THE RELATION BETWEEN CERTAIN PSYCHOLOGICAL MEASURES AND SURVIVAL IN THE ENGINEERING COLLEGE AT OKLAHOMA STATE UNIVERSITY

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CHAPTER I

INTRODUCTION

A large number of students enroll each year in the College of Engineering at Oklahoma State University. Evidence indicates that a reasonably large number of students do not complete the program. Since it is important that counselors have as much information as possible at their command an effort is made to examine certain data that might be useful in helping them assess the student's potential. These data are examined in the light of the individual's survival in the program over a period of time sufficient to meet the requirements for graduation. Since the test data were obtained at the time of admission to the College of Engineering the extent to which performance on these tests are related to survival has been carefully re-appraised.

As a consequence of the analysis it is possible to see more clearly the extent to which the data obtained relate to (1) graduation from engineering, (2) change of program and graduation, and (3) dropping out of the engineering school. With more specific information concerning the relationship between predictors and survival the counselor will be in a more effective position to help the student make a maximum adjustment to this highly specialized program.

Purpose of the Study

The purpose of this study is to give the counselor in the engineering program a better understanding of the significance of certain factors

which contribute to successful adjustment in it. The extent to which intelligence, interest, grade point average and age relate to success and contribute to a better understanding of this adjustment may determine the extent to which counselors will be able to establish certain hypotheses about the student's future success. The objectives of the investigation are to clarify these findings for the counselor.

Statement of the Problem

The problem to be investigated is concerned with several aspects: (1) the relationship between standings on two examinations (the American Council on Education Psychological Examination and the Pre-Engineering Ability Test) and survival in the engineering program, (2) standing on the two examinations, survival and grade point average at the end of the program, (3) standing on the two examinations, survival and interest patterns at the time of admission to the Engineering College, (4) standing on the two examinations, survival and age at the time of entrance to the engineering school. More specifically the aspects of the problem to be investigated are as follows:

(a) When students who enter the College of Engineering are classified into the upper third, middle third and lower third of the freshman group on the American Council on Education Psychological Examination (ACE) and the Pre-Engineering Ability Test (PEAT) what percentage of students in each of the three classifications graduate from the College of Engineering, change to another program and graduate, drop out of school?

(b) When the association between classification in terms of performance on the two tests and survival in the program are

examined can it be concluded that the association between tests and criterion are independent?

(c) When the correlation is computed between standing on the two tests and survival in the program will the relationship reach a critical level of significance?

(d) When interest data from three scales of the Kuder Preference Record are examined for the students in the three classifications based on the two test results what percentage survive who rank at or above the seventy-fifth percentile on these scales?

(e) When classification on the two tests is examined in connection with success in the engineering program what relationships occur between level of grade point average and graduation from the engineering curriculum, change of program and graduation, failure to survive?

(f) Do differences occur at the time of admission in the mean age of students who survive in engineering as compared to those who change programs and graduate and those who drop out of college?

The test data were collected at the time of admission to the engineering program at Oklahoma State University (September 1953). The data were analyzed after the subjects had an opportunity to complete the university program. The criterion data were obtained from the files of the registrar.

CHAPTER II

A REVIEW OF THE RELATED LITERATURE

This chapter will acquaint the reader with literature related to this investigation. Although none of these studies duplicate this investigation, each provides information regarding various measures to be considered in this study.

Higgins at Cornell University completed an investigation of the relationship between the mathematical ability of the engineering student and his success in the engineering curriculum. The one hundred and fifty-three male subjects were grouped according to their average in mathematics and the mean average of the four year grades was computed for each group. A multiple R of .84 was obtained. This study indicates that students of superior mathematical ability will do superior work in the engineering school.[1]

A study conducted by Siements at the University of California in forecasting the academic achievement of engineering students found that by computing the actual and predicted grade point average score, the coefficient was found to be .89, and the multiple correlation R was calculated to be .88. The total grade point average in the first semester of engineering was the best predictor of success in the

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[1]T. J. Higgins, "Study of Mathematical Ability in Relation to Success in Engineering Studies," Journal of Engineering Education, XXIII (June 1933), 743-746.

complete engineering program.[2]

Porter conducted an investigation on data based on the performance of 638 students admitted to the freshman class in the College of Engineering at the Carnegie Institute of Technology. The subjects were studied to determine the relationship between scholarship while in attendance and four other areas. Correlation analysis shows scholarship during the first semester of the freshman year to be the best single index of achievement during the student's period of attendance in college.[3]

From the University of Minnesota, Berdie and Sutter conducted a study on predicting success of engineering students. The purpose of the study was to evaluate a battery of tests assembled to assist in the prediction of academic success for students considering engineering training as one of their educational alternatives. They felt as though a re-appraisal of predictive techniques was appropriate. A multiple R of .62 was found when all of the predictors were combined. It was found that the best single predictor of over-all grade average in college was rank in the high school graduating class. This was true in this study for three separate groups in terms of first-quarter grades and for the total group in terms of first-year grades. The variables included in this study did not provide predictions of greater accuracy than those which have been reported in the past. They suggested more accurate predictions might be obtained by using additional types of tests--tests of aptitude, interest, and personality.[4]

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[2] C. H. Siemens, "Forecasting the Academic Achievement of Engineering Students," Journal of Engineering Education, XXXIII (1942), 617-621.

[3] M. M. Porter Jr., "The Prediction of Success in an Engineering Curriculum," American Psychologist, I (1946), 278.

[4] R. F. Berdie and N. A. Sutter, "Predicting Success of Engineering Students," Journal of Educational Psychology, XLI (1950), 184-190.

Laycock and Hutcheon from the University of Saskatchewan believed that more accurate measures for predicting success in engineering would be of great value to vocational counselors in high schools and engineering colleges. They chose eight areas from which data were obtained. It was found that first-year engineering grades had appreciable correlations with the following: Grade XII grades, intelligence test, Form Relations test, and physical science interest. A multiple R of .66 was found between grade point average of the engineering students at the end of the first year and the battery of tests. The correlation between the first-year grades and the results of the ACE were surprisingly low, being only .34, while the correlation between the ACE and grade point of Arts and Science freshman students was found to be .50. With intelligence held constant, first-year engineering grades were found to correlate with Grade XII grades .56. The over-all results indicated that Grade XII grades alone were not only the best single predictive measure, but nearly as good as prediction from the battery of four tests.[5]

At Clark University, Jones conducted an investigation to determine the degree to which certain aptitude and achievement tests and secondary school grades would individually and in combination predict scholastic success at different levels of advancement in an engineering college. The final results were based on twenty-seven multiple R's and the accompanying regression equations. The R was .64 in this study for forecasting first semester and first year grades using the mathematics test, the

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[5]S. R. Laycock and N. B. Hutcheon, "A Preliminary Investigation Into the Problem of Measuring Engineering Aptitudes," Journal of Educational Psychology, XXX (April 1939), 280-288.

physics or chemistry test, and secondary school grades. The predictive value of the test progressively decreased in forecasting second, third, and fourth year grades.[6]

In a study conducted by Cohen at the Worcester Polytechnic Institute a multiple R of .51 was found between high school grades and college grades in 1941. When the study was repeated in 1942 a multiple R of .48 was found. A correlation was also run between a battery of tests given the subjects and college grades. The battery consisted of the Iowa Silent Reading Test, Yale University Department of Personnel Study Test II, Form J, Parts 1 and 2, a Studiousness Questionaire, American Council of Education Cooperative General Achievement Tests in Mathematics, The American Council on Education Cooperative General Achievement Test in Physics and Chemistry, and the American Council on Education Cooperative General Achievement Test in Reading Comprehension. In 1941 a multiple R of .57 was found between the college grades and test battery. On cross-validation the R was .51. Thus, high school grades alone are almost as good in predicting academic success in the College of Engineering. The high school grades, however, should not be solely relied upon.[7]

Sisk conducted an investigation involving a multiple factor analysis of mental abilities in the freshman engineering curriculum at Cornell University. He correlated the ACE scores and subject grades for the freshman students. Three factors were discovered. There was a linguistic or verbal factor which was present in all engineering

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[6] V. Jones, "Prediction of Student Success in an Engineering College," American Psychologist, III (July 1948), 295.

[7] L. Cohen, "Predicting Academic Success in an Engineering College and Suggestions for an Objective Evaluation of High School Marks," Journal of Engineering Education, XXXVII (1946), 381-384.

courses, a perceptual factor which might be a study or interest factor and, thirdly, a factor with significant loadings on chemistry and drawing.[8]

Ritter at Marquette University conducted a study showing correlation between high school rank, college grade point average and ACE raw score ranks. A correlation of .70 was found between ACE raw score rank and grade point average. It was felt that the results of this study would be useful to the counselors in promoting the academic welfare of each individual engineering student in the program.[9]

McClanahan and Morgan conducted a study, the purpose of which was to investigate the predictive value of the various tests regularly administered to new students enrolling in engineering at Colorado Agriculture and Mechanical College. They obtained a multiple R of .84 between first year grade point average and a battery of tests consisting of the American Council on Education Cooperative English Test, Iowa Placement Examination Chemistry Aptitude, Nelson-Denny Reading Test, ACE, and high school rank. The multiple R was as high as .84 with the high school rank omitted. They found the best single predictor of first year engineering grades among the variables was the Chemistry test, followed by the ACE, the English test, and the Reading test. Intercorrelations indicated that the English test, the ACE and the Reading test showed a great deal of overlap. The low correlation of high school rank with the first year grades indicated it to be the poorest predictor. Multiple coefficients of correlation indicated that the Chemistry and English

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[8] H. L. Sisk, "A Multiple Factor Analysis of Mental Abilities in the Freshman Engineering Curriculum," Journal of Psychology, IX (1939), 165-177.

[9] R. L. Ritter, Effective Counseling for Engineering Freshman," Journal of Engineering Education, XLIV (1954), 636-641.

tests were the best and most economical battery for predicting first year grades. The multiple R was .81 for these two tests along.[10]

The results of several test analyses described in a study by Lord, Cowles and Cynamon from Brooklyn College indicated that the Pre-Engineering Inventory Composite Score performs very satisfactorily as a predictor of engineering success. This study substantiated findings that the Pre-Engineering Inventory, in general, and the Composite Score in particular, are valid predictors in engineering school success. They reported the validity coefficients of the Pre-Engineering Ability Test to be .60 using the first year grade as a criterion.[11]

Drake and Thomas from the University of Wisconsin conducted a study in which the Pre-Engineering Ability Test was administered to freshman students. Purpose of the study was to secure information that would enable them to have more beneficial counseling for these students. To be sure that course grades would be entirely independent of the test scores, the scores were not reported to the Engineering College until the first semester grades had been recorded. The rank in high school and ACE scores were also available on most subjects. The study resulted in that it appeared that data from the Pre-Engineering Test, in conjunction with either the ACE or centile rank in high school graduating class, separated the high achieving students from the poor achieving students very well. Although the Pre-Engineering test alone gives almost as good a separation of students at the top, the use of both test improves the separation at

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[10] W. R. McClanahan, "Use of Test in Counseling Engineering Students in College," Journal of Educational Psychology, XXXIX (December 1948), 491-501.

[11] F. Lord, J. T. Cowles, and M. Cynamon, "The Pre-Engineering Inventory as a Predictor of Success in Engineering Colleges," Journal of Applied Psychology, XXXIV (February 1950), 30-39.

the lower extreme. They reported that it is not recommended that such data as this be used along in eliminating students from the study of engineering, although it might well be used along with other data.[12]

Moore of the Carnegie Institute of Technology conducted a study on the validity of the Pre-Engineering Ability Test. The test was administered to engineering freshman entering Carnegie Institute in September 1951. At the close of the semester the correlation between total scores on the Pre-Engineering Ability Test and student's averages of course grades earned for the first semester work was .68. His finding supports the view that the objectives of providing a shorter, more convenient test without sacrificing the predictive powers of the longer test (Pre-Engineering Inventory) have been attained, and that no less confidence accrues to the Pre-Engineering Ability Test total score than to the Pre-Engineering Inventory composite score in situations appropriate to the use of the Pre-Engineering Inventory composite score.[13]

Speer of the Illinois Institute of Technology in an attempt to find out whether or not engineers are socially oriented, the norms and manual for the Kuder Preference Record were examined. The data of this indicated that engineers are low in social service interest, i.e., lacking in interest in activities that tend to improve the welfare of others. Next, data on students at Illinois Institute of Technology was studied. These student's scores were compared with the scores of two groups of graduate engineers who were practicing in the field. It was found that

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[12] L. E. Drake and W. F. Thomas, "Forecasting Academic Achievement in the College of Engineering," Journal of Engineering Education, XLIV (1953), 275-276.

[13] R. C. Moore, "A Note on the Validity of the Pre-Engineering Ability Test," Journal of Engineering Education, LXII (1952), 512.

there was a marked increase in social interest the longer the individual had been graduated. It appeared that engineering students have an interest in society, but not in persons, and that the experiences of employment and the necessity of getting along with others tends to develop some interest in service to persons.[14]

At the University of Minnesota Berdie conducted a study to determine if the satisfaction a student derives from his college courses could be predicted by his responses on the Strong Vocational Interest Blank or by other predictive indices. The results indicated that no single factor bears a high relationship to a student's satisfaction with his curriculum. Satisfaction is significantly related to academic achievement but the correlation between these two variables was only .23. The results of this study do not demonstrate that interests will or will not predict cirriculum satisfaction.[15]

Feder and Adler at State University of Iowa conducted an investigation where the possibility of selecting promising candidates for engineering training by means of examining techniques was subjectd to experimental study, using as subjects the class which entered the College of Engineering of the University of Iowa in 1931. The Iowa Qualifying Examination battery was used. Each test in the battery gave satisfactory predictions of first semester and first year grades, the correlation coefficients ranging from .57 and .72.[16]

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[14] G. S. Speer, "Measuring the Social Orientation of Freshman Engineers," Journal of Engineering Education, XXXIX (1948), 86-89.

[15] R. F. Berdie, "Prediction of College Achievement and Satisfaction," Journal of Applied Psychology, XXVIII (1944), 239-245.

[16] D. D. Feder and D. E. Adler, "Predicting the Scholastic Achievement of Engineering Students," Journal of Engineering Education, XXXIX (1939), 380-385.

A number of measuring instruments have been employed by various investigators to predict success in engineering school. Tests of aptitude and achievement have been used widely. The correlations between single predictors and criteria like grades have been moderately substantial in some instances. Multiple correlation coefficients based upon tests in various combinations correlated against similar criteria, have been as high as .88. In a number of these studies, however, no attempts were made to cross validate on other samples. The degree of shrinkage that might have occurred as a consequence of cross validation is not reported.

Studies involving interest inventories have dealt with the Kuder Preference Record and Strong Vocational Insterest Blank. Evidence seems to indicate that engineering students tend to have preferences for mechanical, computational and scientific activities.

This investigation is a predictive study involving less refined techniques than multiple correlation or discriminant analysis. The goal in this study was to determine the extent to which clearly defined outcomes might be obtained that would be of value in predicting success in the engineering program by classifying cases into various groupings on the basis of percentages of individuals reaching critical levels on certain tests and grouping them into three categories of outcomes four years after entering engineering school. The findings, in general, are in line with research based upon more refined methods of analysis.

CHAPTER III

SUBJECTS AND MATERIALS

A description of the subjects, the tests used in the study and the methods of analysis employed to answer the specific questions to be investigated are presented below.

Subjects

The subjects in this study were male freshman students who enrolled in Engineering III (Orientation) at Oklahoma State University in the fall of 1953. The subjects ranged in age from twenty-six years, eleven months to seventeen years, eight months. The subjects were divided into three classification groups (the top third, middle third, and lower third) on the basis of comparable scores on the American Council on Education Psychological Examination and Pre-Engineering Ability Test. These two tests were administered to the subjects in the engineering program at the beginning of the freshman year. Each group contained thirty subjects selected from a total of 200 freshmen.

In the summer of 1959, after a lapse of time sufficient to fulfill requirements for graduation, the students in the three classifications were divided into three groups; (1) those who entered the College of Engineering and graduated, (2) those who transferred to another program and graduated, and (3) those who dropped out of college.

Description of the Tests Used in the Study

The Bureau of Tests and Measurements at Oklahoma State University

gave each freshman student enrolling in the College of Engineering in 1953 the following tests:

1. American Council on Education Psychological Examination for College Freshmen (ACE), 1948 edition.[17]

This is a test to appraise what had been called scholastic aptitude or general intelligence, with special reference to the requirements of most college curricula. The test was designed to be helpful in the advisement of students, and to lead to early discovery of bright students. The test may also serve to help classify students in accordance with ability or preparation.

All students take exactly the same test by the same instructions. Answers are marked on special answer sheets and these are scored by hand or by means of an electric scoring machine. Since all students take the same identical test, only one set of norms is required.

The ACE consists of six sub-tests. There are the Quantitative Sub-Tests (the Q-score) and the Linguistic Sub-Tests (the L-score). Included in the quantitative sub-tests are the arithmetical reasoning, number series and figure analogies. The linguistic sub-tests consists of same-opposites, completion, and verbal analogies. The order of the tests has been arranged to control the fatigue element by alternating linguistic and quantitative materials. The Q-score represents ability to think in quantitative terms. The L-score depends upon linguistic ability. The total is based upon the results of all six sub-tests. The total score was used in this analysis. The two principle subscores and the total score are used in counseling. Speed is very important on this test.

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[17]Constructed by L. L. and T. G. Thurstone. A new form of the test was published each August by the Educational Testing Service.

The scores roughly indicate the mental alertness of the student. However, other intellectual evidences in a student should not be disregarded. It is recommended that the test be used in combination with other evidence of ability such as grades.

In regard to the norms for the interpretation of scores on the examination, they are prepared by the Educational Testing Service on the basis of the reports sent in by the colleges using the test. The norms include table of percentiles for the three sets of scores, Q, L and total. The reliability of the instrument is above .92.

2. The Pre-Engineering Ability Test (PEAT), Form ZPA[18]

This test is for prospective and enrolled Engineering College freshmen. It is a short, easily administered and readily scored test designed to have wide general usefulness in predicting scholastic success in first-year engineering school. This test measures ability to read and interpret scientific materials and to solve mathematical problems of increasing levels of difficulty. Thus, the test is divided into two parts, the comprehension of scientific materials and general mathematical ability. The sum of the scores on the two parts is the total score. The total score was used in this investigation. The total score is a combined measure of the ability to apply reading skills to the interpretation of charts, tables, and paragraphs, and ability to apply arithmetic and algebraic principles to problem solving. This test is a measure of aptitude rather than achievement.

The authors reported the reliability of the Pre-Engineering Ability Test total score to be high enough for use in the selection or

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[18] Published by the Educational Testing Service.

guidance of individual students. They also reported the reliability coefficient to be estimated at .90 by means of the Kuder-Richardson Formula 20 for a group of 305 members of the 1950 entering engineering freshman class of an eastern engineering college.

The validity coefficient of this test reported by Lord, Cowles and Cynamon was .60 using first year grades as criteria.[19] Moore reported validity coefficients nearly as high for the Pre-Engineering Ability test as he did for the Pre-Engineering Inventory.[20] The Pre-Engineering Ability Test was developed from the Pre-Engineering Inventory.

In setting up norms for this test, carefully designed experimental test administrations to entering freshmen at one of the larger eastern colleges of engineering in September 1949 and September 1950 provided a means of equating Composite Scores for the Pre-Engineering Inventory to raw scores (number of correct responses to 85 items) on the Pre-Engineering Ability Test.

3. Kuder Preference Record, Form BM.[21]

This test provides a measure of individual interest and a profile of these interests in ten broad areas: 0--Outdoor, 1--Mechanical, 2--Computational, 3--Scientific, 4--Persuasive, 5--Artistic, 6--Literary, 7--Musical, 8--Social Service, and 9--Clerical. One additional scale, the Verification scale (V scale) is also included in the test which assesses the test taking attitude of the examinee. Areas used in this

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[19]Lord, Op. cit., p. 30-39.

[20]Moore, Op. cit., p. 512.

[21]Published by the Science Research Association.

study were the scores for each subject on scales 1, 2 and 3.

Each item on the test is in the form of a forced choice in the terms of three possible alternatives. The subject chooses the one he like most and the one he likes least. The raw scores of each of the ten scales are convented into percentile ranks which compare the individual with a norm group of several thousand men in a number of different occupations.

The Kuder Record has two specific uses. One to point out occupations for further study for the individual. Another is to verify a person's choice of occupation. The Record is also intended for use in employee counseling.

Triggs reported correlations of the Preference Record scales with scores on the American Council on Education Psychological Examination. The correlations were generally low, but she found correlations of about .40 between the Preference Record Literary scale and the L-score for both men and women, and between the Preference Record Computational scale and the Q-score for the women.[22]

Kuder gave the reliabilities of the Preference Record Scales for one thousand men as follows: Mechanical .92, Computational .85, and Scientific .85. The reliability of all of the scales on the Kuder range from .84 to .93.[23]

Intercorrelations of the scores of one thousand men used in the norm group of the Kuder are as follows: Mechanical and Computational -.11, Mechanical and Scientific .31, and Computational and Scientific .10.[24]

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[22] F. O. Triggs, "A Further Comparison of Interest Measurement by the Kuder Preference Record and the Strong Vocational Interest Blank for Men," Journal of Education Research, XXXVII (1944), 538-544.

[23] G. F. Kuder, Examiner's Manual for the Preference Record, (Chicago: 1939), p. 21.

[24] Ibid.

Methods of Analysis

In order to deal with the questions with which the investigation is concerned the following steps were undertaken:

(1) Out of a pool of 200 freshman students in engineering on whom varying amounts of data were available, ninety were selected whose scores on the ACE and PEAT were closely comparable; thirty were in the top third of the distribution of scores on both tests, thirty were in the middle third and thirty in the lower third.

(2) An expectancy table was constructed as indicated below; from this table expectancies for survival, for change of program, for attrition were analyzed in terms of percentages, i.e.:

ACE / PEAT	% Graduated	% Changed Colleges and Graduated*	% Dropped	Total
Upper 1/3				
Middle 1/3				
Lower 1/3				
Total				

* At Oklahoma State University Curricula in Engineering, Business, Education, etc., are referred to as Colleges.

(3) The association between standing on the tests and the criterion was assessed by means of the contingency coefficient (C); the significance of C was tested by chi square.

(4) The percentages of students in the three classifications based upon scores on the two tests and the three criterion groups, scoring on the Mechanical, Computational and Scientific scales of the Kuder, were computed.

(5) The percentage of students in the three classifications based upon scores on the two tests and the three criterion groups, obtaining particular over-all grade point averages at the end of each student's training period, were determined.

(6) The mean age of the students in the three classifications based upon scores on the two tests and the three criterion groups were examined at the time of admission to the program to determine if the factor of chronological maturity seems to have a relationship to the criterion.

CHAPTER IV

TREATMENT OF THE DATA AND ANALYSIS OF RESULTS

The treatment of the data and the interpretation of the findings are discussed below. Although the number of cases employed in the study is small the outcomes are similar to results obtained in other investigations in this field.

Classification Based on the Two Tests Related to Standing on the Criterion

Table I presents the number of students in each of the three classification groups who graduated from the Engineering College, changed programs and graduated, dropped out of school. It should be noted that a large number of students in the top third of the distributions of the two tests graduated as compared to the number in the lower third. A larger number of students in the lower third dropped out of school than was true of those in the top third, yet the number in the top third was larger, it seems, than should be expected. These students may have become dissatisfied with the engineering program at Oklahoma State University and changed to another Engineering College or they became convinced that this kind of training was not what they wanted. Only a very few students in the upper third of the distribution of the test data changed to other colleges on the campus and graduated. This suggests that the somewhat less able students may change to other programs (Business, Education, etc.) and if adequately motivated, succeed to graduation.

TABLE I

CLASSIFICATIONS OF STUDENTS ON THE AMERICAN COUNCIL ON EDUCATION PSYCHOLOGICAL EXAMINATION (ACE) AND THE PRE-ENGINEERING ABILITY TEST (PEAT) WHO ACHIEVE GIVEN LEVELS OF ACADEMIC SUCCESS

ACE / PEAT	Graduated	Changed Colleges and Graduated	Dropped	Total
Upper 1/3	16	2	12	30
Middle 1/3	8	5	17	30
Lower 1/3	3	4	23	30
Total	27	11	52	30

A total of 27 students in all three classifications graduated from the engineering program, 11 changed to other programs and graduated while 52 failed to complete the engineering course or any other type of program at Oklahoma State University. These findings indicate that about 30 per cent of the students who enter engineering take their degrees which is in line with the national trend.

In Table II the data referred to above are presented in the form of percentages. In developing expectancy tables for counselors about 500 cases should be utilized; it is unlikely that the addition of more cases would change the nature of the distribution. It is interesting to note that meaningful trends occur in the data of this study even though the number of cases falls far below an N of 500.

TABLE II

PERCENTAGE OF STUDENTS IN EACH CLASSIFICATION BASED ON TESTS ACHIEVING A GIVEN LEVEL OF ACADEMIC SUCCESS

ACE / PEAT	Graduated	Changed Colleges and Graduated	Dropped	Total
Upper 1/3	53.33%	6.67%	40.00%	100%
Middle 1/3	26.67%	16.67%	56.67%	100%
Lower 1/3	10.00%	13.33%	76.67%	100%

In looking at the results in Table II the outcomes suggest that if a student is in the upper third of the distribution of the ACE and PEAT and enrolled in the engineering curriculum at Oklahoma State University the chances are about 53 in 100 that he will graduate four years hence, about 7 in 100 that he will change to some other program and graduate, about 40 in 100 that he will drop out of school. If he is in the lower third of the distribution on the ACE and PEAT the changes are 10 in 100 he will graduate, about 12 in 100 that he will change programs and graduate, about 77 in 100 that he will drop out of Oklahoma State University. If the student is in the lower two-thirds of the distribution of the two tests the chances are 81 in 100 that he will change programs and graduate four years hence.

The Relationship Between Standing on the Tests and Criterion

In order to assess the extent to which standing on the tests was related to a level of academic success chi square was computed for the data in Table II. The statistical test was undertaken to determine if the two variables were independent. The chi square was found to be 10.40 which is significant at the five per cent level of confidence for four degrees of freedom, indicating that the hypothesis of independence may be rejected. When the degree of association was determined by converting chi square into the contingency coefficient the correlation was .32. Since the chi square met an acceptable level of statistical significance the degree of association indicated a real relationship.

This validity coefficient is in line with validity coefficients found in the literature. Laycock and Hutcheon found a correlation of .34 between first-year marks and the ACE.[25] Drake and Thomas found that

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[25]Laycock, Op. cit., p. 280-288.

the Pre-Engineering Test, in conjunction with either the ACE or centile rank in high school graduating class separated the high achieving students from the poor achieving students very well.[26] It is likely that the contingency coefficient would have been somewhat higher if the percentage of students in the top third of the distribution of the two tests, who dropped out of school, had been smaller. The use of the discriminant function may have raised this value somewhat, but this analysis was not concerned in assessing the efficiency of this technique.

Interest Patterns Related to Survival and Attrition in the Engineering Curriculum at Oklahoma State University

This portion of the investigation was undertaken to see if a greater percentage of students in the three classifications based upon the distribution of data for the two tests and who graduated from the Engineering College showed greater preferences on the Kuder Preference Record for mechanical, computational and scientific activities than students who changed programs and graduated or those who dropped out of school. The 75th percentile on a scale was used as the point at or above which interest was considered critical for a given subject.

The data in Table III a show that the abler students who graduated from the engineering program tended to exhibit a somewhat higher interest in activities of a scientific nature as measured by Scale 3 of the Kuder, while those who changed colleges and graduated showed little interest in mechanical and scientific activities. More than 66 percent of the students in the high group who dropped out indicated a preference for work of a mechanical nature, suggesting less interest in scientific activities as compared to the engineering graduates.

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[26] Drake, Op. cit., p. 275-276.

TABLE III a

PERCENTAGES OF SUBJECTS IN THE UPPER THIRD OF THE TWO ABILITY TESTS SCORING ABOVE THE 75th PERCENTILE ON THE MECHANICAL, COMPUTATIONAL AND SCIENTIFIC SCALES OF THE KUDER PREFERENCE RECORD WHO ACHIEVED A GIVEN ACADEMIC LEVEL

Upper 1/3

	Graduated	Changed Colleges and Graduated	Dropped
Mechanical Scale	56.25%	100%*	66.67%
Computational Scale	18.75%	50.00%	41.67%
Scientific Scale	68.75%	100%*	58.33%

*percentage of students below the 75th percentile

The results in Table III b indicated greater preference among the graduates for mechanical activities as measured by the Kuder than for computational or scientific activities. This pattern tended to characterize the dropouts in this classification also. This might suggest that the subjects in the middle range of ability, with the exception of those who changed colleges and graduated, were more mechanically minded, more "practical" in their technical preferences than the subjects in the top range of ability who graduated.

TABLE III b

PERCENTAGES OF SUBJECTS IN THE MIDDLE THIRD OF THE TWO ABILITY TESTS SCORING ABOVE THE 75th PERCENTILE ON THE MECHANICAL, COMPUTATIONAL AND SCIENTIFIC SCALES OF THE KUDER PREFERENCE RECORD WHO ACHIEVED A GIVEN ACADEMIC LEVEL

Middle 1/3

	Graduated	Changed Colleges and Graduated	Dropped
Mechanical Scale	62.50%	20%	47.06%
Computational Scale	50.00%	20%	5.88%
Scientific Scale	50.00%	20%	17.65%

The data in Table III c are more difficult to interpret. Interest preferences for the students in the lower third of ability who graduated are not clearly defined. At least a third stated interests in computational activities, but none of them indicated preferences for mechanical or scientific activities. The dropouts tended to indicate more clearly defined interests in mechanical and scientific work. The low ability students who dropout may be interested in the work that engineers do but cannot master the program of training. The low ability students, however, who graduated achieved despite limited ability and lack of clearly defined preferences as measured by the three scales of the Kuder. The reasons for these outcomes are not clear unless it can be assumed that the small number of cases represent, in this instance, an atypical group of individuals.

TABLE III c

PERCENTAGES OF SUBJECTS IN THE LOWER THIRD OF THE TWO ABILITY TESTS SCORING ABOVE THE 75th PERCENTILE ON THE MECHANICAL, COMPUTATIONAL AND SCIENTIFIC SCALES OF THE KUDER PREFERENCE RECORD WHO ACHIEVED A GIVEN ACADEMIC LEVEL

Lower 1/3

	Graduated	Changed Colleges and Graduated	Dropped
Mechanical Scale	100%*	50.00%	47.83%
Computational Scale	33.33%	100%*	26.09%
Scientific Scale	100%*	25.00%	52.17%

* percentage of students below the 75th percentile

Grade Point Averages of Students Who Graduated From The Engineering College, Changed Colleges and Graduated, Dropped Out

The over-all grade point averages of the subjects in all three

ability groups were computed at the completion or termination of a program. The data are presented in Table IV a, Table IV b, and Table IV c. The results are presented in terms of percentages of students achieving a given level of academic performance.

The results in Table IV a indicate that in the high ability group 67.50 per cent of the students who graduated from the engineering program achieved a grade point average of 3.00 or better. A significant observation is that 58.33 per cent of the students in the high ability group who dropped out got a grade point average of 3.00 or better. In fact, 75.00 per cent of the students who dropped out were doing acceptable academic work. This represents a significant loss of talent. These students may have felt that the program was not meeting their needs or they did not possess the necessary drive to deal with the demands of this exacting program. The students who changed to other programs did acceptable work at a more modest level of academic achievement.

TABLE IV a

PERCENTAGES OF SUBJECTS IN THE UPPER THIRD OF THE TWO ABILITY TESTS WHO ACHIEVED GIVEN GRADE POINT AVERAGES AT THE COMPLETION OR TERMINATION OF THEIR PROGRAMS

Upper 1/3

	Graduated	Changed Colleges and Graduated	Dropped
3.00 pt. or Better*	67.50%		58.33%
2.00 pt. or Better **	32.50%	100%	16.67%
Less than 2.00 pt.***			25.00%

*letter grades of B and above
**letter grades of C
***letter grades of D and below

In Table IV b 62.50 per cent of the students who graduated from the Engineering program received grade point averages of 2.00 or better, while 37.50 per cent were achieving grade point averages of 3.00 or better. Eighty per cent of the students in this middle third of ability received grade point averages of 2.00 or better. Nearly half of the dropouts in this group were obtaining failing grades.

TABLE IV b

PERCENTAGES OF SUBJECTS IN THE MIDDLE THIRD OF THE TWO ABILITY TESTS WHO ACHIEVED GIVEN GRADE POINT AVERAGES AT THE COMPLETION OR TERMINATION OF THEIR PROGRAMS

Middle 1/3

	Graduated	Changed Colleges and Graduated	Dropped
3.00 pt. or Better	37.50%	20.00%	5.88%
2.00 pt. or Better	62.50%	80.00%	47.06%
Less than 2.00 pt.			47.06%

In Table IV c, the group falling into the lower third in ability, none of the students who graduated from the engineering curriculum, or those who changed colleges and graduated, received grade point averages of 3.00 or better. Twenty-two per cent of the dropouts were making grade point averages of 2.00 or better, but more than three quarters of this group were making less than a grade point average of 2.00 at the termination of their work.

TABLE IV c

PERCENTAGES OF SUBJECTS IN THE LOWER THIRD OF THE TWO ABILITY TESTS WHO ACHIEVED GIVEN GRADE POINT AVERAGES AT THE COMPLETION OR TERMINATION OF THEIR PROGRAMS

Lower 1/3

	Graduated	Changed Colleges and Graduated	Dropped
3.00 pt. or Better			
2.00 pt. or Better	100%	100%	21.75%
Less than 2.00 pt.			78.25%

The relation between grades and survival and attrition are rather clearly indicated in these tables. The students with high ability tend to do well in the engineering curriculum, although the number of drop-outs in the high ability group is too high. Students with lesser degrees of ability seem to change to other programs and graduate or drop out of school.

Mean Ages of the Students at the Time of Admission to the Program

The data in Table V concerning the ages of the students at the time of admission to the engineering program imply certain trends. The mean age of the students in the top ability group who graduated from the engineering curriculum is 19 years, 8 months, while the mean age of students in the high ability group who dropped out of school is lower. It is possible that the younger students in the abler group have adjustment problems to contend with that the older students do not experience.

TABLE V

MEAN AGES OF THE STUDENTS AT THE TIME OF ADMISSION TO THE PROGRAM IN THE THREE ABILITY GROUPINGS WHO GRADUATED FROM THE ENGINEERING PROGRAM, CHANGED COLLEGES AND GRADUATED, DROPPED OUT

ACE PEAT	Graduated	Changed Colleges and Graduated	Dropped
Upper 1/3	19 yr. 8 mo.	17 yr. 9 mo.	17 yr. 2 mo.
Middle 1/3	19 yr. 2 mo.	18 yr. 2 mo.	19 yr. 1 mo.
Lower 1/3	21 yr. 5 mo.	18 yr. 5 mo.	19 yr. 3 mo.

It should be observed that the students in the lower third of ability who graduated from the engineering program were somewhat older on the average than the students in the top third who graduated. These older students may have disciplined themselves to continue in the program even though they were not completely certain that it was the best for them because of limited abilities and uncertain interests.

The significant fact in these data, it seems, is that the abler students who dropped out are, on the average, less mature than the others. This finding has implications for the counseling program.

The data reviewed in this part of the report is summarized in the following section.

CHAPTER V

SUMMARY AND CONCLUSIONS

This study was undertaken to investigate the extent to which certain data obtained on a group of male student who entered the College of Engineering at Oklahoma State University in September 1953 could be employed in making assessments concerning the academic success achieved by these students. Since, within recent months, a great deal of emphasis is being placed upon a more complete understanding of the variables which are related to success in high level scientific programs it was deemed worthwhile to re-examine certain of these factors in connection with the performance of students in the engineering curriculum at Oklahoma State University.

The procedure of the investigation was to select ninety students four years after admission to the College of Engineering and to place them into three classifications on the basis of comparable scores on the American Council on Education Psychological Examination and the Pre-Engineering Ability Test. The upper third of the group consisted of those students whose scores on the two tests put them into the top third of the distribution of test scores for college freshmen; the middle third consisted of those whose scores on the two tests put them into the middle third of the distribution; the lower third consisted of those whose scores put them into the lower third of the distribution. The students were compared with data collected from a number of colleges throughout the country.

The analysis involved an examination of the relationship between standing in the three classifications on the basis of the test results and (1) successful completion of the engineering program, (2) change of college and successful completion of the program, (3) dropping out of school. In addition, the following were investigated: (1) the percentages of individuals in each classification and each criterion group who reached critical levels (the 75th percentile) on the Mechanical, Computational, Scientific scales of the Kuder, (2) the percentages of individuals in each classification and criterion group who reached or exceeded given grade point averages at the end of four years or at the termination of a program, (3) the mean age of the students in each classification and each criterion group at the time of admission to Oklahoma State University.

Summary of Results

The results of the investigation may be summarized briefly as follows:

(1) When an expectancy table is prepared on the basis of the data obtained in this investigation the chances are 53 in 100 that the abler students will graduate from the engineering program at Oklahoma State University, about 7 in 100 that they will change programs and graduate, 40 in 100 that they will drop out of school.

(2) For the students in the middle third of ability the chances are about 27 in 100 that they will graduate from the engineering program, about 17 in 100 that they will change programs and graduate, about 57 in 100 that they will drop out.

(3) For students in the lower third of ability as measured by the

two tests the chances are 10 in 100 they will graduate, 13 in 100 that they will change schools and graduate, about 77 in 100 that they will drop out.

(4) The degree of association between classification on the tests and survival and attrition was .32 (contingency coefficient); chi square was significant at the 5 per cent level of confidence for four degrees of freedom, which suggested that the degree of association was statistically significant.

(5) The interest patterns obtained on the Kuder indicated that the abler students who graduated from the engineering program tended to have marked preferences for scientific work, with a somewhat less marked preference for work of a mechanical nature, while the dropouts in this group had higher mechanical interest.

(6) The students in the middle third of ability had a greater preference for mechanical activities, which held true for the dropouts.

(7) The students in the lower third of ability who graduated had a low preference for work of a mechanical and scientific nature, while the interests of the dropouts in this group were higher on these two scales.

(8) In none of the three classifications of students who changed programs and graduated were preferences in mechanical and scientific activities present to any great degree.

(9) Two-thirds of the students in the upper third of ability who graduated from the engineering program had over-all grade point averages of 3.00 or better at the time of graduation, while 58 per cent of the dropouts in the high ability group

had over-all grade point averages as high. Twenty-five per cent of the dropouts had grade point averages under 2.00 at the time of the termination of a program.

(10) Thirty-eight per cent of the students in the middle third of ability who graduated had over-all grade point averages of 3.00 or above, while 47 per cent of the dropouts had failing grades; eighty per cent of the students in this classification who changed schools and graduated had over-all grade point averages of 2.00 or better.

(11) The percentage of students in the lower third of ability who graduated made C grades; more than 78 per cent of the dropouts in this group had failing grades.

(12) When the mean age of the students at the time of admission was examined for each classification and each criterion group it was observed that the mean age for the high ability group who graduated from the Engineering College was 19 years, 8 months, while the mean age of the dropouts was 17 years, 2 months.

(13) The mean age of the students in the lower third of ability who graduated was highest of all, 21 years, 5 months.

(14) The mean age of the students in the top third who changed schools and graduated was 17 years, 9 months, which represented the second youngest age group.

Concluding Remarks

Several observations may be made that have arisen as a result of the analysis of the data. These may be stated briefly as follows:

(1) Although the brighter students seem to be able to handle the

work in the engineering program more capably than the somewhat less able individuals, too many of the brighter students drop out of the engineering program.

(2) This high drop out rate may be related to immaturity since the individuals in this group tend to be almost a year younger than the other students at the time of admission.

(3) This would suggest that the students in this group need counseling assistance to help them deal more effectively with the adjustment problems they are likely to encounter on the university campus.

(4) The high ability students who graduated from the Engineering College had high theoretical and scientific interests, while the students with less ability who graduated and the dropouts had more clearly defined mechanical interests.

The outcome that seems most significant is that too many of the students in the top third of ability as determined by the two aptitude tests failed to complete the engineering program. That this group as a whole is immature is certainly a significant factor. However, other factors are probably operating that need further investigation. Questions that might be asked are: (1) what are the academic and social backgrounds of these students? (2) what special skills do they possess? (3) what goals and values do they embrace? (4) what characteristics of temperament and personality do they possess? (5) what counseling techniques are most effective with these students? The need to understand more fully the adjustment difficulties of the abler student is greater now than ever.

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