	.200
STATUS	.775	3.577	.570	.232	-.246
INFREQUE	.244	1.683	.942	.261	-.202
ACQUIESENC	1.202	22.126	.312	.245	.569

APPENDIX F

RESULTS OF METHOD OF SAMPLING ANALYSIS

TEST OF CS

TESTS OF SIGNIFICANCE USING WILKS LAMBDA CRITERION AND CANONICAL CORRELATIONS

TEST OF ROOTS	F	DFHYP	DFERR	P LESS THAN	R
1 THROUGH 2	1.268	22.000	566.000	.186	.251
2 THROUGH 2	.902	10.000	283.500	.532	.176

	UNIVARIATE F TESTS			STANDARDIZED DISCRIMINANT FUNCTION COEFFICIENTS
VARIABLE	F(2, 293)	MEAN SQ	P LESS THAN	1
REALISTIC	.231	1.509	.794	-.084
INTELLECT	.242	3.712	.785	-.822
SOCIAL	2.304	25.940	.102	.225
CONVENTION	.057	.564	.945	.026
ENTERPRISI	.645	4.062	.525	-.225
ARTISTIC	1.409	27.176	.246	.127
SELF CONTR	.368	4.351	.693	.290
MASCULINIT	.705	4.359	.495	.275
STATUS	.632	3.616	.532	.014
INFREQUE	3.628	26.076	.028	-.672
ACQUIESENC	3.452	62.715	.033	.889

TEST OF S

TESTS OF SIGNIFICANCE USING WILKS LAMBDA CRITERION AND CANONICAL CORRELATIONS

TEST OF ROOTS	F	DFHYP	DFERR	P LESS THAN	R
1 THROUGH 1	1.525	11.000	283.000	.122	.237

	UNIVARIATE F TESTS			STANDARDIZED DISCRIMINANT FUNCTION COEFFICIENTS
VARIABLE	F(1, 293)	MEAN SQ	P LESS THAN	1
REALISTIC	.432	2.825	.511	-.016
INTELLECT	.005	.031	.942	.214
SOCIAL	8.089	100.095	.003	-.642
CONVENTION	.011	.104	.918	-.007
ENTERPRISI	.003	.021	.957	.520
ARTISTIC	1.154	22.261	.284	.071
SELF CONTR	.020	.231	.889	.053
MASCULINIT	3.368	20.833	.067	.238
STATUS	4.438	25.388	.036	-.582
INFREQUE	2.199	15.802	.139	.342
ACQUIESENC	1.886	34.257	.171	-.112

N. B. This is a test of sampling method within female sample.

TEST OF C

TESTS OF SIGNIFICANCE USING WILKS LAMBDA CRITERION AND CANONICAL CORRELATIONS

TEST OF ROOTS	F	DFHYP	DFERR	P LESS THAN	R
1 THROUGH 2	6.744	22.000	566.000	.001	.513
2 THROUGH 2	4.948	10.000	283.500	.001	.395

	UNIVARIATE F TESTS			STANDARDIZED DISCRIMINANT FUNCTION COEFFICIENTS	
VARIABLE	F(2, 293)	MEAN SQ	P LESS THAN	1	2
REALISTIC	9.217	60.254	.001	.001	.643
INTELLECT	10.177	155.851	.001	.394	-.384
SOCIAL	5.867	66.061	.003	-.114	-.393
CONVENTION	8.375	82.922	.001	-.116	-.112
ENTERPRISI	20.778	150.083	.001	-.688	.620
ARTISTIC	1.849	35.667	.159	.157	.409
SELF CONTR	6.086	71.949	.003	-.012	.133
MASCULINIT	1.361	8.421	.258	.004	.253
STATUS	22.667	129.687	.001	-.483	-.271
INFREQUE	5.188	37.284	.006	-.018	-.378
ACQUIESENC	.487	8.842	.615	.342	-.543

APPENDIX G

RESULTS OF BETWEEN-COLLEGE-ANALYSIS WITHOUT MAILBOX SAMPLE

TEST OF CS

TESTS OF SIGNIFICANCE USING WILKS LAMBDA CRITERION AND CANONICAL CORRELATIONS

TEST OF ROOTS	F	DFHYP	DFERR	P LESS THAN	R
1 THROUGH 2	1.095	22.000	940.000	.345	.181
2 THROUGH 2	.821	10.000	470.500	.609	.131

	UNIVARIATE F TESTS			STANDARDIZED DISCRIMINANT FUNCTION COEFFICIENTS
VARIABLE	F(2, 480)	MEAN SQ	P LESS THAN	1
REALISTIC	.350	3.043	.699	.635
INTELLECT	.326	5.138	.726	.179
SOCIAL	1.074	10.825	.342	.765
CONVENTION	.469	4.251	.626	-.115
ENTERPRISI	2.057	16.357	.129	-.711
ARTISTIC	1.545	27.202	.214	-.411
SELF CONTR	.728	9.735	.484	.546
MASCULINIT	.153	.840	.858	-.050
STATUS	.067	.398	.935	.341
INFREQUE	.578	4.130	.561	-.465
ACQUIESENC	.260	5.609	.764	-.313

TEST OF S

TESTS OF SIGNIFICANCE USING WILKS LAMBDA CRITERION AND CANONICAL CORRELATIONS

TEST OF ROOTS	F	DFHYP	DFERR	P LESS THAN	R
1 THROUGH 1	8.737	11.000	470.000	.001	.412

	UNIVARIATE F TESTS			STANDARDIZED DISCRIMINANT FUNCTION COEFFICIENTS
VARIABLE	F(1, 480)	MEAN SQ	P LESS THAN	1
REALISTIC	14.727	124.889	.001	.523
INTELLECT	1.695	27.194	.194	-.524
SOCIAL	4.844	48.808	.028	-.119
CONVENTION	.102	.927	.749	-.241
ENTERPRISI	.528	4.198	.468	.056
ARTISTIC	3.624	63.807	.058	.007
SELF CONTR	8.248	110.295	.004	-.216
MASCULINIT	61.550	337.667	.001	.802
STATUS	3.671	21.693	.056	.045
INFREQUL	.015	.105	.904	-.036
ACQUIESENC	.074	1.535	.786	.088

TEST OF C

TESTS OF SIGNIFICANCE USING WILKS LAMBDA CRITERION AND CANONICAL CORRELATIONS

TEST OF ROOTS	F	DFHYP	DFERR	P LESS THAN	R
1 THROUGH 2	11.493	22.000	940.000	.001	.537
2 THROUGH 2	6.842	10.000	470.500	.001	.357

	UNIVARIATE F TESTS			STANDARDIZED DISCRIMINANT FUNCTION COEFFICIENTS	
VARIABLE	F(2, 486)	MEAN SQ	P LESS THAN	1	2
REALISTIC	15.565	131.991	.001	.212	-.900
INTELLECT	20.737	332.725	.001	.497	.475
SOCIAL	9.844	99.186	.001	.076	.652
CONVENTION	18.975	171.968	.001	-.193	.261
ENTERPRISI	46.156	367.082	.001	-.641	-.557
ARTISTIC	.405	7.132	.667	.161	-.134
SELF CONTR	3.877	51.880	.021	.096	-.067
MASCULINIT	1.276	6.999	.280	.046	-.028
STATUS	37.572	222.039	.001	-.363	.137
INFREQUE	5.684	40.629	.004	-.094	.147
ACQUIESENC	.426	8.882	.653	-.103	.163

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