

SCHOLARSHIP, INTELLIGENCE AND PERSONALITY

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That a science may become exact it is necessary that it become more or less mathematical, and until its phenomena are related if not explained by means of mathematical equations or in numbers, its deductions must be based on observations whose interpretations are largely matters of opinion. Of course a set of observations may lead to a conclusion which may be formally enunciated as a law which may not be mathematical in form, but nevertheless it is based on the laws of probability.

Again a science, mathematical or non-mathematical, is no truer than the set of assumptions on which it is based. These assumptions may be purely arbitrary or be based on probability, and we judge the reliability and the validity of the assumptions according to the consistency of the results deduced from them. In other words the final test is whether one may safely forecast results. The dangers of extrapolation are well known so that one must use extreme care in making deductions whose scope is greater than the scope of the observations upon which the set of assumptions was made.

At the present time psychologists and educationists are in the throes of testing and they busy themselves in devising various and sundry tests for determining the gifts and talents, or the lack of them, in individuals and sets of individuals. Munsterburg, of Harvard, began the application of such tests in business and since his time most psychologists and educators, good, bad, or indifferent, have entered into the game, so that now the field of mental science and its principal branches, education, business psychology, abnormal psychology and penology, have been reduced to observational studies whose conclusions should depend largely on the laws of probability as enunciated by various statistical formulas.

Modern scientific magazines contain many statistical studies of one kind or another in which the authors prove or think they prove that when certain sets of conditions exist one may conclude that certain results will follow. Other studies, in which the authors are not so speculative or overzealous, give the results of a large number of observations and point out the attributes which seem to be related through cause and effect or which may depend on a common cause but may be more or less independent of each other. The reliability and validity of the conclusions, however, depend in every case on the reliability and validity of the tests or observational methods employed. By reliability is meant the degree of accuracy with which a test or observation measures what it is designed to measure, and by validity is meant the degree with which a test actually measures what it was designed to measure. It is just here that most tests and observations are open to question, so that any conclusions that may be drawn or any speculations that may be made must await confirmation or rejection according to what follows after a sufficient period of time has elapsed.

The results to be discussed in this paper are based on three distinct sets of measurements and observations made on the class of engineers who graduated at Purdue University in 1930. The first set of data was obtained through the orientation tests given to those engineers by the University Division of Educa-

tional Reference in the fall of 1926. The test whose results are discussed here was the Psychological Examination of the American Council on Education prepared by Dr. L. L. Thurstone, of the University of Chicago, and it will be referred to here as the test of intelligence. The second set of data was obtained from Mr. J. E. Walters, Director of Personnel in the engineering schools at Purdue and these data are known as personality ratings and referred to here as personality. The traits of personality, namely, Address and Manner, Attitude, Character, Cooperative Ability, Disposition, Industry, Initiative, Judgment, Leadership, and Native Capacity, were rated for each student by the fifteen references given by the student and which included five teachers, five students and five others. Each trait is rated on the basis of 10 and the general personality rating of each student is the average of his ten ratings. The third set of data was derived from the grades made by these students at Purdue and will be referred to here as scholarship. Mr. Walters also secured these and supplied them to the author.

Three distinct studies were made under the author's direction during three different years by classes in mathematical statistics. Each member of a class was assigned a certain portion of the study and then the results were compiled and the work carried to completion. The names of the members of the three classes whose work forms the basis of this report are given at the end of this paper.

The first study was made in the year 1927-1928 when the group of students studied were Sophomores. Of these Sophomore engineers there were 423 whose personality records were complete, with an average personality rating of 7.2. The average of the Freshman grades of 424 of these students was 80.7, and the general psychological test average for 461 of these students was 59.6. A random sample of 100 students whose records were complete was chosen with the following averages: Freshman grades, $81.53 \pm .459$; intelligence test, 59.56 ± 1.78 ; personality, $7.31 \pm .042$. The difference of these averages from the averages of the whole class are such as would be expected in random sampling. Using the subscripts 1, 2, 3, to refer to grades, intelligence and personality, respectively, the following correlations were determined: $r_{12} = .458 \pm .0532$, $r_{13} = .610 \pm .0424$, $r_{23} = .286 \pm .0619$, $r_{12.3} = .84$, $r_{13.2} = .566$, $r_{23.1} = .010$. These partial correlation coefficients indicate a high correlation between grades and intelligence, a lesser, but still significant, relation between grades and personality, and practically no relationship between intelligence and personality. The first result is to be expected. The second result raises the question of the possible influence of personality in the teacher's grading. However, as only one third of the students' references were teachers, this influence is probably not as serious as it might at first seem. The third result is surprising and interesting but not inconsistent with the results of other observations.

The regression equation for the whole class is:

$$X_1 = .113(X_2 - 59.6) + 6.1(X_3 - 7.2) + 80.7,$$

and the multiple correlation coefficient is $r_{1.23} = .679$. As a check on this multiple correlation coefficient and the regression equation, a sample of 53 student records was taken by Mr. Walters and their actual grade averages were compared with those predicted by the equation with the resultant multiple coefficient equal to .694, which checks very well. This value would indicate that one would not be justified in predicting the Freshman grade average for any given individual whose intelligence and personality ratings were known, but that for a group of individuals from a given county or large city the formula might be used.

The second study was made during 1928-1929 by taking another random sample of 100 of these engineers and comparing their Freshman grades with their intelligence ratings and their particular personality traits of Industry and Judgment. Using the subscripts 1, 2, 3, 4, to refer to grades, intelligence, industry and judgment, respectively, the following results were obtained:

$$\begin{aligned}
 A_1 &= 81.5, \quad A_2 = 59.5, \quad A_3 = 7.64, \quad A_4 = 7.22, \\
 r_{12} &= .44 \pm .081, \quad r_{13} = .65 \pm .058, \quad r_{23} = .18 \pm .097, \quad r_{14} = .58 \pm .066, \\
 r_{24} &= .28 \pm .092, \quad r_{34} = .68 \pm .054, \\
 r_{12.3} &= .434 \pm .081, \quad r_{12.4} = .357 \pm .087, \quad r_{23.4} = -.015 \pm .100, \\
 r_{13.4} &= .43 \pm .082, \quad r_{13.2} = .654 \pm .057, \quad r_{14.2} = .534 \pm .072, \\
 r_{24.3} &= .220 \pm .095, \quad r_{14.3} = .25 \pm .094, \quad r_{23.1} = .156 \pm .098, \\
 r_{24.1} &= .034 \pm .100, \quad r_{34.2} = .670 \pm .055, \quad r_{34.1} = .49 \pm .076, \\
 r_{12.34} &= .403 \pm .083, \quad r_{13.24} = .469 \pm .078, \quad r_{23.14} = -.199 \pm .096, \\
 r_{14.23} &= .172 \pm .097, \quad r_{24.13} = .128 \pm .098, \quad r_{34.12} = .500 \pm .075.
 \end{aligned}$$

These results indicate some relationship between grades and intelligence and between grades and industry, but nothing significant between grades and judgment. There is some relationship between industry and judgment but practically none between intelligence and industry and none between intelligence and judgment, the negative value for $r_{23.14}$, if at all significant, indicates an inverse relationship between intelligence and industry. These results may arise out of mass education, since the brighter student must in general follow the pace set by the mediocre student and the slower student. Also possibly the subject matter of many of the courses may leave little to the judgment of the student. There is much food for thought in these results.

From the above data the following regression equations were obtained:

$$\begin{aligned}
 X_1 &= .115(X_2 - 59.5) + 81.5, \\
 X_1 &= .086(X_2 - 59.5) + 4.84(X_3 - 7.64) + 81.5, \\
 X_1 &= .0794(X_2 - 59.5) + 3.91(X_3 - 7.64) + 1.78(X_4 - 7.22) + 81.5.
 \end{aligned}$$

The corresponding multiple correlation coefficients are $r_{1.23} = .74 \pm .045$, and $r_{1.234} = .748 \pm .044$. For a random sample of 25 students, where their actual grades were compared with the grades predicted by the last two regression equations, the values $r_{1.23} = .785 \pm .035$, $r_{1.234} = .79 \pm .045$, were obtained, which agree very well and indicate that the regression equations might be used in predicting not what any individual might do, but what a group of individuals might be expected to do in scholarship in their Freshman year.

The third study was made during 1929-1930, and a new set of personality ratings obtained during the Junior year of the class of 1930 was used. Also the average of the grades of each of these students was obtained for their first three years in Purdue, and then these students were classified according to rank in scholarship and grouped into ten groups, the ten per cent whose averages were the lowest being given the rank value one, and the ten percent whose averages were the highest being given the rank value ten, with the other eight groups ranked in between. Also the grades were not expressed in percentages but were determined by the formula

$$S = \frac{6.5H + 5A + 4B + 3P + 2C + 1D + 1F}{H + A + B + P + C + D + F},$$

where H,A,B,P,C,D,F are the numbers of semester hours in which those particular letter grades were received. The intelligence test grades are still the same as in the previous two studies. There were only 350 students left of the original group for whom the data on grades and personality were complete and only 210 of these for whom all three sets of data were complete. Using the subscripts 1,2,3 to refer to grades, intelligence and personality, respectively, the following results for the 350 students were found: $A_1 = 5.77$, $A_3 = 5.465$, $r_{13} = .571$. Thus there is still a significant relationship between scholarship and personality, but it is not quite so high as in the first study where $r_{13} = .610$.

The preliminary results for the 210 students for whom all the data were complete are as follows:

$$A_1 = 5.24 \pm .128, A_2 = 67.57 \pm 1.13, A_3 = 5.066 \pm .133, \\ r_{12} = .368 \pm .0402, r_{13} = .551 \pm .0324, r_{23} = .165 \pm .053.$$

The difference between the grade averages A for the 350 students and the sample of 210 students is just about sufficient to indicate a lower scholarship standard for the smaller group. No explanation has been given for this. The intelligence average for this group, however, is significantly higher than for the original group studied as Freshmen. The correlation between grades and personality is still significant, but the relation between grades and intelligence is distinctly less than for the Freshman grades and intelligence. This would indicate that the intelligence test loses its value for forecasting results for even a group, as the group as a whole continues its study. There appears to be little relation between intelligence and personality, as was also found in the previous studies.

Continuing the study of these 210 students the results are $r_{12,3} = .340 \pm .0411$, $r_{13,2} = .536 \pm .0331$, $r_{23,1} = -.047 \pm .0464$, which further confirm the preceding results. It would thus appear that there is a closer relation between scholarship and personality when these are brought up to date than between the intelligence test given in the Freshman year and the average grade of three years of subsequent work. In fact the intelligence test given at the beginning of the Freshman year is of little value for the purpose of predicting the scholarship of even a large group of students during their college course. This may be due to a number of causes. First, this widely used intelligence test may be neither valid nor reliable. This, of course, cannot be settled here. Second, the large number of students withdrawing includes both strong and weak students, but generally more of the latter class, and as the remaining students continue into the more advanced courses of their choice where their interest is certainly greater than in the required courses, their work will be of a higher standard with the corresponding higher grades. This would indicate that a display of intelligence depends to a certain extent upon the attitude of the individual, or the intelligence displayed may up to a certain point vary directly as the interest of the individual is aroused. Hence any intelligence test which ignores that fact fails to a certain degree to accomplish its purpose. Third, one may even question whether the results of the correlation methods are valid. However, the methods of correlation are the methods of the theory of least squares which are the best we have, and the results based on this theory have proved fairly reliable in other scientific work. And, fourth, many factors that enter into the determination of grades, due to the lack of uniformity and standardization, are not taken into account in the bare grade data, so that grades may not be as great a measure of intelligence and scholarship as we have been inclined to believe. They may measure industry to a far greater degree than we realize, and

hence what we call scholarship may not be so much a measure of intelligence as it is a measure of industry and interest and the other factors of personality.

In conclusion these studies seem to indicate that grades which are used to measure scholarship are not so much a measure of intelligence as they are a measure of personality, as personality is defined here. They indicate further the necessity of a reevaluation of our grading methods so that they may be both reliable and valid. And finally they show that one may not safely use an intelligence test, which may or may not be valid and reliable, as a means of predicting the scholarship performance of an individual or a small group of individuals over any great period of time subsequent to the test.

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