AN INQUIRY INTO THE RELATIONSHIP BETWEEN CERTAIN DIFFERENTIAL APTITUDE TEST SCORES AND GRADES EARNED IN JUNIOR AND SENIOR HIGH SCHOOL INDUSTRIAL ARTS

A Thesis

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CHAPTER I

THE PROBLEM AND DEFINITIONS OF TERMS USED

For some time there has been a difference of opinion as to whether scores on the Differential Aptitute Tests can be used to predict success in industrial arts courses in non-vocational secondary schools. A limited amount of investigation has been done in this area on the junior and senior high school level; therefore, there is uncertainty as to how much value to place on these test results.

I. THE PROBLEM

Statement of the problem. The purpose of this study was (1) to investigate the relationship between scores attained on certain Differential Aptitude Tests and grades made in industrial arts courses, (2) to determine which of the tests studied have the greatest relationship to certain industrial arts courses, and (3) to determine whether the relationship between the test scores and senior high school grades is the same as it was in junior high school.

Limitations of the study. This study is limited to the 1963-1964 juniors at Shawnee Mission North High School who took at least one industrial arts course as sophomores. Because of this limitation, some of the advanced classes which have small enrollments may not be a true representation of the junior class. The study was further limited to three tests (Space Relations, Mechanical Reasoning, and Abstract

Reasoning) of the Differential Aptitude Test Battery. The results of this study are true for the 1963-1964 juniors at Shawnee Mission North High School but care should be exercised in applying these findings to all situations.

Importance of the study. The secondary school student has so many demands put upon him that he often becomes confused, frustrated, discouraged; eventually he may lose interest in education. Any encouragement which can be given students who appear to have aptitude and interest in certain types of work may be of major importance in the student's attitude and future development. Also, students who appear to lack aptitude and interest for certain types of work should be cautioned upon entering this work. Because of insufficient knowledge of how the Differential Aptitude Test scores may be used to help predict success or failure in certain classes, the test scores may not be used to full advantage, even though they are available.

The major hypothesis for this study is that there is a positive relationship between certain Differential Aptitude Test scores and grades in industrial arts. A second hypothesis is that Space Relations and Abstract Reasoning have a definite bearing on drafting courses; therefore, the scores from these tests may well be used in counseling students interested in this area.

II. DEFINITIONS OF TERMS USED

Differential Aptitude Tests. The Differential Aptitude Tests are

a battery of eight tests, each having its own administration and norms.[1] The battery is made up of the following tests: Abstract Reasoning, Space Relations, Mechanical Reasoning, Verbal Reasoning, Numerical Ability, Clerical Speed and Accuracy, and Language Usage. The latter has two sections, one on spelling and one on sentences.[2] These tests are designed for students from grade eight through twelve. Each test is made up of multiple choice questions. The student is directed to select the correct or most nearly correct answer and to record his choice on a special scoring sheet. The tests may be graded electronically or manually.

Space Relations and Mechanical Reasoning. These two tests are designed to measure the student's ability to visualize concrete objects and visually to manipulate them so as to recognize everyday physical forces and principles.[3] The tests are designed principally for dealing with things rather than words or people. The Mechanical Reasoning test consists of mechanical situations along with simple word questions. The items used are simple, frequently encountered mechanisms which do not require special knowledge and do not resemble textbook illustrations.[4] The Space Relations Test requires the ability to visualize a constructed

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[1]George K. Bennett, Harold G. Seashore, and Alexander G. Wesman, Manual for the Differential Aptitude Tests (New York: The Psychological Corporation, 1959), p. 3.

[2]Ibid.

[3]Ibid., p. 5.

[4]Ibid., p. 7.

object from a picture of a pattern and the ability to imagine how an object would appear if rotated in various ways.

Abstract Reasoning. This test is intended to be a nonverbal measure of the students reasoning ability.[5] It involves the perception of an operative principle in the changing diagrams. A certain type of pattern is developed; the student is to recognize the pattern and indicate which step would come next, rather than to discriminate between length or intensity of a line.

Correlation coefficient. This is an index of correlation between two sets of measures.[6] The index, as used in this study, was created by Karl Pearson, an English statistician, and is named after him. The full name of this index is the Pearson product-moment correlation coefficient but is frequently referred to as (1) the correlation coefficient, (2) coefficient of correlation, or (3) r. In this study, the term correlation coefficient and the symbol r will be used.

Significance. Statistical significance is based on the normal distribution, or some variation of that distribution.[7] If data for a population is distributed normally, standard tables of the normal curve may be applied, to determine whether the sample in question varies from

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[5] Ibid.

[6] Paul Bloomers and E. F. Lindquist, Elementary Statistical Methods in Psychology and Education (Boston: Houghton Mifflin Company, 1960), p. 374.

[7] Allen L. Edwards, Experimental Design in Psychological Research. (New York: Rinehart and Company, Inc., 1950), pp. 121-26.

the mean to an unusual degree. The sampling distribution of r in small samples is decidedly skewed, particularly if the population r is large. Since this is the case, a small-sample test of significance, such as the t-test, must be used to determine whether the obtained value of r deviates sufficiently from zero to be meaningful, or significant, and is not just the result of errors in sampling. Table VI is based on the application of the t-test, and was used in this study to indicate the value of r that can be considered significant for various degrees of freedom (N-2, in this case).[8]

Level of significance. As the value of r, or any sampling statistic, varies further from the mean, it is increasingly likely that the correlation of the whole population is not zero. When the statistic is of a numerical value that would occur by chance sampling error only five times in 100 repetitions, in a population with zero correlation, it is said that the statistic, in this case r, is significant at the 5 per cent level. If so large a deviation from the mean would occur only once in 100 times by pure chance error in sampling, the value of r is said to be significant at the 1 per cent level.

Junior high school. The junior high school consists of a three year program which includes grades seven, eight, and nine.

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[8]Appendix A

Senior high school. Senior high school includes grades ten, eleven, and twelve.

III. METHOD OF PROCEDURE

Determining which students to use for the study was the first step in the procedure. Shawnee Mission North High School and the three junior high schools that are located within the Shawnee Mission North High School attendance area (Milburn, Old Mission, and Hocker Grove Junior High School) were selected. North High School was chosen because it is the oldest school in the district and should have the most stable records. These junior high schools are also the oldest junior high schools in the system.

The Shawnee Mission High School District was organized in 1921 and provides secondary school facilities for the common school districts of Shawnee and Mission townships. Shawnee Mission is a suburb of Kansas City. It is bounded by Kansas City, Missouri, to the east, and Kansas City, Kansas, to the north. The district consisted of one high school until 1955, when four junior high schools were opened. At the present time, the system consists of eight junior high schools and three senior high schools with a combined enrollment of more than 13,000 students.

After it was decided which schools to include in the study, it was necessary to determine the number of years that the Differential Aptitude Tests had been administered in the system and on what level they were administered. It was found that the tests were first given on

the ninth grade level, but starting with 1961 this was changed to the eighth grade, the 1963-64 juniors, to gain more value from the tests.

In order to make this study more valid, only juniors who had taken the Differential Aptitude Tests on the eighth grade level and who had completed at least one course in industrial arts during their sophomore year were included. The study was limited to juniors because it was felt that it would be more meaningful if the students had taken several courses in industrial arts. The group studied in each course ranged in size from 52 to 117 junior high school students and from 11 to 84 senior high school students. The total group size included 138 students, 66 per cent of whom had taken two or more industrial arts courses in their sophomore and junior years. Of the high school students who took only one course in industrial arts, drafting was taken more frequently than any other course.

Another step in the procedure was to determine which areas of industrial arts to include in this study. It was decided to study the areas of drafting, metalworking, woodworking, and auto mechanics. The following classes were used to make up the various areas: drafting included Elementary Drafting and Machine Drawing; metalworking included Seventh or Eighth Grade Metal and Drawing, Ninth Grade Metal and Electricity, Metal Shop I, and Metal Shop II; woodworking included Seventh or Eighth Grade Wood and Drawing, Ninth Grade Wood and Drawing, Woodworking I, and Woodworking II; and auto mechanics included Auto Mechanics I. Architectural Drawing and Auto Mechanics II are offered in the senior

year, but these courses could not be included because the Differential Aptitude Tests, at the eighth grade level, are not available for the seniors.

The first years of metalworking and woodworking are listed as "seventh or eighth" because the boy who takes metalworking in the seventh grade and also chooses to take industrial arts in the eighth grade must take woodworking and vice versa. This means that some of the students took Seventh or Eighth Grade Metal and Drawing as seventh graders and others took the same course as eighth graders. No effort was made to differentiate between the grades of those who took the course in the seventh grade and those who took it in the eighth grade. These classes are one semester in length and start with the first six weeks in basic drafting.

At the present time Shawnee Mission offers Ninth Grade Metal and Electricity and Ninth Grade Wood and Drawing on a one or two semester basis, but when the students in this study were ninth graders these were one semester courses. In this study Ninth Grade Metal and Electricity refers to twelve weeks of metalworking and six weeks of basic electricity. Ninth Grade Wood and Drawing refers to approximately six weeks of mechanical drawing and twelve weeks of woodworking. In many cases the drawing may consist largely of project drawing.

After the courses were selected, the permanent records were used to obtain the Differential Aptitude Test scores and the industrial arts grades for both junior and senior high school. Scores in Space Relations,

Mechanical Reasoning, Abstract Reasoning, and the sum of these three tests scores were compared with the various industrial arts grades to determine if there was a positive or negative relationship. The Pearson product-moment correlation coefficient was calculated for the Differential Aptitude Test Scores and grades in the various courses. The correlation coefficients were then compared with a table of values of correlation coefficients in order to see whether they could be considered significant at the 5 per cent level or 1 per cent level.[9] These findings were reported in tabular form to show the relationship between test score ranges and grades in the various courses, as well as the correlation coefficient and its significance.

Another comparison was to calculate the frequency per cent for each letter grade within the particular raw score ranges (Tables III - XXXXVI). In calculating these percentages the number was rounded off to the nearest whole number. This means that the total per cent ranges from 99 to 102, with the majority being an even 100.

Procedure Used in Calculating the Correlation Coefficient. The raw scores from the Differential Aptitude Tests and course grades were gathered and arranged into tabular form (Tables III - XXXXVI). The grade frequency information was then transformed to a bivariate frequency distribution and a value entered in each cell (Table I). The value of

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[9] Ibid.

each cell is the product of the Y and X values for that cell. The fy and fx are the frequency with which students fall into that column or row. The fyY is fy times the Y-variate and the fxX is fx times the

TABLE I

A BIVARIATE FREQUENCY DISTRIBUTION USED IN CALCULATING THE PEARSON PRODUCT-MOMENT CORRELATION COEFFICIENT BETWEEN SPACE RELATIONS AND WOOD SHOP I[10]

Y-Variate \ X-Variate	1	2	3	4	5	fy	fyY	fyY^2	Σf cells XY
5		2 (10)	2 (15)	1 (20)	3 (25)	8	40	200	145
4			1 (12)	6 (16)		7	28	112	108
3			4 (9)	2 (12)	2 (15)	8	24	72	90
2		1 (4)	1 (6)	2 (8)		4	8	16	26
1		3 (2)	6 (3)	2 (4)	1 (5)	12	12	12	37
fx		6	14	13	6	39	112	412	406
fxX		12	42	52	30	136			
fxX^2		24	126	208	150	508			
Σf cells XY		30	102	164	110	406			

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X-variate. Going on, the fyY^2 is the fyY times the Y-variate and the fxX^2 is the fxX times the X-variate. The Σf cells XY is obtained by multiplying the frequency of each cell by that cell value and adding all these sums for each row and column. All the other rows and columns must also be totaled.

[10] Bloomers, op. cit., p. 392.

At this point the information obtained was transferred to the following formula:

$$r = \frac{\Sigma f \text{ cell } XY - \frac{f_x X \times f_y Y}{N}}{\sqrt{\left[f_x X^2 - \frac{(f_x X)^2}{N}\right]\left[f_y Y^2 - \frac{(f_y Y)^2}{N}\right]}}$$ "

which is

$$r = \frac{406 - \frac{136 \times 112}{39}}{\sqrt{\left[508 - \frac{(136)^2}{39}\right]\left[412 - \frac{(112)^2}{39}\right]}} = \frac{15.44}{\sqrt{[33.74][90.36]}} = .280$$

All calculations were carried out two places and then rounded off to the nearest number except the final value of r which was carried out three places and rounded off to the nearest number.

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[11] Bloomers, op. cit., p. 394.

CHAPTER II

REVIEW OF THE LITERATURE

In stating that a person has or does not have an aptitude for a certain type of work, it is not said that he will or will not succeed in that work. It merely implies that, other things being equal, if he has an aptitude for a certain type of work, he is more likely to succeed in that work than someone who does not have this aptitude. In the manual for the Differential Aptitude Tests the authors use the definition of aptitude as given in Warren's Dictionary of Psychology:

> A condition or set of characteristics regarded as symptomatic of an individual's ability to acquire with some (usually specified) knowledge, skill, or set of responses, such as the ability to speak a language, to produce music. . . .[1]

Recognizing that there are various aptitudes and various tests available to test for aptitude, it becomes necessary to determine what each test or group of tests measures and how these results may be used. It must be kept in mind that aptitude tests do not guarantee success or failure, but that they indicate abilities in various areas.

I. LITERATURE ON MECHANICAL REASONING

There is a limited amount of information available on the relationship between the Differential Aptitude Test scores and certain areas of

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[1]George K. Bennett, Harold G. Seashore, and Alexander G. Wesman, Manual for the Differential Aptitude Tests (New York: The Psychological Corporation, 1959), p. 2.

industrial arts. Nothing specific was available on any junior high school courses or general metals and woodworking. It is possible that these courses are of such a general nature that the aptitudes in question do not play a real part in grades earned at this level. The authors of the Manual For The Differential Aptitude Tests state that the fact that the Mechanical Reasoning test has been very helpful in predicting grades for certain industrial arts courses indicates that it can be helpful.[2] They further state that the fact that it has not predicted well in other courses may be due to course content or the unreliability of the grades given in those courses rather than any inherent weakness in the test. It is also mentioned that a student who does not do well on this test should expect to have difficulty in industrial arts courses.[3] Furthermore, it has been found that men who are now in the mechanical trades generally performed better in mechanical reasoning than they did in verbal skills.[4]

The information thus far indicates that the Mechanical Reasoning test is quite useful in some areas of industrial arts; however, Ewald states that "caution should be exercised in using the Mechanical Reasoning Test as a predictor of academic success in vocational education."[5]

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[2]Ibid., p. 39.

[3]Ibid., p. 8.

[4]G. K. Bennett, H. G. Seashore, and A. G. Wesman, "Aptitude Testing: Does It 'Prove Out' In Counseling Practice?" Occupation, 30:593, 1952.

[5]Hattie Hoff Ewald, "The Relationship Of Scores Of The Differential Aptitude Tests To Scholarship In High School and College" (unpublished Doctoral dissertation, The University of South Dakota, Vermillion, 1961), p. 153.

II. LITERATURE ON SPACE RELATIONS

The Space Relations test is one which would appear to be quite valuable in drafting, metalworking, and woodworking, because it makes use of three dimensional visualization. Unless the instructor uses pre-designed projects in metalworking and woodworking, the students will need to visualize the completed project to draw it properly. This would be true of basic courses as well as the more advanced with the exception that in basic courses there may not be as great a premium placed on "original" projects. When this is the case, the student with less space relations ability may still do quite well by preparing pre-designed projects. The same may be said for drafting. As long as the emphasis is on learning symbols, techniques, and developing skills, there will be little need for Space Relations, but as soon as the emphasis is placed on drawing three dimensional objects from two views, drawing perspectives, machine drawings, and other types of drawings, this will no longer be true. Wesman says that the Space Relations test is effective for mechanical drawing.[6]

The authors of the Differential Aptitude Tests say that the limited data now available does not provide an adequate criterion for the Space Relations test, but that the test is of general value in predicting success in engineering and mechanical design and to some extent in ad-

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[6] Alexander G. Wesman, "The Differential Aptitude Tests," Personnel And Guidance Journal, 31:167, December, 1952.

vanced mechanical drawing.[7]

It is rather difficult to tell which particular tests to use in order to obtain the best results when predicting course grades although a counselor would learn by experience which ones are likely to be the best predictors.

One area in which Space Relations does a good job of predicting success is in watch repair training, as shown in Table II. The left half of the table shows the number of students that fell into each score range and the grade which they earned. The right half of the table converts these numbers to percentages of students who earned various grades in each score range. Of the one hundred and eleven students tested, nine fell in the eighty to ninety-nine score range and of these nine, six students (or 67 per cent) received A's and the other three (or 33 per cent) received B's. The same information is given for the sixty to seventy-nine range, the forty to fifty-nine range, etc. It should be noted that in the eighty to ninety-nine score range there were no grades lower than B and in the sixty to seventy-nine range there were no grades lower than a C. On the other end of the scale, 91 per cent of all the scores falling between zero and nineteen received a C or lower.

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[7]George K. Bennett, Harold G. Seashore, and Alexander G. Wesman, Manual for the Differential Aptitude Tests (New York: The Psychological Corporation, 1959), p. 3.

TABLE II

SPACE RELATIONS SCORES AT TIME OF ADMISSION AND END OF COURSE GRADES FOR 111 STUDENTS IN THE AMERICAN INSTITUTE OF SPECIALIZED WATCH REPAIR (r = .69)[9]

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	E	D	C	B	A		E	D	C	B	A
9				3	6	80-99				33	67
33			7	19	7	60-79			21	58	21
43	1	8	17	17		40-59	2	18	40	40	
14	3	5	4	2		20-39	21	36	29	14	
12	4	3	4	1		0-19	33	25	33	9	

[9] Bennett, Seashore, and Wesman, op. cit., p. 63.

III. LITERATURE ON ABSTRACT REASONING

The Abstract Reasoning test by itself does not appear to have much value in determining industrial arts results. This may be due to the nature of the work done in the basic courses, but because the test deals with problem solving situations rather than verbal exercises, it will be included in this study to determine whether there is any meaningful relationship between the two results. According to the authors of the Differential Aptitude Tests manual, Abstract Reasoning is of most value in predicting subsequent science grades, but they go on to say that in some schools it also predicts moderately well in other areas, one of which is industrial arts.[10]

IV. LITERATURE ON THE TOTAL OF THE THREE TESTS: MECHANICAL REASONING, SPACE RELATIONS, AND ABSTRACT REASONING

It cannot be expected that any one test can do a good job of predicting possible success in a given area, but a combination of tests should be more reliable. This would also appear to be true for industrial arts. Of the various combinations of tests that could be used, it would seem that the tests which would have the greatest relation to success in industrial arts would be the nonverbal tests, those dealing with visualization and manipulation of ideas rather than words. These are very definitely requirements for a good student in the more advanced industrial

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[10] Ibid., p. 38.

arts courses in areas such as machine shop, pattern making, and various drawing and design courses.

It has been found that the total of the scores on the Abstract Reasoning, Mechanical Reasoning, and Space Relations tests can well be used to predict probable grades in industrial arts. These totals predict relationships but are not absolute where individuals are concerned. Doppelt, Seashore, and Odgers say that the sum of these three tests is a good predictor of success in machine shop but is not useful for auto mechanics.[11] They suggest, however, that the total should not be used to eliminate students but that the students should be made to understand their probability of success or failure. The authors of the Differential Aptitude Test Manual would support the fact that the results of these tests are reliable enough to be quite useful for predicting grades for machine shop.[12] Along this same line, Stoughton says that these three tests "are more useful for predicting shop success than for predicting general educational success."[13]

This information would lead one to believe that there is value in these tests, and that if the results are used properly they can be a helpful instrument in counseling students.

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[11] Jerome E. Doppelt, Harold G. Seashore, and John G. Odgers, "Validation of the Differential Aptitude Tests for Auto Mechanics and Machine Shop Students," Personnel and Guidance Journal, 37:654, May, 1959.

[12] Bennett, Seashore, and Wesman, op. cit., p. 87.

[13] R. W. Stoughton, "The Differential Predictive Value of the DAT In The Connecticut Technical Schools," (unpublished Doctoral dissertation, The University of Connecticut, Storrs, 1955), p. 1355. (Abstract.)

CHAPTER III

ANALYSIS OF THE DATA

The purpose of this study was to ascertain the relationship between the part scores of the Differential Aptitude Tests and grades in industrial arts at Shawnee Mission North High School and at the junior high schools which prepare the students for Shawnee Mission North High School. It was further desired to determine which tests seem to be the most useful to help predict success in the various areas of industrial arts.

Data were gathered and analyzed for the Differential Aptitude Tests and the various areas of industrial arts. The information is presented in the form of expectancy tables which also give the correlation coefficient and the level of significance for this data. The information is presented in the following order: (1) Drafting, (2) Metalworking, (3) Auto Mechanics, and (4) Woodworking.

Tables III to XXXXVI should be read in the following manner. The left half of the table presents the data in actual numbers with the N indicating the frequencies in each score range. The raw score indicates the performance on the Differential Aptitude Test and the right half of the table is the same as the left half except that it presents the information in terms of per cent. Table III will be used as an example of the manner in which these tables are to be read. The top row shows that of the 34 students who ranged between 80-99 on the Differential

Aptitude Test, nine received an A, 16 received a B, 6 received a C, and 3 received a D. The right half of the table indicates that the 9 students who achieved an A comprised 27 per cent of the 34 frequencies, the 16 who attained a B comprised 47 per cent, the 6 who earned a C comprised 18 per cent, and the 3 who received a D comprised 8 per cent of the frequencies between 80-99. The remaining portion of the table is read in the same manner.

Tables III-XXXXVI will be summarized in groups of four, rather than individually.

Data for Elementary Drafting. Elementary Drafting consists of 84 students and is a sophomore course. The data for this course (Tables III-VI) may give a first impression that there is no significant correlation, because of the unusual scatter of scores, but a significant correlation does exist. The order in which the scores on these tests correlated with industrial arts grades beginning with the highest is: the total of Space Relations, Mechanical Reasoning, and Abstract Reasoning (r = .340); Abstract Reasoning (r = .317); Space Relations (r = .301); and Mechanical Reasoning (r = .108). The correlation coefficient of all of the tests is significant at the 1 per cent level except that of Mechanical Reasoning which is far short of significance at the 5 per cent level.

Data for Machine Drawing. The data for Machine Drawing (Tables VII-X) show that the same tests which were significant for Elementary

TABLE III

SPACE RELATIONS SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 84 STUDENTS IN ELEMENTARY DRAFTING

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
34		3	6	16	9	80-99		8	18	47	27
21	1	5	9	1	5	60-79	5	24	43	5	24
13			8	3	2	40-59			62	23	15
6		1	1	3	1	20-39		17	17	50	17
10	1	4	3	2		0-19	10	40	30	20	

[1] r = .301

[2] Significant at 1 per cent level.

TABLE IV

MECHANICAL REASONING SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 84 STUDENTS IN ELEMENTARY DRAFTING

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
21		3	6	6	6	80-99		14	29	29	29
30	1	5	8	10	6	60-79	3	17	27	33	20
19		3	9	5	2	40-59		16	49	26	10
11	1	1	3	4	2	20-39	9	9	27	36	18
3		1	1		1	0-19		33	33		33

[1] r = .108

[2] Not significant at 5 per cent level.

TABLE V

ABSTRACT REASONING SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 84 STUDENTS IN ELEMENTARY DRAFTING

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
27	1	3	4	8	11	80-99	4	11	15	29	41
20		2	6	9	3	60-79		10	30	45	15
17	1	3	9	2	2	40-59	6	18	53	12	12
12		2	6	3	1	20-39		17	50	25	8
8		3	2	3		0-19		38	25	38	

[1] $r = .317$

[2] Significant at 1 per cent level.

TABLE VI

TOTAL OF SPACE RELATIONS, MECHANICAL REASONING, AND ABSTRACT REASONING SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 84 STUDENTS IN ELEMENTARY DRAFTING

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
6			1	2	3	270-309			17	33	50
16			3	7	6	230-269			19	44	38
20	1	7	6	3	3	190-229	5	35	30	15	15
21		1	7	10	3	150-189		5	34	48	14
10		2	6	1	1	110-149		20	60	10	10
8	1	2	3	1	1	70-109	13	25	38	13	13
3		1	1	1		30-69		33	33	33	
0						0-29					

[1] $r = .340$

[2] Significant at 1 per cent level.

TABLE VII

SPACE RELATIONS SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 30 STUDENTS IN MACHINE DRAWING

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
14				8	6	80-99				57	43
5			2	2	1	60-79			40	40	20
3				2	1	40-59				67	33
4				4		20-39				100	
4		1		3		0-19		25		75	

[1] $r = .408$

[2] Significant at 5 per cent level.

TABLE VIII

MECHANICAL REASONING SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 30 STUDENTS IN MACHINE DRAWING

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
8			1	5	2	80-99			13	63	25
9				5	4	60-79				56	44
7			1	4	2	40-59			14	59	29
5				5		20-39				100	
1		1				0-19		100			

[1] $r = .331$

[2] Not significant at 5 per cent level.

TABLE IX

ABSTRACT REASONING SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 30 STUDENTS IN MACHINE DRAWING

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
10				5	5	80-99				50	50
10			1	7	2	60-79			10	70	20
4			1	2	1	40-59			25	50	25
2				2		20-39				100	
4		1		3		0-19		25		75	

[1] $r = .454$

[2] Significant at 5 per cent level.

TABLE X

TOTAL OF SPACE RELATIONS, MACHANICAL REASONING, AND ABSTRACT REASONING SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 30 STUDENTS IN MACHINE DRAWING

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
3				1	2	270-309				33	67
6				4	2	230-269				67	33
7			1	4	2	190-229			14	57	29
7			1	4	2	150-189			14	57	29
3				3		110-149				100	
1				1		70-109				100	
3		1		2		30-69		33		67	
0						0-29					

[1] $r = .446$

[2] Significant at 5 per cent level.

Drafting were also significant for this course. The highest correlation value is found in Abstract Reasoning (r = .454); next is the total of Space Relations, Mechanical Reasoning, and Abstract Reasoning (r = .446); Space Relations is next (r = .408); followed by Mechanical Reasoning (r = .331). The first three correlations mentioned are significant at the 5 per cent level and Mechanical Reasoning is, again, not significant at the 5 per cent level for this group.

Data for Seventh or Eighth Grade Metal and Drawing. The correlation between the tests studied and Seventh or Eighth Grade Metal and Drawing should be noted (Tables XI-XIV). All four of the correlations are significant at the 1 per cent level. Their placement from highest to lowest is: the total of Space Relations, Mechanical Reasoning, and Abstract Reasoning (r = .397); Mechanical Reasoning (r = .338); Abstract Reasoning (r = .331); and Space Relations (r = .312).

Data for Ninth Grade Metal and Electricity. In studying this data it will be noted that only two correlations are significant at the 1 per cent level (Tables XV-XVIII). In order of their significance they are: the total of Space Relations, Mechanical Reasoning, and Abstract Reasoning (r = .399); Space Relations (r = .386); Mechanical Reasoning (r = .306); and Abstract Reasoning (r = .207). The two correlations which are significant at the 1 per cent level are the total of Space Relations, Mechanical Reasoning, and Abstract Reasoning, and Space Relations. Mechanical Reasoning is significant at the 5 per cent level and Abstract Reasoning is not significant at either level.

TABLE XI

SPACE RELATIONS SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 116 STUDENTS IN SEVENTH OR EIGHTH GRADE METAL AND DRAWING

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
35			13	14	8	80-99			37	40	23
32		4	14	8	6	60-79		13	44	25	19
22		2	10	7	3	40-59		9	45	32	14
13	1	1	6	5		20-39	8	8	46	38	
14		4	6	4		0-19		29	43	29	

[1] r = .312

[2] Significant at 1 per cent level.

TABLE XII

MECHANICAL REASONING SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 116 STUDENTS IN SEVENTH OR EIGHTH GRADE METAL AND DRAWING

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
25			8	9	8	80-99			32	36	32
34		5	10	13	6	60-79		15	29	38	18
26		2	15	8	1	40-59		8	58	31	4
20		2	10	7	1	20-39		10	50	35	5
11	1	2	6	1	1	0-19	9	18	55	9	9

[1] r = .338

[2] Significant at 1 per cent level.

TABLE XIII

ABSTRACT REASONING SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 116 STUDENTS IN SEVENTH OR EIGHTH GRADE METAL AND DRAWING

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
32		2	10	9	11	80-99		6	31	28	34
27		3	11	9	4	60-79		11	41	33	15
18		1	7	9	1	40-59		6	39	50	6
21		2	12	6	1	20-39		10	57	29	5
18	1	3	9	5		0-19	6	17	50	28	

[1] $r = .331$

[2] Significant at 1 per cent level.

TABLE XIV

TOTAL OF SPACE RELATIONS, MECHANICAL REASONING, AND ABSTRACT REASONING SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 116 STUDENTS IN SEVENTH OR EIGHTH GRADE METAL AND DRAWING

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
5			2		3	270-309			40		60
19			5	7	7	230-269			27	37	37
21		2	8	9	2	190-229		10	38	43	10
28		3	12	9	4	150-189		11	43	32	14
17		2	8	6	1	110-149		12	47	35	6
15		2	8	5		70-109		13	53	33	
8	1	1	5	1		30-69	13	13	63	13	
3		1	1	1		0-29		33	33	33	

[1] $r = .397$

[2] Significant at 1 per cent level.

TABLE XV

SPACE RELATIONS SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 53 STUDENTS IN NINTH GRADE METAL AND ELECTRICITY

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
15			5	8	2	80-99			33	53	13
14		1	7	6		60-79		7	50	43	
8		2	2	3	1	40-59		25	25	38	13
6			4	2		20-39			67	33	
10		5	2	3		0-19		50	20	30	

[1] r = .386

[2] Significant at 1 per cent level.

TABLE XVI

MECHANICAL REASONING SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 53 STUDENTS IN NINTH GRADE METAL AND ELECTRICITY

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
13		1	6	5	1	80-99		8	46	38	8
13		2	1	9	1	60-79		15	8	69	8
12		1	6	4	1	40-59		8	50	33	8
8		1	3	4		20-39		13	38	50	
7		3	4			0-19		43	57		

[1] r = .306

[2] Significant at 5 per cent level.

TABLE XVII

ABSTRACT REASONING SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 53 STUDENTS IN NINTH GRADE METAL AND ELECTRICITY

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
13		2	3	6	2	80-99		15	23	46	15
6			4	2		60-79			67	33	
8		1	3	3	1	40-59		13	38	38	13
14		1	7	6		20-39		7	50	43	
12		4	3	5		0-19		33	25	42	

[1] r = .207

[2] Not significant at 5 per cent level.

TABLE XVIII

TOTAL OF SPACE RELATIONS, MECHANICAL REASONING, AND ABSTRACT REASONING SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 53 STUDENTS IN NINTH GRADE METAL AND ELECTRICITY

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
2				1	1	270-309				50	50
7			2	4	1	230-269			29	57	14
13		2	6	5		190-229		15	46	38	
9			3	5	1	150-189			23	56	11
6		2	2	2		110-149		33	33	33	
7		1	3	3		70-109		14	43	43	
5			3	2		30-69			60	40	
4		3	1			0-29		75	25		

[1] r = .399

[2] Significant at 1 per cent level.

Data for Metal Shop I. The data for Metal Shop I (Tables XIX-XXII) reveal that all four correlations are significant at the 5 per cent level and that Space Relations and the total of Space Relations, Mechanical Reasoning, and Abstract Reasoning are also significant at the 1 per cent level. The order in which these correlations placed (from highest to lowest) is: Space Relations (r = .374); the total of Space Relations, Mechanical Reasoning, and Abstract Reasoning (r = .336); Mechanical Reasoning (r = .315); and Abstract Reasoning (r = .253).

Data for Metal Shop II. It might be expected that as the courses progress (involve more work with machines) the correlations between the Differential Aptitude Tests and the course grades would be more significant. Tables XXIII-XXVI indicate that this may not be true, possibly because of the small group studied. The size of the N is approximately one third as large as that in Metal Shop I, therefore it requires a higher degree of correlation in order to be significant, but in Metal Shop I all correlations were significant at the 5 per cent level. However, in Metal Shop II, Mechanical Reasoning and Abstract Reasoning are not significant at this level. The correlations are as follows: the total of Space Relations, Mechanical Reasoning, and Abstract Reasoning (r = .517); Space Relations (r = .441); Abstract Reasoning (r = .272); Mechanical Reasoning (r = .230).

Data for Auto Mechanics I. Mechanical Reasoning appears to be an important asset to success in Auto Mechanics I. A correlation coefficient

TABLE XIX

SPACE RELATIONS SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 67 STUDENTS IN METAL SHOP I

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
13		3	5	3	2	80-99		23	39	23	15
18			10	5	3	60-79			56	28	17
14			8	5	1	40-59			57	36	7
10		2	6	2		20-39		20	60	20	
12		6	6			0-19		50	50		

[1] $r = .374$

[2] Significant at 1 per cent level.

TABLE XX

MECHANICAL REASONING SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 67 STUDENTS IN METAL SHOP I

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
8		1	3	2	2	80-99		13	38	25	25
18		2	9	5	2	60-79		11	50	28	11
19		1	11	7		40-59		5	58	37	
13		3	8		2	20-39		23	62		15
9		4	4	1		0-19		44	44	11	

[1] $r = .315$

[2] Significant at 5 per cent level.

TABLE XXI

ABSTRACT REASONING SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 67 STUDENTS IN METAL SHOP I

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
12			8	2	2	80-99			67	17	17
11		2	4	4	1	60-79		18	36	36	9
12		2	7	2	1	40-59		17	58	17	8
17		2	6	7	2	20-39		12	35	41	12
15		5	10			0-19		33	67		

[1] r = .253

[2] Significant at 5 per cent level.

TABLE XXII

TOTAL OF SPACE RELATIONS, MECHANICAL REASONING, AND ABSTRACT REASONING SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 67 STUDENTS IN METAL SHOP I

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
1			1			270-309			100		
6		1	2	1	2	230-269		17	33	17	33
11		2	5	3	1	190-229		18	45	27	9
15			9	4	2	150-189			60	27	13
11			5	5	1	110-149			45	45	9
13		3	8	2		70-109		23	62	15	
6		2	4			30-69		33	67		
4		3	1			0-29		75	25		

[1] r = .366

[2] Significant at 1 per cent level.

TABLE XXIII

SPACE RELATIONS SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 23 STUDENTS IN METAL SHOP II

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
4			1	2	1	80-99			25	50	25
6			3	1	2	60-79			50	17	33
4			1	3		40-59			25	75	
5		1	2	2		20-39		20	40	40	
4		1	2	1		0-19		25	50	25	

[1] r = .441

[2] Significant at 5 per cent level.

TABLE XXIV

MECHANICAL REASONING SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 23 STUDENTS IN METAL SHOP II

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
3				2	1	80-99				67	33
4			2	2		60-79			50	50	
6		1	3	2		40-59		17	50	33	
8		1	2	3	2	20-39		13	25	38	25
2			2			0-19			100		

[1] r = .230

[2] Not significant at 5 per cent level.

TABLE XXV

ABSTRACT REASONING SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 23 STUDENTS IN METAL SHOP II

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
3			1	2		80-99			33	67	
4			2	1	1	60-79			50	25	25
3			1	1	1	40-59			33	33	33
7			3	3	1	20-39			43	43	14
6		2	2	2		0-19		33	33	33	

[1] r = .272

[2] Not significant at 5 per cent level.

TABLE XXVI

TOTAL OF SPACE RELATIONS, MECHANICAL REASONING, AND ABSTRACT REASONING SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 23 STUDENTS IN METAL SHOP II

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
0						270-309					
1			1			230-269			100		
4				2	2	190-229				50	50
6			2	4		150-189			33	67	
3			2		1	110-149			67		33
6		1	3	2		70-109		17	50	33	
2		1		1		30-69		50		50	
1		1				0-29		100			

[1] r = .517

[2] Significant at 5 per cent level.

of .393 is required for significance at the 1 per cent level and the r value of Mechanical Reasoning in this case is .447. Tables XXVII-XXX reveal that in this study the only other significant correlation is the total of Space Relations, Mechanical Reasoning, and Abstract Reasoning with a correlation coefficient value of .376. This is significant at the 5 per cent level. The remaining correlations are Space Relations ($r = .255$) and Abstract Reasoning ($r = .229$).

Data for Seventh or Eighth Grade Wood and Drawing. In studying this data (Tables XXXI-XXXIV) it will be noted that Mechanical Reasoning has the highest correlation. The required r value at the 1 per cent level is .254 and Mechanical Reasoning has a value of .281. The other correlations are: the total of Space Relations, Mechanical Reasoning, and Abstract Reasoning ($r = .264$); Abstract Reasoning ($r = .169$); and Space Relations ($r = .164$). The total of the three tests is significant at the 1 per cent level, but Space Relations and Abstract Reasoning are not even significant at the 5 per cent level.

Data for Ninth Grade Wood and Drawing. The results in Ninth Grade Wood and Drawing are somewhat surprising. As the data in Tables XXXV-XXXVIII indicates, the correlation is significant at the 1 per cent level in each case. The r value must be .354 in order to be significant at the 1 per cent level. The ranking of the various correlations from highest to lowest is: the total of Space Relations, Mechanical Reasoning, and Abstract Reasoning ($r = .497$); Abstract Reasoning ($r = .403$); Mechanical

TABLE XXVII

SPACE RELATIONS SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 43 STUDENTS IN AUTO MECHANICS I

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
7		1	4	2		80-99		14	57	29	
13		3	7	3		60-79		23	54	23	
9	1	1	1	5	1	40-59	11	11	11	56	11
6		2	2	2		20-39		33	33	33	
8	2	3	2	1		0-19	25	38	25	13	

[1] r = .255

[2] Not significant at 5 per cent level.

TABLE XXVIII

MECHANICAL REASONING SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 43 STUDENTS IN AUTO MECHANICS I

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
6		1	1	4		80-99		17	17	67	
10		2	4	3	1	60-79		20	40	30	10
11		3	5	3		40-59		27	45	27	
10	1	1	5	3		20-39	10	10	50	30	
6	2	3	1			0-19	33	50	17		

[1] r = .447

[2] Significant at 1 per cent level.

TABLE XXIX

ABSTRACT REASONING SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 43 STUDENTS IN AUTO MECHANICS I

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
6		1	1	4		80-99		17	17	67	
7		1	5	1		60-79		14	71	14	
8	1	2	2	3		40-59	13	25	25	38	
12	1	2	5	3	1	20-39	8	17	42	25	8
10	1	4	3	2		0-19	10	40	30	20	

[1] r = .229

[2] Not significant at 5 per cent level.

TABLE XXX

TOTAL OF SPACE RELATIONS, MECHANICAL REASONING, AND ABSTRACT REASONING SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 43 STUDENTS IN AUTO MECHANICS I

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
1			1			270-309			100		
4		1	1	2		230-269		25	25	50	
6		2	2	2		190-229		33	33	33	
11			5	6		150-189			45	55	
5	1	1	1	1	1	110-149	20	20	20	20	20
9		3	5	1		70-109		33	56	11	
4	1	1	1	1		30-69	25	25	25	25	
3	1	2				0-29	33	67			

[1] r = .376

[2] Significant at 5 per cent level.

TABLE XXXI

SPACE RELATIONS SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 117 STUDENTS IN SEVENTH OR EIGHTH GRADE WOOD AND DRAWING

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
40			14	21	5	80-99			35	53	13
29	1	2	11	11	4	60-79	3	7	38	38	14
21			6	13	2	40-59			29	62	10
13		1	6	6		20-39		8	46	46	
14		1	8	4	1	0-19		7	57	29	7

[1] r = .164

[2] Not significant at 5 per cent level.

TABLE XXXII

MECHANICAL REASONING SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 117 STUDENTS IN SEVENTH OR EIGHTH GRADE WOOD AND DRAWING

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
25			7	12	6	80-99			28	48	24
36		1	14	16	5	60-79		3	39	44	14
26	1		11	14		40-59	4		42	54	
20		1	9	9	1	20-39		5	45	45	5
10		2	4	4		0-19		20	40	40	

[1] r = .281

[2] Significant at 1 per cent level.

TABLE XXXIII

ABSTRACT REASONING SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 117 STUDENTS IN SEVENTH OR EIGHTH GRADE WOOD AND DRAWING

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
33		1	11	15	6	80-99		3	33	45	18
28		1	13	12	2	60-79		4	46	43	7
20			5	15		40-59			25	75	
18	1		5	9	3	20-39	6		28	50	17
18		2	11	4	1	0-19		11	61	22	6

[1] r = .169

[2] Not significant at 5 per cent level.

TABLE XXXIV

TOTAL OF SPACE RELATIONS, MECHANICAL REASONING, AND ABSTRACT REASONING SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 117 STUDENTS IN SEVENTH OR EIGHTH GRADE WOOD AND DRAWING

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
6			1	4	1	270-309			17	67	17
21			6	10	5	230-269			29	48	24
23		1	10	10	2	190-229		4	43	43	9
28		1	13	11	3	150-189		4	46	39	11
14	1		3	9	1	110-149	7		21	64	7
16			7	9		70-109			44	56	
7		2	3	2		30-69		29	43	29	
2			2			0-29			100		

[1] r = .264

[2] Significant at 1 per cent level.

TABLE XXXV

SPACE RELATIONS SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 52 STUDENTS IN NINTH GRADE WOOD AND DRAWING

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
13			4	7	2	80-99			31	54	15
14		1	5	7	1	60-79		7	36	50	7
11		1	4	4	2	40-59		9	36	36	18
5			2	2	1	20-39			40	40	20
9	1	3	3	2		0-19	11	33	33	22	

[1]$r = .359$

[2]Significant at 1 per cent level.

TABLE XXXVI

MECHANICAL REASONING SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 52 STUDENTS IN NINTH GRADE WOOD AND DRAWING

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
10			3	6	1	80-99			30	60	10
12			6	4	2	60-79			50	33	17
14	1		3	8	2	40-59	7		21	57	14
8			3	4	1	20-39			38	50	13
8		5	3			0-19		63	38		

[1]$r = .391$

[2]Significant at 1 per cent level.

TABLE XXXVII

ABSTRACT REASONING SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 52 STUDENTS IN NINTH GRADE WOOD AND DRAWING

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
12			2	9	1	80-99			17	75	8
10			6	2	2	60-79			60	20	20
9			2	5	2	40-59			22	56	22
8		2	2	4		20-39		25	25	50	
13	1	3	6	2	1	0-19	8	23	46	15	8

[1] $r = .403$

[2] Significant at 1 per cent level.

TABLE XXXVIII

TOTAL OF SPACE RELATIONS, MECHANICAL REASONING, AND ABSTRACT REASONING SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 52 STUDENTS IN NINTH GRADE WOOD AND DRAWING

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
1				1		270-309				100	
9			3	5	1	230-269			33	55	11
8			2	5	1	190-229			25	63	13
11			5	4	2	150-189			45	36	18
5			1	3	1	110-149			20	60	20
11	1	2	4	3	1	70-109	9	18	36	27	9
3			2	1		30-69			67	33	
4		3	1			0-29		75	25		

[1] $r = .497$

[2] Significant at 1 per cent level.

Reasoning (r = .391); and Space Relations (r = .359).

Data for Woodworking I. The data found in Tables XXXIX-XXXXII reveal a similar trend to that dealing with previous woodworking courses (Tables XXXI-XXXIV and XXXV-XXXVIII). The highest correlation is the total of Space Relations, Mechanical Reasoning, and Abstract Reasoning (r = .498). The other correlations are Mechanical Reasoning (r = .373); Abstract Reasoning (r = .330); and Space Relations (r = .280). The correlation on Space Relations is not significant at the 5 per cent level.

Data for Woodworking II. The previous woodworking courses seemed to establish a pattern, but this course does not follow suit (Tables XXXXIII-XXXXVI). Where the other classes are lowest in Space Relations, this course is the highest with a correlation coefficient value of .624. In fact, this is the only correlation which is significant and only at the 5 per cent level. The required r value for significance at the 5 per cent level is .602. The values of the correlations in this group are as follows: Space Relations (r = .624); the total of Space Relations, Mechanical Reasoning, and Abstract Reasoning (r = .540); Abstract Reasoning (r = .426); and Mechanical Reasoning (r = .358). There are only 11 students in this group and this may not give a true representation of the correlation between these tests and the grades earned in the course.

SUMMARY OF THE DATA PRESENTED

The value of the various correlation coefficients can best be compared to each other, and to the significant r value, when presented

TABLE XXXIX

SPACE RELATIONS SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 39 STUDENTS IN WOODWORKING I

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
8		2	2	1	3	80-99		25	25	13	38
7			1	6		60-79			14	86	
8			4	2	2	40-59			50	25	25
4		1	1	2		20-39		25	25	50	
12		3	6	2	2	0-19		25	50	17	9

[1] $r = .280$

[2] Not significant at 1 per cent level.

TABLE XXXX

MECHANICAL REASONING SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 39 STUDENTS IN WOODWORKING I

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
7			2	4	1	80-99			29	57	14
7		1	2		4	60-79		14	29		57
9		1	3	5		40-59		11	33	56	
6			4	2		20-39			67	33	
10		4	3	2	1	0-19		40	30	20	10

[1] $r = .373$

[2] Significant at 5 per cent level.

TABLE XXXXI

ABSTRACT REASONING SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 39 STUDENTS IN WOODWORKING I

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
5		1		1	3	80-99		20		20	60
4			2	2		60-79			50	50	
9		1	4	3	1	40-59		11	44	33	11
9		1	1	6	1	20-39		11	11	66	11
12		3	7	1	1	0-19		25	58	8	8

[1] $\underline{r}$ = .330

[2] Significant at 5 per cent level.

TABLE XXXXII

TOTAL OF SPACE RELATIONS, MECHANICAL REASONING, AND ABSTRACT REASONING SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 39 STUDENTS IN WOODWORKING I

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
0						270-309					
5			1		4	230-269			20		80
7		2	2	3		190-229		29	29	43	
3				2	1	150-189				67	33
4			1	3		110-149			25	75	
12			7	3	2	70-109			58	25	17
5		2	2	1		30-69		40	40	20	
3		2	1			0-29		67	33		

[1] $\underline{r}$ = .498

[2] Significant at 1 per cent level.

TABLE XXXXIII

SPACE RELATIONS SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 11 STUDENTS IN WOODWORKING II

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
2					2	80-99					100
1				1		60-79				100	
3				1	2	40-59				33	67
0						20-39					
5			3	1	1	0-19			60	20	20

[1] r = .624

[2] Significant at 5 per cent level.

TABLE XXXXIV

MECHANICAL REASONING SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 11 STUDENTS IN WOODWORKING II

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
2				1	1	80-99				50	50
4			1		3	60-79			25		75
2				2		40-59				100	
1			1			20-39			100		
2			1		1	0-19			50		50

[1] r = .358

[2] Not significant at 5 per cent level.

TABLE XXXXV

ABSTRACT REASONING SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 11 STUDENTS IN WOODWORKING II

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
2					2	80-99					100
1				1		60-79				100	
3			1	1	1	40-59			33	33	33
2				1	1	20-39				50	50
3			2		1	0-19			67		33

[1] r = .426

[2] Not significant at 5 per cent level.

TABLE XXXXVI

TOTAL OF SPACE RELATIONS, MECHANICAL REASONING, AND ABSTRACT REASONING SCORES AT FIRST SEMESTER EIGHTH GRADE TESTING AND COURSE GRADES OF 11 STUDENTS IN WOODWORKING II

N	Number Receiving Each Grade					Raw Score	Per Cent Receiving Each Grade				
	F	D	C	B	A		F	D	C	B	A
0						270-309					
3				1	2	230-269				33	67
0						190-229					
1					1	150-189					100
1				1		110-149				100	
5			2	1	2	70-109			40	20	40
0						30-69					
1			1			0-29			100		

[1] r = .540

[2] Not significant at 5 per cent level.

TABLE XXXXVII

A TABLE SHOWING THE REQUIRED VALUE OF r AT THE 5 AND 1 PER CENT LEVELS OF SIGNIFICANCE, THE r VALUE OF EACH GROUP, AND THE SIGNIFICANT r VALUES

Name of Course	required value of r		r value of Space Relations		r value of Mechanical Reasoning		r value of Abstract Reasoning		r value of S.R., M.R. and A.R.	
	5%	1%	5%	1%	5%	1%	5%	1%	5%	1%
Elementary Drafting	.217	.283	*.301	*.301	.108	.108	*.317	*.317	*.340	*.340
Machine Drawing	.361	.463	*.408	.408	.331	.331	*.454	.454	*.446	.446
Seventh and Eighth Metal and Drawing	.195	.254	*.312	*.312	*.338	*.338	*.331	*.331	*.397	*.397
Ninth Metal and Electricity	.273	.354	*.386	*.386	*.306	.306	.207	.207	*.399	*.399
Metal Shop I	.250	.325	*.374	*.374	*.315	.315	*.253	.253	*.366	*.366
Metal Shop II	.413	.526	*.441	.441	.230	.230	.272	.272	*.517	.517
Auto Mechanics I	.304	.393	.255	.255	*.447	*.447	.229	.229	*.376	.376
Seventh and Eighth Wood and Drawing	.195	.254	.164	.164	*.281	*.281	.169	.169	*.264	*.264
Ninth Wood and Drawing	.273	.354	*.359	*.359	*.391	*.391	*.403	*.403	*.497	*.497
Woodworking I	.325	.418	.280	.280	*.373	.373	*.330	.330	*.498	*.498
Woodworking II	.602	.735	*.624	.624	.358	.358	.426	.426	.540	.540

* These r's are significant at the level indicated.

in tabular form. Table XXXXVII is such a table. At the left of the table are the required values of r to be significant at the 5 per cent and the 1 per cent level. To the right of these columns are the r values of the various Differential Aptitude Tests. Each r value which is significant has been marked for the level, or levels, at which it is significant. It is also possible to tell how far above or below the significant r values the correlation coefficients fall.

It should be noted that the r value of Space Relations, Mechanical Reasoning, and Abstract Reasoning is significant at the 5 per cent level ten out of the eleven times and at the 1 per cent level seven out of the eleven times. Space Relations is significant at the 5 per cent level eight out of eleven times and at the 1 per cent level five times. Mechanical Reasoning is next with seven out of eleven times at the 5 per cent level and four times at the 1 per cent level. Abstract Reasoning is lowest with six times at the 5 per cent level and three times at the 1 per cent level.

The following statements can also be made about the data in Table XXXXVII. Space Relations, Abstract Reasoning, and the total of Space Relations, Mechanical Reasoning, and Abstract Reasoning are significant at the 1 per cent level for Elementary Drafting. Mechanical Reasoning is not even significant at the 5 per cent level. The results are the same for Machine Drawing except that they are now significant at the 5 per cent level rather than the 1 per cent level. Seventh and Eighth Grade Metal and Drawing is one of two courses where the correlation

coefficient is significant at the 1 per cent level in all four correlations. Space Relations and the total of Space Relations, Mechanical Reasoning, and Abstract Reasoning are significant at the 1 per cent level for Ninth Grade Metal and Electricity. For this same course Mechanical Reasoning is significant at the 5 per cent level. For Metal Shop I, Space Relations and the total of Space Relations, Mechanical Reasoning, and Abstract Reasoning are significant at the 1 per cent level. Mechanical Reasoning and Abstract Reasoning are significant at the 5 per cent level. The correlation coefficient for Metal Shop II is significant only at the 5 per cent level and only for Space Relations and the total of the three Differential Aptitude Tests used. Mechanical Reasoning is significant at the 1 per cent level for Auto Mechanics I and the total of the three tests used in this study is significant at the 5 per cent level. For Seventh or Eighth Grade Wood and Drawing the same correlations are significant as in Auto Mechanics I except that they are both significant at the 1 per cent level. Ninth Grade Wood and Drawing is the other course for which all correlations are significant at the 1 per cent level. Mechanical Reasoning and Abstract Reasoning are both significant at the 5 per cent level for Woodworking I and the total of the three tests is significant at the 1 per cent level. It is interesting to note that for Woodworking II, only Space Relations is significant at the 5 per cent level.

After studying Table XXXXVII several questions come to mind. Which of the test areas has been significant most frequently and which test area has had the highest correlation coefficient most frequently? Table XXXXVIII reveals that the total score of the three tests (Space

TABLE XXXVIII

A TABLE SHOWING THE RANK OF THE CORRELATION COEFFICIENTS BETWEEN INDUSTRIAL ARTS GRADES AND CERTAIN DIFFERENTIAL APTITUDE TESTS WITH 1 AS THE HIGHEST CORRELATION AND 4 AS THE LOWEST

Name of Course	Space Relations	Mechanical Reasoning	Abstract Reasoning	Total of S.R., M.R. and A. R.
Elementary Drafting	* 3	4	* 2	* 1
Machine Drawing	# 3	4	# 1	# 2
Seventh or Eighth Metal and Drawing	* 4	* 2	* 3	* 1
Ninth Metal and Electricity	* 2	# 3	4	* 1
Metal Shop I	* 1	# 3	# 4	* 2
Metal Shop II	# 2	4	3	# 1
Auto Mechanics I	3	* 1	4	# 2
Seventh or Eighth Wood and Drawing	4	* 1	3	* 2
Ninth Wood and Drawing	* 4	* 3	* 2	* 1
Woodworking I	4	# 2	# 3	* 1
Woodworking II	# 1	4	3	2

* Significant at the 1 per cent level.

Significant at the 5 per cent level.

Relations, Mechanical Reasoning, and Abstract Reasoning) has the highest correlation six times and second highest five times. All of these values were significant at the 5 per cent level and seven times they were significant at the 1 per cent level.

Space Relations was next, ranking first two times, second two times, third three times, and fourth four times. The correlation coefficient for Space Relations and industrial arts grades was significant eight times.

Mechanical Reasoning has the highest correlation two times, second highest two times, third highest three times, and lowest four times. It should be noted that all seven times when this test ranked first, second, or third, the correlation coefficient was significant at the 1 per cent or 5 per cent level.

Abstract Reasoning was significant only six times even though it had the highest correlation once, the second highest twice, third highest five times, and the fourth highest three times.

CHAPTER IV

SUMMARY AND CONCLUSIONS

A limited amount of information is available on the correlation between the various Differential Aptitude Tests scores and grades in industrial arts on the junior and senior high school level. The available information stated that Mechanical Reasoning is useful in predicting for certain industrial arts courses and that the Space Relations test is effective for mechanical drawing. Doppelt, Seashore, and Odgers say that the sum of the Space Relations, Mechanical Reasoning, and Abstract Reasoning tests is a good predictor of success in machine shop, but not as useful for auto mechanics.

The purpose of this study was (1) to determine whether there is a positive relationship between certain Differential Aptitude Test scores and grades in industrial arts at Shawnee Mission North High School; (2) to determine which of the tests studied may have the greatest bearing on certain industrial arts courses; and (3) to determine whether the results of the Space Relations and Abstract Reasoning tests appear to be good predictors for success in drafting courses.

This study was conducted at Shawnee Mission North High School and included 138 students. The students used were (1) juniors, (2) students who had completed at least one industrial arts course in the sophomore year, and (3) students who had taken the Differential Aptitude Test in the eighth grade. It was found that some students had failed to complete the entire battery of the Differential Aptitude Tests; therefore, only

those students for whom the scores were available on the Space Relations, Mechanical Reasoning, and Abstract Reasoning tests were used.

The courses studied represent four course areas. These areas are as follows: (1) drafting, which consisted of Elementary Drafting and Machine Drawing, (2) metalworking, which included Seventh or Eighth Grade Metal and Drawing, Ninth Grade Metal and Electricity, Metal Shop I, and Metal Shop II, (3) auto mechanics which consisted only of the basic course (because Auto Mechanics II is offered to seniors and they were not used in this study), and (4) woodworking, which consisted of Seventh or Eighth Grade Wood and Drawing, Ninth Grade Wood and Drawing, Woodworking I, and Woodworking II. Seventh, eighth, and ninth grade drawing is placed in the woodworking and metalworking area because drawing takes up only six weeks of the course, whereas metal working and woodworking take up twelve weeks.

ANALYSIS OF THE DATA

After the individuals and courses to be used were selected, the required information was obtained from their permanent records. This information was plotted on a frequency table which contained rows for course grades and a column with intervals for raw scores from the Differential Aptitude Test. These tables also showed the per cent of students who got the various grades in each raw score interval.

A bivariate frequency distribution was used in order to obtain the necessary information to calculate the Pearson product-moment correlation coefficient. The correlation coefficient was checked against a table of values of r that are significant at various levels in order

to check for significance at the 5 per cent and the 1 per cent levels.

The findings of this study indicate that certain tests and sums of the tests are of predictive value for various areas of industrial arts. The sum of Space Relations, Mechanical Reasoning, and Abstract Reasoning is significant at the 1 per cent or 5 per cent level in all cases except Woodworking II. The Space Relations Test is effective as a predictor in drawing and metalworking. Mechanical Reasoning is significant for the lower levels of auto mechanics, metalworking, and woodworking. Abstract Reasoning seems to be significant for drafting.

CONCLUSIONS

On the basis of this study the following statements can be made about the 1963-1964 juniors at Shawnee Mission North High School:

1. There is a positive relationship between the scores on Space Relations, Mechanical Reasoning, Abstract Reasoning, and the sum of these scores, and industrial arts grades in every case.
2. The sum of Space Relations, Mechanical Reasoning, and Abstract Reasoning is a better predictor of course grades in junior and senior high school industrial arts than any one of the individual scores.
3. Space Relations and Abstract Reasoning scores are good predictors for drafting grades; however, the sum of the three tests studied should also be considered.
4. Mechanical Reasoning is effective as a probable predictor for

auto mechanics. The sum of the three tests studied should also be used as a predictor.

5. Abstract Reasoning appears to be the least effective predictor for woodworking, metalworking, or auto mechanics.

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TABLE VI

[illegible] the 1 Per Cent

[illegible]

[illegible]

15

APPENDIX

[illegible] Marburg, Iowa State [illegible] the author and publisher, [illegible] test of significance,

[illegible]

[1] Allen L. [illegible], Experimental Design in Psychology, [illegible] York: Rinehart [illegible] Company, 1956), p. 208.

TABLE VI

Values of r at the 5 and the 1 Per Cent Levels of Significance*[1]

Degrees of Freedom	5%	1%	Degrees of Freedom	5%	1%
1	.997	1.000	24	.388	.496
2	.950	.990	25	.381	.487
3	.878	.959	26	.374	.478
4	.811	.917	27	.367	.470
5	.754	.874	28	.361	.463
6	.707	.834	29	.355	.456
7	.666	.798	30	.349	.449
8	.632	.765	35	.325	.418
9	.602	.735	40	.304	.393
10	.576	.708	45	.288	.372
11	.553	.684	50	.273	.354
12	.532	.661	60	.250	.325
13	.514	.641	70	.232	.302
14	.497	.623	80	.217	.283
15	.482	.606	90	.205	.267
16	.468	.590	100	.195	.254
17	.456	.575	125	.174	.228
18	.444	.561	150	.159	.208
19	.433	.549	200	.139	.181
20	.423	.537	300	.118	.148
21	.413	.526	400	.098	.128
22	.404	.515	500	.088	.115
23	.396	.505	1000	.062	.081

*Table VI is abridged from Table V.A. of Fisher: Statistical Methods for Research Workers, Oliver & Boyd Ltd., Edinburgh, by permission of the author and publishers. Additional entries were taken from Snedecor: Statistical Methods, Iowa State College Press, Ames, Iowa, by permission of the author and publisher. The probabilities given are for a two-tailed test of significance, i.e., with the sign ignored.

[1] Allen L. Edwards, Experimental Design in Psychological Research (New York: Rinehart and Company, Inc.), p. 408.