

PREDICTING ACHIEVEMENT IN  
THE SCHOOL OF AGRICULTURE

by

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## TABLE OF CONTENTS

INTRODUCTION . . . . .	1
PROCEDURE . . . . .	5
Method of Data Collection . . . . .	5
Measures of Psychological Characteristics . . . . .	5
Criterion . . . . .	11
RESULTS AND DISCUSSION . . . . .	12
Personal Data . . . . .	12
Psychological Characteristics . . . . .	14
Psychological Characteristics and Achievement . . . . .	25
Combination of Predictors . . . . .	30
SUMMARY. . . . .	32
ACKNOWLEDGMENTS. . . . .	37
BIBLIOGRAPHY . . . . .	38

## INTRODUCTION

The purpose of this study<sup>1</sup> is twofold: first, to describe an entering freshman class in the School of Agriculture, Kansas State College, in terms of objective measures of aptitude, interest, personality, and attitude; and second, to determine which, if any, of these objective measures or combination of measures can be used as predictive indices for differentiating between successful and unsuccessful freshmen in agricultural curricula in their first semester in residence.

Although a great many investigations concerned with the problem of predicting success in particular curricula have been made, only a few have been concerned with the prediction of college achievement in agricultural curricula. These latter studies have assessed only a limited range of psychological characteristics and have placed major emphasis on scholastic aptitude and achievement variables as predictors.

The University of Minnesota studies of Freeman and Johnson (3), published in 1942, furnish a prototype for research in this general area. Their study of 68 freshmen enrolled in the Division of Agriculture of the College of Agriculture, Forestry and Home Economics, during the year of 1936-37, revealed that the Johnson Science Application test was the best single predictor ( $r = .54$ ) of first year honor point ratio. The next best predictors were the high school percentile rank ( $r = .46$ ), Cooperative Algebra test ( $r = .42$ ) and the College Aptitude Test ( $r = .31$ ). A multiple correlation coefficient of .61 was obtained from the combination of these four predictor variables.

McGehee (9) in 1943 reported the results of his examination of the

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<sup>1</sup>This investigation was supported as a part of Project #406, Agricultural Experiment Station, Dean A. D. Weber, Director.

predictive value of three psychological tests for the various curricula at North Carolina State College of Agriculture and Engineering. For 199 freshmen enrolled in the agricultural curricula, using as a criterion grades converted into a point-average ratio, he found the American Council on Education Psychological Examination's total score correlated .34, the Cooperative English Test .34, and the Cooperative Mathematics Test .27. The multiple correlation obtained for the three tests was .41.

Hertel and DiVesta (5) evaluated five variables in predicting the success of students entering the New York College of Agriculture. They found that the high school grade average was the best single predictor ( $r = .525$ ) of college first term grade average. The most useful test in the battery was the Ohio State University Psychological Examination. For agricultural science students, the following correlations were found between test scores and college first term grade averages: Ohio State Psychological Test, .478; Cooperative Natural Science Test, .295; and Cooperative Mathematics Test, .233. The corresponding correlations for the general agriculture students were: Ohio State University Psychological Test, .46; Cooperative Natural Science Test, .361; and Cooperative Mathematics Test, .294.

The significance of the more familiar variables such as linguistic and quantitative ability, and scientific aptitude have been established by these studies. However, there have been no studies of the personality characteristics of agriculture majors, and according to Stuit, et al. (11) in a summary of prediction studies in professional schools, only one published report of measured vocational interests. In this study, Mathison (8) found that the results obtained from the Strong Vocational Interest Test could not be used as a reliable predictor of success in an agricultural college training pro-



gram. Stuit et al. (11), p. 132, point out, however, an interest inventory may be useful as a predictive measure:

.....in a counseling situation - to verify the claimed interest of the counselee by ascertaining the extent to which his interests resemble those of individuals already engaged in the field of agriculture. The interest inventory may, therefore, be used in a supplementary role, provided other measures seem to indicate that the counselee possesses the requisite abilities and aptitudes for agricultural training.

Only one study has reported on the contribution of attitudinal and motivational factors. DiVesta, et al. (2), extending the study previously reported (5), included the Johnson Science Application Test and a locally devised measure of motivation as part of their revised test battery. The most promising finding of this study was the potential usefulness for prediction of this measure of motivation.

The Orientation Inventory, as the measure was called, contained seventeen multiple choice items. Each item produced a score that could be valued from one to five, one indicating that the factor would not hinder the individual's achievement and five indicating that the factor would hinder achievement considerably. In its complete form, the Inventory correlated  $-.22$  with the first term grade point average. The negative correlation is a function of the scoring method.

An item analysis was made of the student responses to the 17 items. Five of the items were found to significantly differentiate between the more successful and less successful students, and five other items tended toward significance. Seven of these items were then combined to yield a part-score of the Inventory. Of the seven items, two referred to the individual's satisfaction with his present course of study. Two dealt with the time spent in extra-curricula activities and two others dealt with study habits and note taking ability. Only one of the items dealt with the adjustment of the in-

dividual. The seven item part-score was found to correlate  $-.32$  with the criterion.

When the three most predictive measures of the test battery, Ohio State Psychological Test, Johnson Science Application Test and Part-Orientation Inventory Score, plus the high school grade average, were used as a team, a multiple correlation of  $.64$  with the criterion was obtained. Except for the high school grade average, the Orientation Inventory was found to add more to the correlation than any other variable in the study. The authors, in view of this evidence and the results of the item analysis of the Inventory, conclude that:

.....a test, with items centered about the areas of motivation, adjustment, and study habits, in that order of importance, should produce an instrument highly useful in the prediction of academic success. (2)  
p, 347.

A limitation on this finding was the failure to cross-validate the Orientation Inventory on a group different from the standardization group.

The problem of this study is:

1. To determine objectively certain psychological characteristics of 220 entering freshmen in the School of Agriculture and to compare their status with relevant norm groups.
2. To determine the relationship between these measured characteristics and first semester grade point average at Kansas State College.

Particular emphasis was placed upon the investigation of motivational, attitudinal, interest and personality factors in this investigation.

## PROCEDURE

### Method of Data Collection

In the fall of the school year 1954-55 the following tests were administered to all entering freshmen in the School of Agriculture: Iowa Test of Educational Development #6 - Ability to Interpret Reading Materials in the Natural Sciences, Brown-Holtzman Survey of Study Habits and Attitudes, California Psychological Inventory, Strong Vocational Interest Test. In addition, a biographical data sheet was completed by each of the students and the scores on the American Council on Education Psychological Examination, 1952 Edition, Cooperative English Test, Form Y, and the Cooperative Reading Test were obtained from the Student Counseling Center. The tests were administered in two sessions by staff members of the Student Counseling Center.

A total of 247 freshmen males were involved in the testing program. This number was reduced by the exclusion of 19 students who had transferred to Kansas State from another college, yet were still classified as freshmen. One student was omitted from the study for not having completed a minimum of 10 semester hours for the fall semester, seven students were not included for whom all data were not complete. Complete data was obtained for a total of 220 male students.

### Measures of Psychological Characteristics

The California Psychological Inventory was selected to provide personality data for the study. It was chosen in preference to other measures of personality and motivation because of the apparent relevance of some of its

scales to the variables involved in academic achievement. Gough (4), p. 1, author of the Inventory, states:

The California Psychological Inventory was created in the hope of attaining two goals of personality assessment. The first goal, largely theoretical in nature, has been to use, and to develop, descriptive concepts which possess broad personal and social relevance. Many of the standard personality tests and assessment devices designed for use in special settings, such as the psychiatric clinic, or have been constructed so as to apply to a particular kind of problem, such as vocational choice. The present endeavor has been concerned with characteristics of personality which have a wide and pervasive applicability in reference to human behavior, and which in addition, are related to the favorable and positive aspects of personality rather than to the morbid and pathological.

The second goal for the CPI has been the practical one of devising brief, accurate and dependable subscales for the identification and measurement of the variable chosen for inclusion in the inventory. A further consideration has been that the instrument be convenient and easy to use, and suitable for large scale application.

The test is printed in booklets of 472 True-False items and contains 18 standard scales plus additional experimental special scales.

Three scales attempt to check on the validity or honesty of the responses which a person gives on the test. The Infrequency (In) scale indicates carelessness or falsification in answering. The Good Impression (Gi) scale attempts to identify persons capable of creating a favorable impression and the Dissimulation (Ds) scale attempts to identify persons tending to exaggerate their problems.

The other fifteen scales seek to assess directly some personality trait. One additional special scale, College Attendance (Cl), which was designed to differentiate between high school students who go on to college and those who do not, was included in this study.

The remaining scales and their purposes as taken from the "Preliminary Guide for the Use and Interpretation of the California Psychological Inventory" (4, pp. 3,4), are as follows:

<u>Name of Scale</u>	<u>Purpose</u>
1. Re (social responsibility)	To identify persons who will be seen by others as responsible and dependable.
2. To (tolerance)	To identify persons with permissive, accepting, and tolerant social beliefs and attitudes.
3. Fl (flexibility)	To indicate the degree of flexibility and adaptability of a person's thinking and social behavior.
4. St (social status)	To serve as an index or prediction of actual or potential social status. The scale attempts to measure some of the personal qualities which are usually correlated with status, but it is not, in itself, a direct measure of status.
5. Do (dominance)	To assess factors of leadership ability, dominance, and social initiative.
6. Sp (social participation)	To identify persons of outgoing, sociable, participative temperament.
7. Fe (femininity)	To assess the masculinity or femininity of interests. High scores are indicative of feminine interests.
8. De (delinquency)	To indicate the potentiality for delinquent, troublesome behavior, and the tendency to rebel against authority and convention.
9. Ie (intellectual efficiency)	To indicate the degree of personal and intellectual efficiency which the subject has attained.
10. Ac (academic achievement)	To identify those factors of interest and motivation which facilitate academic achievement at the high school level.



- |                                 |  |
|---------------------------------|--|
| 11. Hr (honor point ratio)      | To identify those factors of interest and motivation which facilitate scholastic achievement at the college undergraduate level.     |
| 12. Py (psychological interest) | To measure the similarity of a person's interests to those of advanced students and professional workers in the field of psychology. |
| 13. Sr (social presence)        | To assess factors such as poise, spontaneity, and self-confidence in personal and social interaction.                                |
| 14. Im (impulsivity)            | To assess factors such as impulsivity, self-centeredness, and lack of self-discipline in personal and social interaction.            |
| 15. Sa (self-acceptance)        | To assess factors such as sense of personal worth, self-acceptance and capacity for independent thinking and action.                 |

The reliability data for the California Psychological Inventory were collected by the author using the test-retest method on a group of 256 high school students. The reliability coefficients obtained ranged from .60 to .77 with the exception of two scales. The author qualifies this occurrence by stating:

All of the reliability coefficients are high enough to indicate that the scales may be taken as dependable measures, with two possible exceptions, the psychological interests scale, and the infrequency scale. The psychological factor may account for its tendency to fluctuate overtime. For the infrequency scale an adequate index of reliability is especially hard to derive because of the distribution of scores it yields. Almost everyone gets a score of zero, one, two, or three, with only a very few subjects scoring higher. This means that even the slightest chance fluctuation in answering (one or two questions) can lead to a great displacement in one's position in the total distribution of scores (4) p. 10.

Gough (4) has done extensive work in validating the various scales in the Inventory. The validity of most of the scales was determined by correlating them with subjective ratings of the individuals tested. However,

such scales as Intellectual Efficiency, Academic Achievement, and Honor Point Ratio have been correlated against objective criteria. Intellectual Efficiency correlated .49 with a standard test of intelligence in a sample of 461 high school students. Academic Achievement correlated .41 with high school grades for 1,138 girls, and .40 with grades for 867 boys. Honor Point Ratio correlated .38 with college grades in a sample of 917 students.

More detailed information as to the validity and reliability of the California Psychological Inventory can be found in the reference cited.

The measure of vocational interest selected was the Strong Vocational Interest Test for Men. The Strong Test determines whether an individual has interests similar to persons successfully engaged in a given occupation. It apparently measures one aspect of motivation (Strong, 10). It contains scales for 44 different occupations and three special scales.

The occupational scales that were selected for this study were: Physician, Veterinarian, Physicist, Engineer, Production Manager, Farmer, Vocational Agriculture Teacher, Forest Service Man, Y.M.C.A. Secretary, Musician, Office Man, Life Insurance Salesman and Lawyer. The scales Farmer, Veterinarian, Vocational Agriculture Teacher and Forest Service Man were chosen due to their evident relationship to the field of agriculture. The remaining scales were subjectively chosen, each as a representative of one of the eleven occupational groups. The choice was made primarily on the basis of choosing the scale in each occupational group which had the highest inter-correlation with the remaining scales in the group among a sample of 285 college seniors described by Strong (10). The three non-occupational scales, Interest Maturity, Occupational Level, and Masculinity-Femininity were also included.

The Brown-Holtzman Survey of Study Habits and Attitudes was chosen as

a suitable measure of study habits, motivation and attitude toward scholastic activities. According to the Manual (Brown-Holtzman, 1) the purposes of measure are: a) to identify students whose study habits are different from students who earn high grades, b) to aid in understanding students with academic difficulties, and c) to provide a basis for helping such students to improve their study habits and attitudes and thus more fully realize their best potentialities.

The Survey of Study Habits and Attitudes has met sufficient standards to establish its reliability and validity as a research tool. The numerous studies reported in the Manual (1) indicate that it has proved to be an effective predictor of academic achievement, if answered honestly and frankly. It is assumed that these conditions prevailed during its administration in this study. Also, the Survey's correlation with the ACE Psychological Examination is low enough to indicate that it is measuring factors other than mental ability.

The Iowa Test #6 - Ability to Interpret Reading Materials in the Natural Sciences was included in the test battery to determine the students' ability to think competently about scientific matters. The test is not designed to measure the student's store of scientific knowledge but rather how well he can use this knowledge in interpreting what he reads about scientific matters in the world today (7). From the evidence of previous studies, an ability of this nature appears relevant to success in agricultural curricula.

In order to have measures of scholastic aptitude, reading and English skills in the study, the test scores for the ACE Psychological Examination, 1952 Edition, and Cooperative English Test, Form Y, were obtained from the Student Counseling Center. The ACE provides subtest scores for Linguistic



and Quantitative ability and a total score representing general scholastic aptitude. The Cooperative English Test, Form Y, is divided into tests of expression and tests of reading comprehension. The expression tests yield scores for Mechanics of Expression and Effectiveness of Expression. The Reading Comprehension Test, which is a part of the Cooperative English Test, Form Y, provides three subtest scores: (1) Vocabulary Score, (2) Speed of Comprehension Score, (3) Level of Comprehension Score and a total Reading Score.

#### Criterion

The criterion used for the prediction section of this study was first semester grade point average. The grade point average at Kansas State College is computed by dividing the total grade points received for each semesters work by the total number of credit hours completed. Three grade points are assigned for each hour of credit at the grade of A, two for the grade of B, one for the grade of C, zero for each grade of D, and minus one for each grade of failure.

It was found that the mean grade point average of the 220 students involved in this study was .867. The percentage of students receiving the various grade point averages can be found in Table 1.

Table 1. Number and percentage of 220 agricultural freshmen receiving various grade point averages for the first semester.

Grade Point Average	Number	Percentage
-1.00 to -.49	9	4.1
-.49 to .00	24	10.9
.00 to .49	54	24.5
.50 to .99	30	13.6
1.00 to 1.49	50	22.7
1.50 to 1.99	28	12.7
2.00 to 2.49	17	7.7
2.50 to 2.99	7	3.2
3.00	1	.5
Total	220	

## RESULTS AND DISCUSSION<sup>1</sup>

### Personal Data

A biographical information sheet was completed by the 220 students. The data collected from this sheet included age, curriculum, present vocational goal, certainty of vocational goal and father's occupation.

It was found that 7.3 per cent were 17 years of age, 71.8 per cent were 18 years of age, 11.4 per cent were 19 years of age and the remaining 9.5 per cent were between 20 and 26 years of age.

<sup>1</sup>The statistical analysis of the data used in this study was performed by the Statistical Laboratory, Agricultural Experiment Station, Kansas State College.

The curriculum attracting the largest enrollment was general agriculture with 64.5 per cent of the students and, next, agricultural education with 14 per cent of the students. A large enrollment in general agriculture is expected since students planning on majoring in soils, agricultural economics, animal husbandry, dairy husbandry, entomology, horticulture and poultry husbandry, must spend their freshman and sophomore years in this curriculum before declaring their major. The complete list of the number of students enrolled in each curriculum is given in Table 2.

Table 2. Number of freshmen agriculture students enrolled in the various agricultural curricula.

Curriculum	⋮	Number
General Agriculture		142
Technical Agronomy		10
Agricultural Education		32
Dairy Manufacture		4
Agricultural Journalism		4
Landscape Design		5
Horticulture		2
Flour and Feed Milling		11
Agricultural Administration		10
Total		220

The responses to the question asking for the student's present vocational goals were separated into four categories: (1) those planning to enter farming; (2) those planning to enter occupations related to agricul-

ture, such as industry, government service and education; (3) those planning to enter occupations not related to agriculture; and (4) those who did not know. It was found that 54.5 per cent of the students planned to enter farming, 40.9 per cent planned to enter occupations related to agriculture, .4 per cent planned to enter occupations not related to agriculture and 4.2 per cent did not know.

The responses to the question asking for the occupation of the student's father was separated into the same categories as the question on the student's vocational goal, with the exception of the "do not know" category. It was found that 76.8 per cent of the fathers were engaged in farming, 7.2 per cent were in occupations related to agriculture, and 16 per cent were in occupations not related to agriculture.

The question asking the students how certain they were of their vocational goal, revealed that 11.8 per cent were very uncertain, 15 per cent were quite uncertain, 46.8 per cent were quite certain, and 26.4 per cent were very certain of their vocational goal.

#### Psychological Characteristics

The first phase of this investigation was to describe in objective terms certain psychological characteristics of entering freshmen in the School of Agriculture and to compare their status with relevant norm groups.

The selection of the norm groups for comparison was based on the following considerations: (1) first preference was given to twelfth grade norms in order to determine if there was any selection between the average high school senior and agricultural college freshmen; (2) next, preference was given to college freshmen norms, and more especially to Kansas State College freshmen

norms to determine how they compared with an unselected freshman population, (3) final preference was given to whatever norms were available.

The mean scores of the 220 freshmen Agriculture students on the eighteen scales of the California Psychological Inventory were compared with those for 1,424 twelfth grade boys. Table 3 presents this comparison.

The Agriculture freshmen group was statistically significantly different from the twelfth grade sample on twelve of the eighteen scales. They were significantly below the average of the norm group on the Infrequency, Dissimulation, Delinquency, and Impulsivity scales. They were significantly above the average of the norm group on the Good Impression, Social Responsibility, Tolerance, Social Status, Intellectual Efficiency, Academic Achievement, Honor Point Ratio and Psychological Interest scales.

The Infrequency, Dissimulation and Good Impression scales are those that attempt to check the validity of the responses a person gives on the test. From the comparison of the two samples on the Infrequency and Dissimulation scales it was found that the Agriculture students were more honest and did not tend to exaggerate their problems as much as the norm group. However, the Good Impression scale indicated that the agricultural freshmen were more likely to try to create a favorable impression.

As compared to the twelfth grade group the Agriculture freshmen were more socially responsible on the Social Responsibility scale, more tolerant on the Tolerance scale, less impulsive on the Impulsivity scale and had less potentiality for delinquency on the Delinquency scale. The comparison of mean scores on the Social Status scale revealed that the Agriculture freshmen had more personal qualities which are correlated with social status than the norm group. The comparison of mean scores on the Psychological Interest scale indicated that the Agriculture freshmen had interests more

Table 3. Comparison of California Psychological Inventory scores of freshmen Agriculture students and a male twelfth grade sample.

Scale	: Ag. Freshmen		: Norm Group		: Diff. : : in : : means :	: t : test
	: (N = 220)		: (N = 1,424)			
	: M	: SD	: M	: SD		
Infrequency	2.24	1.92	2.58	2.48	.34	2.00*
Good Impression	18.29	6.24	14.86	6.08	3.43	7.42**
Dissimulation	7.60	4.51	10.04	5.33	2.44	7.39**
Social Responsibility	30.06	4.70	27.06	5.63	3.00	7.50**
Tolerance	21.34	4.90	18.05	5.36	3.29	8.43**
Flexibility	8.77	3.26	9.00	3.37	.23	.95
Social Status	17.13	3.98	15.86	4.47	1.27	3.97**
Dominance	24.50	5.53	23.80	6.31	.70	1.55
Social Participation	22.59	5.16	21.98	5.48	.61	1.50
Femininity	15.26	3.40	15.04	3.55	.22	.88
Delinquency	14.67	5.10	17.71	5.91	3.04	7.24**
Intellectual Efficiency	35.83	5.83	34.25	6.29	1.58	3.52**
Academic Achievement	25.25	4.69	22.50	5.38	2.75	7.23**
Honor Point Ratio	16.94	4.21	14.83	4.11	2.11	7.33**
Psychological Interest	9.60	2.86	9.22	2.07	.38	2.53*
Social Presence	33.05	5.57	33.40	5.76	.35	.95
Impulsivity	20.32	8.19	24.99	8.04	4.67	8.05**
Social Acceptance	19.39	3.89	19.18	4.19	.21	.70
College Attendance	30.55	3.94	31.21	3.75		***

\*Significant at the five per cent level.

\*\*Significant at the one per cent level.

\*\*\*Number and description of norm group was not known for the College Attendance scale.



similar to advanced students and professional workers in psychology than the twelfth grade group.

The Agriculture freshmen were significantly above the average for the twelfth grade group on the three objectively validated scales, Intellectual efficiency, Academic Achievement, and Honor Point Ratio. High scores on these scales indicate intellectual efficiency and identify factors of interest and motivation which facilitate scholastic achievement at the high school and college undergraduate levels.

Profile sheets are not available on which a graphic comparison can be made for the Agriculture freshmen and male twelfth graders. However, for visual inspection, Fig. 1 is included comparing the scores of the agricultural freshmen with those for 3,572 male and female high school students of all grade levels. The average scores for the high school norm group is slightly lower than those for the male twelfth grade group. This is probably due to the influence of the female student's scores; sex differences were noted from a comparison of male and female norm groups in the Manual, (Gough, 4).

Figure 2 is also included to present the comparison of the mean scores of the agricultural freshmen with those for 680 male college students of all grade levels. From the inspection of Fig. 1 and Fig. 2, it is interesting to note that although the mean scores of the Agriculture freshmen are significantly higher on several scales in comparison with the high school norm group, they are below average on all of the scales, with the exception of the validation scales, when compared with college students.

High school or college student norms are not available for Strong Interest Test comparisons. However, the Agriculture freshmen scores on the Strong Vocational Interest Test could be compared graphically with the scores

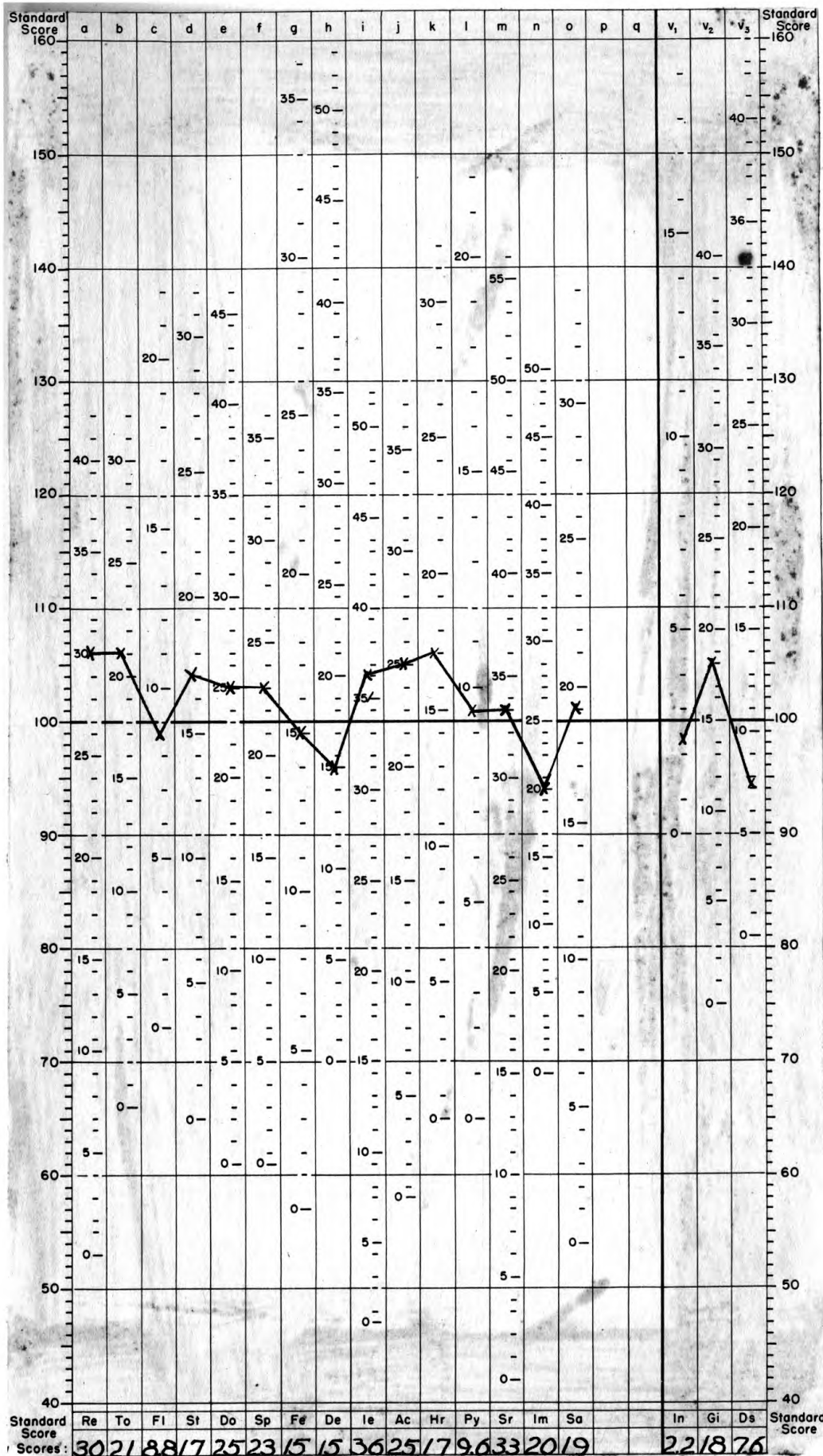


Fig. 1. Comparison of the mean scores of Agriculture freshman group with high school norms for the California Psychological Inventory.



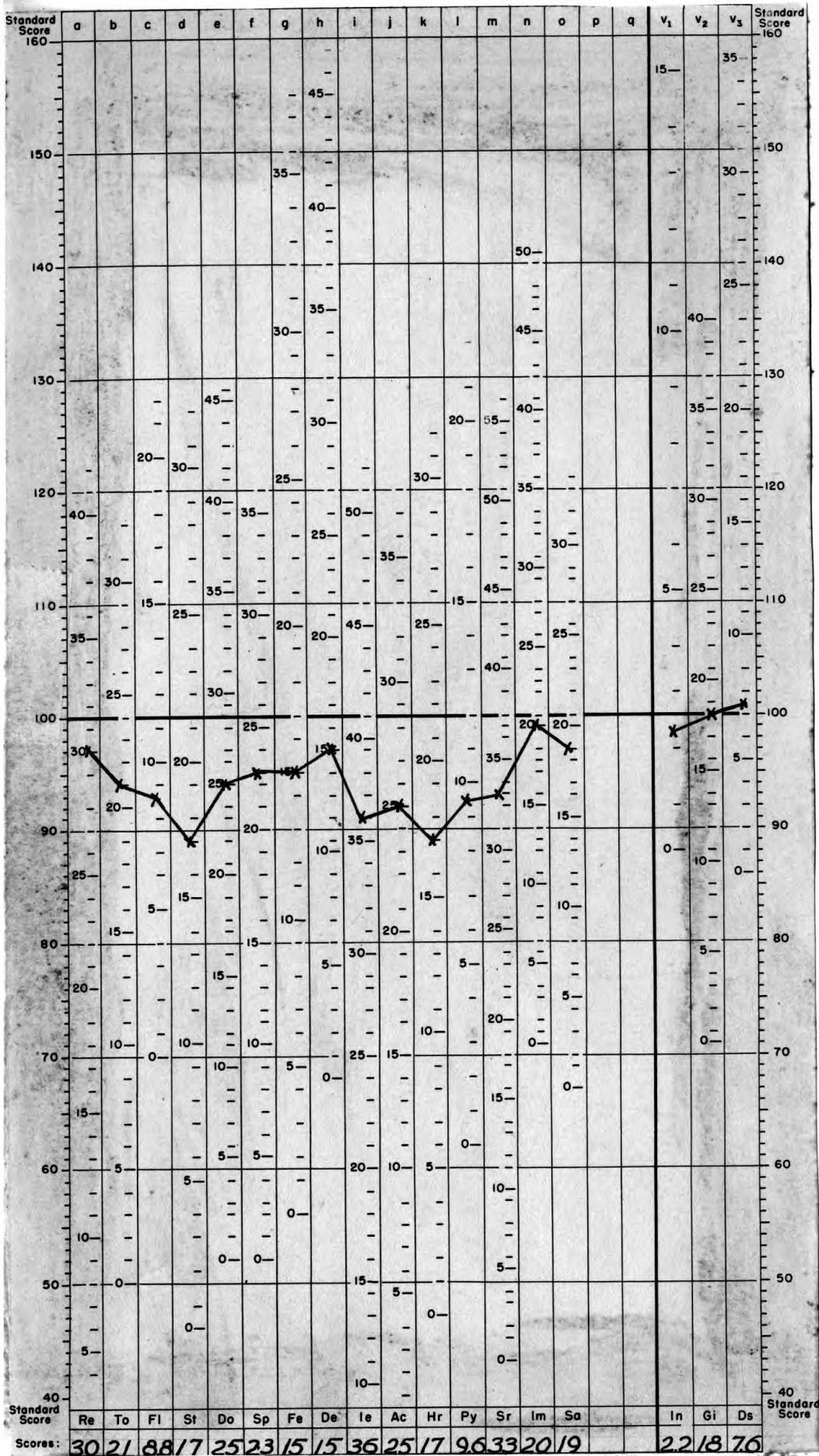


Fig. 2. Comparison of the mean scores of Agriculture freshman group with college norms for the California Psychological Inventory.

of adult males successfully employed in specific occupations. These comparisons on thirteen occupational scales and the three special scales are graphically presented on the Hanks Report Form in Fig. 3.

By inspection of Fig. 3, it is apparent that the Agriculture freshman sample is a select group on the basis of interests. The high scores on the Farmer, Veterinarian, and Vocational Agricultural Teacher scales indicate that their interests are similar to persons successfully engaged in farming or in occupations related to agriculture. The relatively low score on the Forest Service Man scale appears to be one exception.

The three non-occupational scales, Interest Maturity, Occupational Level, and Masculinity-Femininity are designed as predictors of general interests. The Interest Maturity scale measures differences in interests of 15 and 25 year old men. By the standards of the scale, the Agriculture freshmen were immature in interests.

Recent research has cast doubt upon the validity of the Interest Maturity scale as a predictor of interest stability (Hoyt, 6). Whether or not it measures a more general kind of "maturity" is still open to question.

For the Occupational Level scale, the scores of the Agriculture freshmen indicate that their interests are similar to semi-skilled workmen. According to the standards of the scale, a score of this magnitude should be anticipated for persons with high farmer interests. The Masculinity-Femininity scale indicates that their interests are slightly more masculine than feminine.

The comparison of mean scores on the Brown-Holtzman Survey of Study Habits and Attitudes is shown in Table 4. The available norm group is described in the Manual (1) p. 5, as ".....2,114 men in twelve colleges. All were freshmen except for 162 who were sophomores."



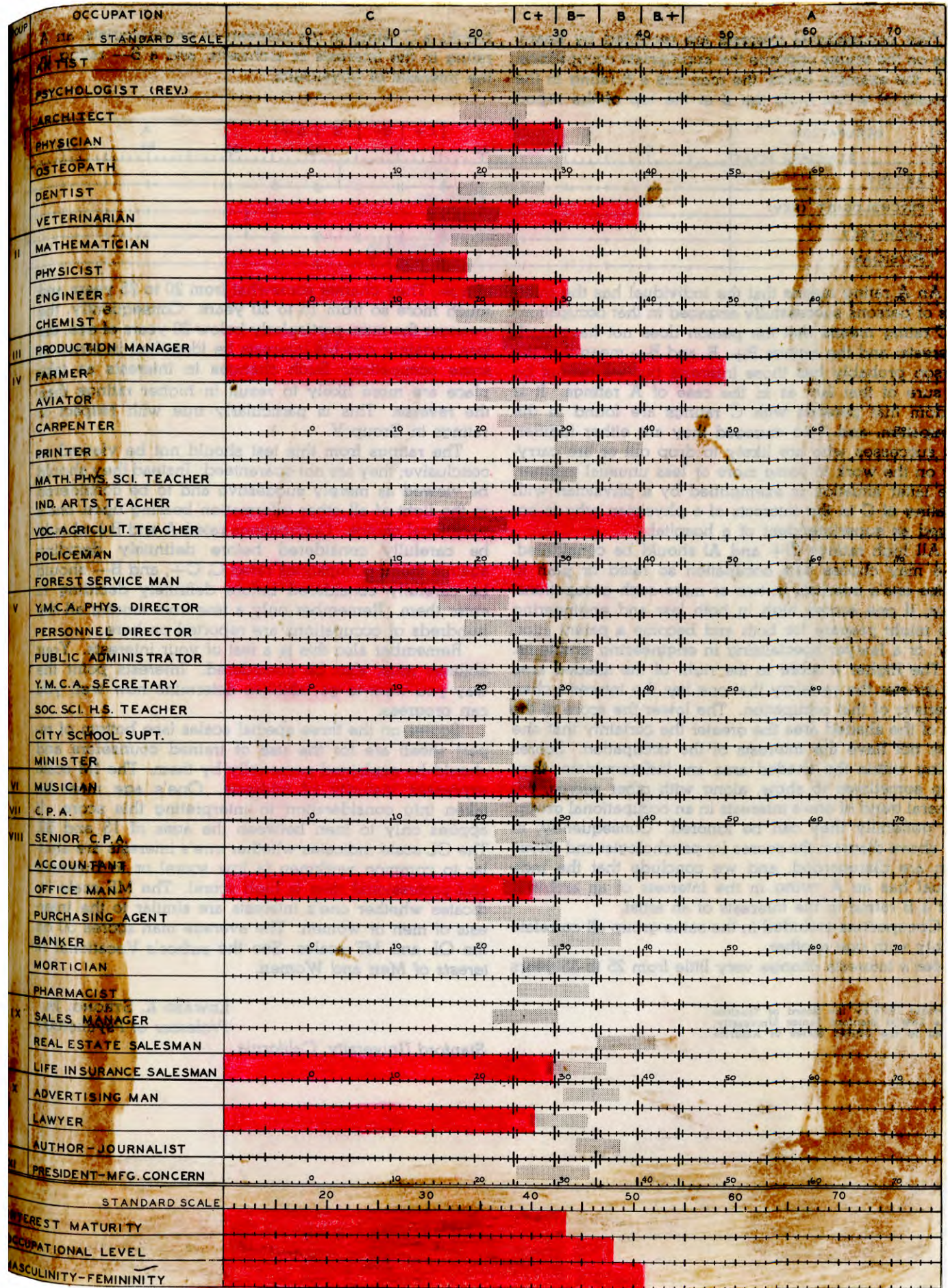


Fig. 3. Profile of mean scores of 220 Freshmen Agriculture Students on the Strong Vocational Interest Test.



Table 4. A comparison of Brown-Holtzman Survey of Study Habits and Attitudes scores of freshmen Agriculture students and norm group sample.

Test	Ag. Freshmen		Norm Group		Diff.	
	(N = 220)		(N = 2114)		in	t
	M	SD	M	SD	Means	Test
Brown-Holtzman	20.45	12.03	35.28	12.95	14.83	16.30**

\*\* Significant at the 1 per cent level.

There was a marked difference in the mean scores of the two groups on this measure of motivation and attitude. The Agriculture freshmen made a significantly lower mean score than the norm group.

The most relevant normative data available for comparison with the scores of the Agriculture freshmen on the Iowa Test #6 - Ability to Interpret Reading Materials in the Natural Sciences was the percentile rank of scores earned by a sample of second semester high school seniors. These data were obtained from the Iowa Test #6 answer sheet. Fig. 4 graphically shows the relationship between the cumulative percentage curves of the two groups.

By inspection of Fig. 4, it can be seen that:

1. The average freshmen agricultural student is only slightly superior to the high school senior in this ability.
2. The range of ability is about the same for both groups.
3. Some selection has taken place at the lower ability levels. In the agricultural freshmen group there are not as many low ability students as might be anticipated from a completely unselected population.
4. Selection has taken place to a lesser degree in the upper ability levels. The distribution of this ability is more proportionate among the top one-half of the students.

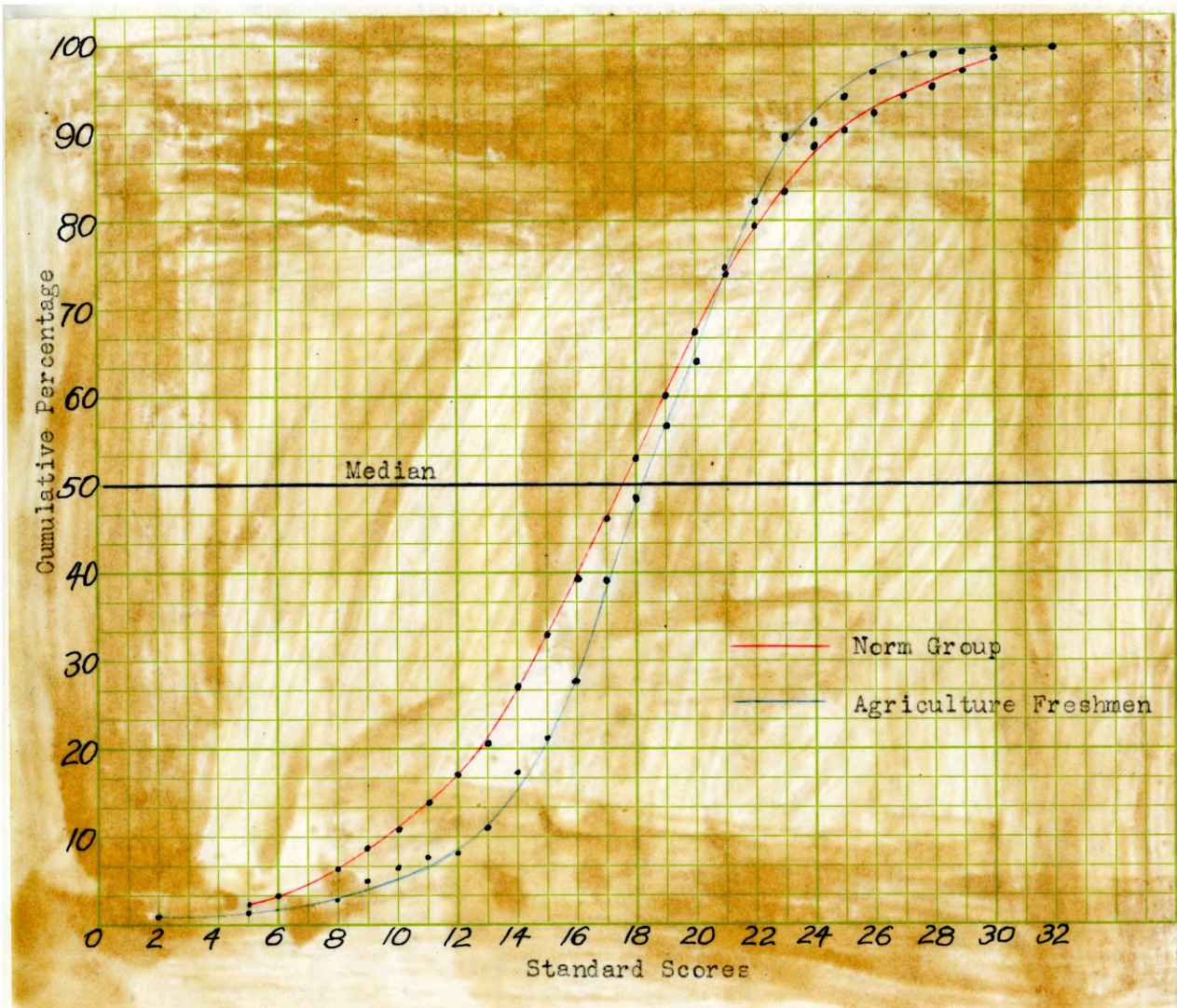


Fig. 4. Cumulative percentage of standard scores of second semester high school seniors and Agricultural freshmen sample on the Iowa Test #6.

The comparisons on the ACE Psychological Examination are shown in Table 5, for the Cooperative English Test in Table 6, and for the Cooperative Reading Test in Table 7. The norm group chosen for these three tests was entering male and female freshmen at Kansas State College for the school year, 1953-54. For the ACE Psychological Examination, 1,245 students were included



Table 5. Comparison of ACE Psychological Examination scores of freshmen agriculture students and norm group samples.

ACE	Ag Freshmen (N = 220)		Norm Group (N = 1245)		Diff. in means	t Test
	M	SD	M	SD		
Q Score	41.86	10.51	41.0	15.7	.86	.78
L Score	58.44	13.92	61.5	16.5	3.06	2.59**
Total Score	100.44	21.51	102.5	26.0	2.06	1.11

\*\*Significant at the 1 per cent level.

Table 6. Comparison of Cooperative English Test scores of freshmen agriculture students and norm group samples.

Coop. English Test	Ag. Freshmen (N = 220)		Norm Group (N = 1241)		Diff. in means	t Test
	M	SD	M	SD		
Mechanics of Exp.	81.94	22.29	88.5	28.0	6.56	3.31**
Effectiveness of Expression	32.05	12.79	35.3	12.4	3.25	3.61**

\*\*Significant at the 1 per cent level.

Table 7. Comparison of Cooperative Reading Test scores of freshmen agriculture students and norm group samples.

Coop. Reading Test	Ag. Freshmen (N = 220)		Norm Group (N = 1230)		Diff. in means	t Test
	M	SD	M	SD		
Total Score	55.48	30.87	57.0	33.2	1.52	.63
Vocabulary	22.06	11.74	23.5	12.0	1.44	1.64
Speed of Reading	19.87	12.46	19.7	13.2	.17	.18
Level of Reading	13.70	9.99	13.3	7.8	.40	.66

in the norm group. For the Cooperative English Test, 1,241 students were included and for the Cooperative Reading Test, 1,230 students.

The comparison of the two groups on the ACE Psychological Examination revealed that the Agriculture freshmen made a significantly lower mean score on the Linguistic sub-test. For Cooperative English Test, the comparisons revealed that the Agriculture freshmen made a significantly lower mean score on both sub-tests, Mechanics of Expression and Effectiveness of Expression. There were no significant differences in mean scores on the Cooperative Reading Test, although the Vocabulary sub-test tended toward significance. The results of the comparisons on these tests support each other indicating, that the Agriculture freshman group is below average for Kansas State College freshmen in the various English skills and verbal ability.

#### Psychological Characteristics and Achievement

The second phase of this investigation was to determine the relationships, if any, between certain measured psychological characteristics, used singly or in combination, and first semester grade point average. The resulting product-moment correlations among the variables and first semester grade point average are given in Table 8.

All of the relationships between ability variables and grade point average were positive and statistically significant. The highest relationship was found for the Effectiveness of Expression, a sub-test of the Cooperative English Test. A high correlation between this measure and first semester grade point average is understandable, since a substantial portion of the Agriculture freshman's first semester grade average is derived from courses in written and oral communication.

Table 8. Correlations among thirty objective measures of psychological characteristics and first semester grade point average for 220 Agriculture freshmen students.

TESTS	ACE			COOP READ				COOP ENG			CPI							STRONG												
	Q	L	T	RT	V	S	L	M	E	IOWA	B-H	Re	St	Fe	Ie	Ac	Hr	Cl	Vet	Far	VAT	Phys	YMCA	OM	LIS	Law	IMS	OLS	M-F	G.P.A.
Quan.	.558	.842	.413	.303	.450	.357	.484	.481	.419	.249	.246	.187	-.081	.276	.249	.246	.164	.059	.156	.204	.076	.126	.054	-.085	-.097	.207	.084	.123	.459	
Ling.		.915	.784	.704	.751	.658	.673	.730	.654	.289	.356	.362	.004	.478	.282	.380	.110	-.076	-.024	.061	.013	.240	.038	-.004	.062	.368	.145	.016	.573	
Tot.			.706	.601	.703	.597	.668	.703	.659	.302	.348	.325	-.037	.442	.302	.359	.141	-.020	.058	.135	.045	.218	.049	-.044	-.006	.331	.131	.048	.593	
R Tot.				.841	.948	.910	.566	.672	.706	.252	.357	.327	.049	.470	.219	.421	.136	-.073	-.005	.043	-.019	.214	.040	-.002	.072	.360	.148	.132	.542	
Voc.					.680	.589	.534	.643	.634	.254	.339	.272	.096	.392	.215	.323	.080	-.086	-.039	.028	-.016	.192	.083	-.027	.057	.365	.155	.006	.537	
Speed						.901	.544	.631	.700	.256	.321	.327	.007	.462	.209	.421	.171	-.032	.056	.072	.016	.188	.003	-.007	.063	.320	.136	.056	.521	
Level							.873	.521	.569	.164	.314	.301	.033	.421	.189	.415	.131	-.062	.008	.049	.014	.194	.011	.020	.062	.280	.101	.021	.428	
Moc								.667	.531	.192	.317	.355	.015	.381	.251	.348	.187	-.046	.002	.059	-.033	.234	.179	-.030	-.038	.345	.076	-.011	.565	
Eff.									.622	.264	.394	.364	-.013	.500	.336	.424	.196	-.072	-.017	.064	.019	.229	.083	-.063	.004	.369	.153	.002	.630	
Iowa										.246	.382	.286	.014	.472	.233	.452	.244	.081	.189	.202	.113	.139	-.007	-.166	-.056	.318	-.008	.125	.598	
B-H											.359	.336	.057	.371	.397	.226	.164	.019	.073	-.023	-.016	.065	.008	.118	.108	.195	.260	-.068	.332	
Re												.331	.505	.488	.596	.564	.340	.092	.131	.291	.215	.198	.014	-.170	-.096	.274	.054	.023	.399	
St													.008	.579	.546	.477	.302	.173	-.185	.076	-.073	.327	.088	.117	.019	.360	-.089	.018	.326	
Fe														-.117	.071	.078	.00	-.166	-.078	-.051	-.079	.090	.043	.101	.036	.030	.107	-.383	.060	
Ie															.625	.613	.401	.036	.066	.199	.068	.237	.070	-.111	-.073	.364	-.004	.169	.401	
Ac																.525	.446	.006	.018	.201	.061	.365	.100	-.067	-.108	.286	.055	.063	.383	
Hr																	.436	-.072	.149	.166	.207	.093	-.103	-.193	.001	.152	.059	.052	.435	
Cl																		.159	.154	.280	.149	.041	.012	-.170	.306	.120	.055	.401	.250	
Vet																			.509	.550	.152	-.378	-.027	-.267	-.348	.064	-.381	.374	.122	
Far																				.524	.440	-.230	-.142	-.612	-.463	-.087	-.492	.566	.053	
VAT																					.205	.291	.123	-.519	-.575	.292	.509	.419	.181	
Phys.																						.205	.291	.123	-.519	-.575	.292	.509	.419	.092
YMCA																														.250
OM																														.089
LIS																														-.127
Law																														-.082
IMS																														.415
OLS																														.149
M-F																														.060

Correlations of .113 or beyond are significant at the 5% level  
 Correlations of .175 or beyond are significant at the 1% level



The next best predictor was the Iowa Test #6, Ability to Interpret Reading Materials in the Natural Sciences. This appears to lend weight to the findings of previous studies that an ability of this nature is related to achievement in agricultural curricula.

On the California Psychological Inventory, the relationships between all of the scales selected for correlational analysis and first semester grade point average were positive and statistically significant with the exception of the Femininity scale. The correlations obtained for the Intellectual Efficiency, Academic Achievement and Honor Point Ratio scales support their descriptions as interest and motivational variables that affect academic achievement.

The Social Responsibility and Social Status scales were selected for this section of the study, because their descriptions presented them as measures of personality variables which might be related to college success. Their significant positive correlations indicate their relationship.

A low positive significant relationship was found for the College Attendance scale. There is insufficient information concerning the scale to warrant comment.

The significant correlations obtained between the personality variables and grade point average illustrate their relationship to academic achievement although this relationship may be partially due to their significant positive correlations with the ability variables. This can be seen by inspection of Table 8.

The Femininity scale was included to determine the relationship between psychological femininity and occupational femininity as indicated by the M-F scale on the Strong Vocational Interest Test. There is a significant rela-

tionship between the two variables. The negative correlation is a function of the scoring method.

Among the scales on the Strong Vocational Interest Test, it was found that the Interest Maturity scale had the highest positive statistically significant relationship with grade point average. The Life Insurance Salesman scale had a negative significant relationship and the other interest variables were found to lie in between. Apart from the Interest Maturity scale, the significant correlations obtained for the remaining scales were not high enough to warrant their use as predictor variables.

The relationship of the Brown-Holtzman Survey of Study Habits and Attitude with grade point average was positive and statistically significant. Although this relationship was lower than some of the other motivational variables in the study, its low intercorrelation with the aptitude variables warranted its try-out as a combined predictor.

It is of interest to note the intercorrelations among the various variables as shown on Table 8.

The ability variables intercorrelated significantly, positively and high. The intercorrelation among the sub-tests of the Cooperative Reading Test are notable examples.

The intercorrelations among the personality and motivational variables of the Brown-Holtzman and California Psychological Inventory were significant and moderately high. This was especially true among the Intellectual Efficiency, Academic Achievement and Honor Point Ratio scales. The personality variables correlate only moderately with the ability measures.

The occupational interests were minimally intercorrelated with the ability and personality variables. This lack of correlation indicates that

the interest scales are independent measures of interest and motivation. With a few notable exceptions the interest scales do not correlate among themselves. The Farmer, Veterinarian and Vocational Agriculture Teacher scales intercorrelate significantly and moderately high. The YMCA Secretary and Office Man scales have a similar relationship.

It is also interesting to note the inverse relationship between the Physicist scale and the YMCA Secretary, Office Man and Life Insurance Salesman scales.

The Interest Maturity scale intercorrelates significantly and positively with the ability and personality variables. It also has a significantly high positive intercorrelation with the YMCA Secretary and Office Man scales.

The zero-order correlations obtained in this prediction aspect of the study warrant the following generalizations:

1. Ability variables are significantly correlated with first semester achievement in the School of Agriculture. The magnitude (.43 to .63) of the relationships obtained in this study compares very favorably with the findings in other investigations and, in fact, may be judged as greater than those usually obtained.
2. Personality variables are significantly related to achievement although not to the same extent as ability factors. The magnitude (.25 to .44) of relationships is impressive compared to the usual findings. (The Femininity scale should not properly be included in this analysis).
3. Interest variables do not appear, with one possible exception, to be significantly related to college achievement. This finding is supported in the prediction literature. One non-occupational scale,

Interest Maturity, did give a useful correlation; this factor should be further investigated.

#### Combination of Predictors

The prediction problem involves not only a determination of relationships among single variables but also investigates the values to be obtained through optimal weighting of prediction variables in combination and to gain further insight into the nature of factors related to academic achievement.

In this study, multiple correlational analyses were made in order to determine an optimal test battery for predictive purposes and to make a further comparison of the effectiveness of ability and personality variables. Considerations of time and cost precluded a complete multiple correlational analysis. Instead, a limited number of variables were chosen for inclusion by inspection of the intercorrelations on Table 8.

These analyses sought to maximize predictive efficiency by combining the appropriate tests. The findings for the ability variables used singly and in combination are reported in Table 9. The findings for non-ability variables used singly and in combination are reported in Table 10.

It was of interest to study the combination of personality and interest items as predictors and to assess their relationship to general scholastic aptitude. The findings are reported in Table 11.

The highest relationship was obtained for the combination of the five variables selected for analysis. The three non-ability scales alone combine to give an adequate prediction of college achievement. The addition of a measure of scholastic aptitude increases the accuracy of prediction. One personality variable, Hr, and the ACE combine to give a prediction about as

Table 9. Correlations of ability variables for prediction of first semester achievement of 220 freshmen Agriculture students.

Predictor Variables	:	Correlation Coefficients
ACE		.593
Iowa Test #6		.598
ACE + Iowa Test #6		.654**

\*\* Coefficient of Multiple Correlation.

Table 10. Correlations of non-ability variables for prediction of first semester achievement of 220 freshmen Agriculture students.

Predictor Variables	:	Correlation Coefficients
Hr		.435
IMS		.415
B-H		.332
B-H + Hr + IMS		.590**

\*\* Coefficient of Multiple Correlation.

Table 11. Multiple Correlations of ability and non-ability variables for prediction of first semester achievement of 220 freshmen agriculture students.

Predictor Variables	:	Multiple Correlation Coefficients
ACE + B-H		.614
ACE + IMS		.636
ACE + Hr		.640
ACE + Hr + IMS + B-H		.686
ACE + Iowa #6 + Hr		.654
ACE + Iowa #6 + B-H		.670
ACE + Iowa #6 + IMS		.683
ACE + Iowa #6 + Hr + B-H + IMS		.709



good as the combination of the two ability variables, the Iowa Test #6 and ACE.

In conclusion, the analyses indicate that a combination of personality and ability variables give a more substantial prediction of college achievement than does either set of variables alone. The substantial relationships found in this study between objective measures of psychological characteristics and agricultural college achievement are the highest reported to date in the prediction literature.

Caution should be taken, however, in replicating the findings of the multiple correlation analysis of this study since the beta weights of the various variables have not been determined. Further research is needed to determine whether or not these obtained relationships will stand up under cross-validation.

#### SUMMARY

An effort was made to determine certain psychological characteristics of an entering freshman class in the School of Agriculture at Kansas State College, and the relationship of these characteristics to first semester grade point average. Two hundred and forty-seven students were given standardized tests of aptitude, personality, interest and attitude. The testing was done by staff members of the Student Counseling Center in the fall of the 1954-55 school year.

The Iowa Test #6 - Ability to Interpret Reading Materials in the Natural Sciences was given, since previous studies indicated that an ability of this nature was relevant to success in agricultural curricula. Interests were tested with the Strong Vocational Interest Test. The California

Psychological Inventory was chosen as the personality measure since some of its scales appeared related to academic achievement. For the measurement of motivation and attitude, the Brown-Holtzman Survey of Study Habits and Attitudes was included. In order to have measures of scholastic aptitude, English and reading skills, the scores of the Agriculture freshmen on the ACE Psychological Examination, Cooperative English Test and Cooperative Reading Test were obtained from the Student Counseling Center.

In addition each student completed a biographical information sheet regarding their age, curriculum, vocational goal, certainty of goal, and father's occupation. Complete data was obtained for 220 male freshmen students.

For a criterion in the prediction section of the study, the first semester grade point average was used. The mean grade point average for the group was .867.

On the California Psychological Inventory, the Agriculture freshmen were statistically significantly different from a male twelfth grade norm group on 12 of 18 scales. They were significantly below the average of the norm group on the Delinquency and Impulsivity scales, as well as two of the validation scales. They were significantly higher on the Good Impression, Social Responsibility, Tolerance, Social Status, Intellectual Efficiency, Academic Achievement, Honor Point Ratio and Psychological Interest scales. When the Agriculture freshmen were graphically compared to a norm group composed of men in all college levels, they fell below average on all of the scales, with the exception of the validation scales.

On the Strong Vocational Interest Test, the Agriculture freshmen group had a distinctive pattern of interests. High scores on the Farmer, Veterin-

arian and Vocational Agriculture Teacher scales indicated their interests were similar to persons successfully engaged in farming or in occupations related to agriculture. According to the standards of the three non-occupational scales, in interests they were immature, similar to semi-skilled workmen and more characteristically masculine than feminine.

The most marked difference was found for the Brown-Holtzman Survey of Study Habits and Attitudes. The Agriculture freshman scored significantly below the average of a college freshman sample.

From a comparison of percentile scores on the Iowa Test #6 - Ability to Interpret Reading Materials in the Natural Sciences, it was found that the average Agriculture freshman was only slightly superior to the average high school senior. They were a select group to some extent at the lower ability levels and to a lesser degree in the upper ability levels.

The Agriculture freshmen were significantly below the average of Kansas State College freshmen on both sub-tests of the Cooperative English Test. These results were supported by the comparisons on the ACE Psychological Examination where they were significantly below average on the sub-test measuring Linguistic ability.

In relating the ability measures to first semester grade point averages, all were found to be correlated, positively, significantly and high. The highest relationship was found for Effectiveness of Expression, a sub-test of the Cooperative English Test. The next best predictor was the Iowa Test #6; the ACE Psychological Examination correlated to a slightly lesser extent.

On the California Psychological Inventory, all the selected scales correlated positively and significantly with the criterion, with the exception of the Femininity scale which had been included to determine its relationship



to the Strong M-F scale. The Intellectual Efficiency, and the Honor Point Ratio scales were found to be the best predictors from the Psychological Inventory. Their significant relationships with grade point average may in part be due to their positive relationships with the ability variables.

There was a significant relationship found between the Femininity scale on the California Psychological Inventory and the M-F scale on the Strong Vocational Interest Test.

Several of the interest scales on the Strong Test showed significant relationships with the grade point average. However, only the Interest Maturity scale correlated high enough to warrant its use as a predictor.

The relationships obtained for the Brown-Holtzman SSHA indicated its value as a supplementary predictor. It correlated significantly and positively with the criterion and had a low intercorrelation with the ability variables.

From the zero-order correlations obtained in this prediction aspect of the study the following generalizations can be made:

1. Ability variables are significantly correlated with first semester achievement in the School of Agriculture.
2. Personality variables are significantly related to achievement although not to the same extent as ability factors.
3. Interest variables are not significantly related to achievement, with one exception, the Interest Maturity scale on the Strong Vocational Interest Test.

Multiple correlational analyses were made in order to determine an optimal test battery for prediction and to make a further comparison of the effectiveness of ability and personality variables.

The most predictive combination of variables was the ACE Psychological Examination, Iowa Test #6, CPI - Honor Point Ratio, Brown-Holtzman SSHA, and Strong - Interest Maturity Scale. The most predictive combination of any two variables was the ACE Psychological Examination and the Iowa Test #6. The CPI - Honor Point Ratio scale, a personality variable, and the ACE Psychological Examination was the next best combination of two predictors.

The three non-ability scales, Brown-Holtzman SSHA, CPI - Honor Point Ratio, and Strong - Interest Maturity scale alone combine to give an adequate prediction of college achievement.

In conclusion, both analyses indicate that a combination of personality and ability variables give a more substantial prediction of college achievement than does either set of variables alone. The substantial relationships found in this study between objective measures of psychological characteristics and agricultural college achievement are the highest reported to date in the prediction literature.

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PREDICTING ACHIEVEMENT IN  
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by

Thomas Eugene Hardy

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