

EDWARD BAUMAN,
*Lakehead University,
 Thunder Bay, Ontario.*

GROUP IQ SCORES AS PREDICTORS OF SUCCESS IN SECONDARY SCHOOLS: A RE-EVALUATION*

ABSTRACT: The purpose of this study was to re-evaluate the use of group IQ scores as predictors of academic grades and high-school completion in the light of recent changes in high-school curriculum content. A 10 percent random sample of students entering Grade 9 in Thunder Bay, Ontario, high schools in 1962 was studied. Mean IQ's are reported for students in the 4- and 5-year programs. Correlations between IQ and marks earned in each of 13 high school subjects were computed and correlations between grade averages and IQ. The proportion of students completing each grade was computed for each of several IQ levels. The correlations between IQ and grades in vocational courses were lower than the correlations between IQ and academic course grades. It is suggested that a minimum IQ of 80 is required for the vocational 4-year program while a minimum of 100 is needed for the 5-year academic program. If students have at least the minimum ability, then factors other than IQ become the primary determinants of success in secondary school.

Intelligence test scores have traditionally been regarded as one of the primary predictors of academic success. In the past considerable research was invested in establishing the relationship between IQ scores and academic achievement in elementary and secondary schools. Pintner (1945) found that correlations between intelligence test scores and high school marks ranged between .28 and .60 with few below .40. Aaron (1946) summarized 24 studies in which intelligence scores were correlated with high school achievement and reported correlations ranging from .25 to .65 with a median of .48. McClelland (1942) reported a correlation of .70 between IQ scores and secondary school achievement. Further research of this type is reviewed by Bhatnagar (1967). Most of such studies, however, were published more than 15 years ago, and relatively few studies of the usefulness of IQ for academic prediction have appeared in recent years.

The present study was prompted by the realization that the curriculum in secondary schools is rapidly changing. Twenty years ago secondary schools still emphasized the core academic subjects such as Math, English, Science and History. Since that time, however, many new course options of a non-academic nature such as driver education,

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arts, crafts, and vocational skills courses have been introduced. Although it had been established that IQ scores were reasonably valid predictors of academic success in an academic secondary school program it remains to be seen whether IQ scores are equally useful for the prediction of success in vocationally oriented secondary school programs as we have them today.

A further consideration was the fact that although we do have figures giving general correlations between IQ and achievement, we do not have enough information to make IQ scores truly useful in individual counseling. As a result we find it difficult to say, for example, whether a boy with an IQ of 95 should attempt an academic high-school program. What is needed is a set of actuarial tables, preferably for each local district, to help the counselor make the best use of the IQ scores in counseling.

The purpose of the present study was to answer practical questions such as the following. Is there a greater correlation between IQ and grades in core academic subjects such as English and Math than between IQ and grades in non-academic subjects like Typing or Physical Education? What is the probability for a student of given IQ of completing an academic high school program today? What correlation is there between IQ and over all grade average in secondary school? What is the average IQ of students in the vocational courses as compared to those in an academic program? In order to answer questions like these a follow-up study was done on a representative sample of students who entered Grade 9 in Thunder Bay secondary schools in 1962.

METHOD

Subjects

A 10 percent sample of the 1962 class of freshmen entering Grade 9 in the secondary schools of Thunder Bay, a city of over 100,000 population in Northwestern Ontario, Canada, was selected for study. In order to insure against bias in the sample the records of every tenth student were selected from the school files. In cases where the selected files were not complete because the needed information was not recorded, and in cases where the students transferred to another district the next file was selected instead of the tenth. In this way a sample of 171 student records was obtained.

The high-school programs offered to students at that time consisted primarily of two streams or levels, the 4-year and the 5-year program. The 5-year program, which includes Grade 13, prepares students for university entrance, the 5th year being equivalent to the first year of university in the U.S.A. and in many provinces of Canada. Within the 5-year program there were three majors: Arts and Science, Commercial, and Technology and Trades. Since the vast majority of students chose the Arts and Science program the other two options were not considered separately in this paper. The 5-year program stresses thorough academic training and is different in content and level from the 4-year program even in Grade 9. A higher standard

in terms of assignments and performance is required of students in the 5-year program at all levels, and students who enter this program usually show good academic promise. The 4-year program, on the other hand, is for those students who do not intend to pursue post-secondary education. It too offers the student a choice of majors in Arts and Science, Commercial, or Technology and Trades. Most of the students chose the latter two majors. The aim of the 4-year program is to give students some vocational training and thus to prepare them to find employment upon completion of Grade 12. Students in this program often choose to learn one of the skilled or semi-skilled trades or prepare for such careers as secretary, stenographer, or book-keeper. Sometimes the 4- and 5-year programs are referred to as the vocational and the academic streams.

Procedure

In order to insure anonymity, all identifying information was removed, and each student was identified only by a number. Data were then collected on IQ, marks obtained in each subject, last year of high school completion, and whether the student was in the 4- or 5-year program. The IQ scores were derived from the Dominion Group Test of Learning Capacity or the Otis Gamma. These group IQ tests were administered routinely to entering freshmen in 1962.

RESULTS

The data were punched onto computer cards and correlations were computed by the Lakehead University Computer. The mean IQ of students in the 5-year program was 111.3 (SD = 9.59). Only one student with an IQ of less than 100 attempted this program. The variability of mean IQ over grades in the 5-year program was very small, ranging from 109.81 in Grade 9 to 112.59 in Grade 13. It can be seen, therefore, that the mean IQ was fairly constant for all grades in the 5-year program.

The mean IQ for students in the 4-year program was 100.07 (SD = 9.75, range = 74-134). Again the mean IQ of this group was constant and did not fluctuate more than one or two points from Grade 9 to Grade 12. It can be seen that the mean IQ of students in the 5-year program is 11 points higher than that of the 4-year students. Most of the 5-year students scored in the 110-119 range, whereas the majority of the 4 year students scored in the 90-99 range.

The correlation between IQ and school grades for the entire sample was .44. This figure agrees well with the findings of Aaron (1946).

The correlations of IQ with marks in different subjects were calculated separately for the 4- and 5-year streams and for the total sample and are presented Tables 1 and 2.

In cases where the number of entries in a cell was less than 5, the cell was left blank. Since the number of entries varied greatly, some correlations which appear to be large are not significantly different from chance, while smaller correlations based on a larger N

TABLE 1

Correlations of IQ and Marks in School Subjects
for Four and Five-year Streams by Grades

Subject	4-Year Program Grades				5-Year Program Grades				
	9	10	11	12	9	10	11	12	13
Math	-.07	.16	.12	.19	.25	.34*	.24	.16	.48
English (average)	.36*	.23	.47*	.57*	.29	.34*	.30	.26	.15
History	.26	.13	.51**	.35	.24	.27	.36*	.13	-.09
Science(s)	.12	-.04	.05	.12	.23	.35*	.19	.14	.28
French	-.15	-.20	—	—	.13	.44**	.25	.09	.54**
Physical Education	.43**	.24	.37	.08	.14	.28	.42**	.31	—
Typing	-.03	.10	.35	—	.36	-.08	—	—	—
Business Practice	-.02	—	.13	.78	.08	—	—	—	—
Book- keeping	—	.13	.90**	.24	—	—	—	—	—
Penman- ship	-.03	.04	.65	—	—	—	—	—	—
Home Eco- nomics	.82*	.19	—	—	—	—	—	—	—
Machine Shop	-.12	.07	.01	—	—	—	—	—	—
Drafting	—	-.79*	—	—	—	—	—	—	—
All Courses	.23*	.14	.54**	.49**	.34*	.38**	.04	.16	.39*
N for Total Grade	88	67	41	35	48	42	42	.37	27

* $p < .05$ ** $p < .01$

reach significance. Tables 1 and 2 show that the correlations between IQ and average grade vary considerably from year to year. The relationship between these two variables is strongest at the beginning and end of secondary school, and weakest in the middle years. In general there is little relationship between success in vocational courses such as typing, business practice, or machine shop, and intelligence scores. It is a little surprising to see that in the 4-year program success in academic subjects such as math, science, and French is totally unrelated to intelligence. English was the only subject in the 4-year stream which showed a consistent correlation with IQ.

The correlation between IQ and success in academic subjects is much stronger within the 5 year program, but even there the trend is inconsistent and the majority of correlations do not reach significance, perhaps due to the small size of the sample.

The analysis of the data for the combined groups gives us the advantage of a larger sample size. It can readily be seen that again the correlations between IQ and grades in academic courses are generally higher than the vocational courses. Although success in English,

TABLE 2
Correlation of IQ and Marks in School Subjects
for 4- and 5-Year Streams Combined

Subject	Combined 4-Yr. and 5-Yr.				
	9	10	11	12	13
Math.....	.19	.17	.21	.12	.57*
English (average).....	.42**	.35**	.37**	.26	.14
History.....	.34**	.25*	.36**	.17	-.41
Science(s).....	.27**	.27*	.16	.13	.36
French.....	.07	.20	.36*	.19	.54*
Physical Education.....	.45**	.37**	.39**	.25	—
Typing.....	—	—	—	—	—
Business Practice.....	.03	—	—	.78	—
Bookkeeping.....	—	.15	.83**	.25	—
Penmanship.....	.03	-.04	-.40	—	—
Home Economics.....	.61*	.20	.09	—	—
Machine Shop.....	-.04	-.05	-.38	—	—
Drafting.....	—	-.78*	—	.62	—
All Courses.....	.41**	.36**	.10	.25*	.36*
N for Total Grade.....	136	109	83	72	29

* $p < .05$
** $p < .01$

history, and science is significantly correlated with IQ in grades 9 and 10, the strength of this relationship diminishes rapidly in the upper grades. On the other hand, there is little correlation between IQ and success in math or French during the first years of high school, but a significant correlation in the final year. One must conclude from this that the value of an IQ score for predicting success in academic subjects varies from year to year and from subject to subject.

The relationship between IQ and overall average grade in each year is presented in Tables 3 and 4. These tables show us the average grade earned by students in different IQ ranges. For example, it can be seen that few students with IQ's in the 90-99 range will receive an average grade of above 70 either in the 4- or the 5-year program. It is most likely that a student with IQ in that range will scarcely pass and will never be at the top of the class, although it can also be seen from the tables that the majority of students in the sample earned the average grades of 50 to 59 percent.

The data for the 4- and 5-year students were analyzed to see whether completion of the high-school program could be predicted from IQ. These data are presented in Tables 5 and 6. These tables show the proportion of students with given IQ who completed a given grade. For example, Table 5 indicates that approximately one-third of the students with IQs in the 90-99 range completed Grade 12 of the 4-year program and two-thirds completed Grade 10. Students with an IQ in this range would rarely attempt a 5-year course. If the student's IQ was in the 80-89 range the proportion completing Grade 12 in the 4-year program drops to 22 percent and the proportion com-

TABLE 3
Distribution of Academic Grades in Relation to IQ (4-yr.)
Reported in Percentages

IQ	Grades					Sample size
	Under 50	50-59	60-69	70-79	80 & +	
120 & Above.....	33.33		33.33		33.33	n = 3
110-119.....	30.00	40.00	10.00	20.00		n = 10
100-109.....	7.50	47.50	40.00	5.00		n = 40
90-99.....	16.33	53.06	26.53	4.09		n = 49
80-89.....	19.23	46.15	34.26			n = 26
Under 80.....	66.66	33.33				n = 3
All IQ levels combined ..	16.80	47.20	30.50	4.65	0.85	N = 131

TABLE 4
Distribution of Academic Grades in Relation to IQ (5-Yr.)
Reported in Percentages

IQ	Grades					Sample size
	Under 50	50-59	60-69	70-79	80 & +	
120 & Above.....		28.57	28.57	14.28	28.57	n = 7
110-119.....	5.55	27.77	33.33	33.33		n = 18
100-109.....		60.00	20.00	13.33	6.66	n = 15
Under 100.....		50.00	50.00			n = 2
All IQ levels combined...	2.40	40.50	28.60	21.40	7.10	N = 42

pleting Grade 10 to 52 percent. Since there were very few students in the extreme upper or lower IQ ranges the figures are unreliable for students under IQ 80 or above IQ 120. Tables 5 and 6 show that the dropout rate was much higher in the 4-year program than in the 5-year program even for students of the same IQ. This fact suggests that factors other than IQ contribute substantially to the dropout rate, especially in the 4-year program.

The occupations of the fathers of the students were rated using the Blishen (1958) scale in order to see whether there was any

TABLE 5
 Percentages of Students Completing Each Grade by IQ Levels
 (4 - yr.)

IQ	Grades				Sample size
	9	10	11	12	
120 & Above.....	67	67	33	33	n = 3
110-119.....	100	89	78	45	n = 9
100-109.....	95	70	53	48	n = 40
90-99.....	80	62	40	32	n = 49
80-89.....	89	52	26	22	n = 27
Under 80.....	67	33			n = 3
All IQ levels combined.	87	63	43	35	N = 131

TABLE 6
 Percentage of Students Completing Each Grade by IQ Levels
 (5 - Yr.)

IQ	Grades					Sample size
	9	10	11	12	13	
120 & Above.....	100	100	100	83	50	n = 6
110-119.....	100	94	89	89	72	n = 18
100-109.....	100	100	100	87	60	n = 15
90-99.....	100	100	—	—	—	n = 1
All IQ levels combined...	100	98	93	85	63	n = 40

relationship between occupational status and probability of completing high school. The data were analyzed using Chi Square, but no significant relationships were found ($X^2 = .237$; $df = 30$, $p = .80$).

DISCUSSION

It appears from the findings of this study that the correlation between IQ and average grades earned in high school has not changed much over the years despite any changes in the curriculum. The present correlation of .44 comes close to the median of .48 reported by Aaron

(1946) in her survey of 24 studies. We may conclude that an IQ score is as useful today as it ever was in predicting general academic success in secondary school, but this is not saying very much for its value as a predictive measure. If we examine the correlations between IQ and specific courses, we find considerable variability within courses over the 5 grades. For example, bookkeeping and I.Q. have a correlation of .83 in Grade 11, but very low correlations are found between these two variables in the other grades (See Table 1). One may suspect the validity of isolated high correlations like this when the other values are generally low and especially when a large number of correlations are computed. It should be noted that a wide scatter of correlation values occurs only in the vocational subjects. The correlations in the academic subjects are relatively consistent over grades. In general one can conclude that marks in English, history, science, and physical education courses are correlated with IQ in the first years of high school. Marks earned in other courses seem to be determined by factors other than intellectual ability.

The results of this study suggest that IQ is not a strong predictor of academic grades and that other factors are more important determinants of success. One might suggest that such factors as work habits and motivation be investigated as predictors of success in high school. An alternative explanation of the findings might be that group IQ scores are more unreliable than individually administered tests and this is why the correlations between IQ and grades were low. Since group intelligence tests are widely used in schools, however, it is appropriate that we should consider the predictive value of group test scores. Another explanation of the low correlations between IQ and grades might well be the unreliability of our criterion, namely high-school grades. By squaring the correlations between IQ and average grade earned we obtain the common variance between the two measures. Since the over-all correlation between grades earned and IQ is .44 we conclude that IQ accounts for about 19 percent of the variance in grades and that 81 percent of the variance is accounted for by factors other than IQ. If one squares the correlations between IQ and marks earned in the individual grades of the 4- and 5-year program one comes to the same conclusion: namely that IQ does not account for much of the variance in grades earned. This conclusion is supported further by the data on Tables 5 and 6. These tables indicate that many students with an IQ of 80-89 do finish Grade 12 of the 4-year program and students with an IQ of 100-109 have as good a chance of completing Grade 12 of the 5-year program as do those with higher IQ's.

The most reasonable interpretation of these findings is that a certain minimum IQ is required for successful completion of high school, and if a student possesses the minimum ability then factors other than IQ become the most important predictors of academic success. This research suggests that the minimum for the 4-year program is 80 and the minimum for the 5-year program is 100. The reason why the correlations between IQ and academic grades were low is that additional ability over and above the minimum required

does not necessarily increase the probability of getting better grades, or of completing the program. For example, bright students can be lazy and therefore may not achieve better grades than hard working students with minimal ability. The group IQ score is useful to the high-school guidance counselor to help him determine whether or not a student has the minimal ability required for a 4- or 5-year program. If the student has the minimum ability then factors other than IQ will be the primary determinants of academic success and high-school completion.

RESUME: Le but de cette étude était de ré-évaluer l'utilisation des cotes de Q.I. de groupe comme indice de prédiction de la réussite scolaire au niveau secondaire en tenant compte des changements récents dans le contenu des programmes.

On a étudié un échantillon aléatoire de 10% des étudiants commençant leur 9e année dans des écoles secondaires à Thunder Bay en Ontario en 1962. On a noté les Q.I. moyens pour les étudiants dans des programmes de quatre et cinq ans. On a calculé les corrélations entre les Q.I. et les notes scolaires obtenues dans chacune des treize matières de niveau secondaire, ainsi que les corrélations entre le rendement scolaire moyen et le Q.I. On a calculé la proportion d'étudiants terminant chaque année pour plusieurs niveaux de Q.I. Les corrélations entre le Q.I. et les notes dans les cours professionnels étaient plus basses que les corrélations entre le Q.I. et les notes de cours académiques. On suggère qu'un Q.I. minimum de 80 est requis pour le programme professionnel de quatre ans, tandis qu'un minimum de 100 est nécessaire pour le programme académique de cinq ans. Si les étudiants ont au moins la capacité minimum, des facteurs autres que le Q.I. deviennent alors les déterminants principaux du succès à l'école secondaire.

REFERENCES

- Aaron, S. The predictive value of cumulative test results. Unpublished doctoral dissertation, Stanford University, 1946.
- Bhatnagar, R. P. Intellectual factors as predictors of academic achievement: A review of research. *Education and Psychology Review*, 1967, 7, 166-173.
- Blishen, B. R. The construction and use of an occupational class scale. *Canadian Journal of Economics and Political Science*, 1958, 24, 519-531.
- McClelland, W. *Selection for secondary education*. London: University of London Press, 1942.
- Pintner, R. *Intelligence testing methods and results*. New York: Henry Holt, 1945.