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Jerry D. Harreld

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A COMPARATIVE ANALYSIS OF APTITUDES MEASURED BY GENERAL
APTITUDE TEST BATTERY (GATB) FOR STUDENT GROUPS IN
VARIOUS SPECIALTIES OF THE VOCATIONAL-TECHNICAL-
TRAINING DEPARTMENT AT KANSAS STATE COLLEGE
OF PITTSBURG

A Special Research Project Submitted to the Graduate
Division in Partial Fulfillment of the Requirements
for the Degree of Specialist in Education

By 744

Jerry D. Harreld

KANSAS STATE COLLEGE OF PITTSBURG

Pittsburg, Kansas

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ABSTRACT

Are there differences in the aptitudes as measured by the General Aptitude Test Battery of students in the various course specialties of the Vocational Technical Training Department of Kansas State College of Pittsburg?

This study investigated the GATB aptitudes of 812 students enrolled in Vocational Technical Training Department of Kansas State College of Pittsburg from May 1, 1960 to June 30, 1964. The statistical techniques of analysis used in this investigation of the measures of variability and central tendencies of the GATB aptitudes were Bartlett's Test of Homogeneity of Variance and the single classification of analysis of variance.

Bartlett's Test established homogeneity for Intelligence, Verbal Aptitude, Numerical Aptitude, and Form Perception in the course specialties of the Vocational Technical Training Department. Spatial Aptitude, Clerical Aptitude, Motor Coordination, Finger Dexterity, and Manual Dexterity were statistically different in their dispersion of scores to differentiate between the course specialties of the Vocational Technical Training Department.

The measures of central tendency for Verbal Aptitude and Manual Dexterity were not statistically different to differentiate between the course specialties. Intelligence, Numerical Aptitude, Spatial Aptitude, Form Perception, Clerical Aptitude, Motor Coordination, and Finger Dexterity were statistically significant in their measures of central tendency to differentiate between the course specialties of the Vocational Technical Training Department.

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CHAPTER I

THE PROBLEM

Introduction to the problem

The world of work is a rapidly changing aspect of modern American society. The metamorphic demands placed on post-high school educational organizations to provide technical workers is congruous with this evolvement. The contemporary student must make a choice from the many training programs available to him. The rising demand for labor to be skilled in order to enter future positions during the coming years is even more of a problem. It is to be expected that aptitudes of potential skilled workers will be evaluated to assist their entrance to the labor market.

The Vocational Technical Training Department at Kansas State College of Pittsburg is designed to provide specialized training for students to enter the labor market with specific technical skills in the technological society of today. The Department of Vocational Technical Training at Kansas State College of Pittsburg employs a battery of aptitude measurement to assist with placement in the ten course specialities within the department. Other units of higher education use standardized test measurement for entrance into their schools and departments. For many years this battery of aptitude measurement has been the General Aptitude Test Battery (GATB)

published by the U.S. Department of Labor.¹ The data acquired by the standardized testing instrument are used by the department to assist with the placement of the student in the course specialties and to provide test information for counseling.

This study attempted to investigate the variation of dispersion and central tendency of each aptitude measurement of the General Aptitude Test Battery within the specialty classification of the Department of Vocational Technical Training of Kansas State College of Pittsburg.

Among the many treatments of statistical data available to research workers in attempting to analyze multi-group data is the analysis of variance model.

Organization of study

Chapter two is a review of the relevant literature dealing with the measurements of aptitudes and their relation to vocational technical education. Chapter three is an outline of the statistical methods used in this study. The results of this investigation are presented in chapter four. The final chapter summarizes the study and presents the conclusions and recommendations.

Hypothesis of study

The basic hypothesis studied was that there are

¹U.S. Department of Labor, Guide to the Use of the General Aptitude Test Battery, Section III: Development, (Washington, D.C.: U.S. Government Printing Office, 1962), p.1.

differences in the aptitudes of students as measured by the General Aptitude Test Battery in the ten course specialties of the Vocational Technical Training Department of Kansas State College of Pittsburg.

CHAPTER II

RELATED LITERATURE

This chapter is a review of the literature pertinent to the understanding of the background of aptitude measurement and vocational education. The Educational Policies Commission statement:

More than ever before, and for ever increasing proportion of the population, vocational competence requires developed rational capacities. The march of technology and science in the modern society progressively eliminates the positions open to low-level talents.¹

stressed the need of our society to maximize the use of each individual's talents within our society for the welfare of the individual and the nation.

The federal government has long been cognizant of the needs of vocational education. A series of legislative acts beginning with the Northwest Ordinance Act that endowed educational institutions with public land indicate the early concern for education. The Morrill Act in 1862 provided aid in the form of public land grants to colleges for agriculture and the mechanic arts.² The Smith-Hughes Act of 1917 provided grants to the individual states for the support of vocational

¹Educational Policies Commission, Central Purposes of American Education, (Washington D.C.: National Education Association, 1961), p. 6.

²J. Chester Swanson (ed.), Development of Federal Legislation for Vocational Education, (Washington D.C.: American Technical Society, 1962), p. 21.

educational programs.³ In 1936, the George-Deen Act extended federal assistance to vocational educational programs.⁴ The George-Barden Act of 1946 provided additional federal support to programs for vocational education.⁵ The Vocational Education Act of 1963 provided for the construction of new schools and new programs in addition to the existing programs.⁶ The Vocational Education Amendments of 1968 amending the Vocational Education Act of 1963 extended federal support of vocational education to the nation.⁷ The continuation of the programs and the use of federal funds indicate the national necessity for vocational education expressed by the leaders of this nation at the federal level.

The ever increasing demand for new programs and the number of students enrolling in the programs of the vocational curriculum are creating a placement problem within these programs. More attention is being given to the placing of each student with his individual talents in the available program that will maximize his chances for vocational success in the future.

The need for the measurement of aptitudes can be traced back to the conclusions of Frank Parsons in Choosing A

³Ibid., p. 49. ⁴Ibid., p. 89. ⁵Ibid., p. 90.

⁴U.S. Department of Health, Education and Welfare, The Vocational Education Act of 1963, (Washington D.C. : U.S. Government Printing Office, 1965), p. 1.

⁷U.S. Congress, Vocational Amendments of 1968, Public Law 90-576, (Washington D.C. : U.S. Government Printing Office, 1968), p. 1.

Vocation in 1909 pleading for instruments to test the capacities of the physical, intellectual, and emotional makeup of the individual client.⁸ A series of measurement books beginning with Clark Hull's publication of Aptitude Testing⁹ in 1928 and Walter Bingham's Aptitude and Aptitude Testing¹⁰ in 1937 has aided the user of testing instruments in looking at measurement devices that can assist in vocational counseling and placement. Super and Crites' revision of Appraising Vocational Fitness¹¹ has further developed this series of books for understanding aptitude measurement.

The first experimental edition of the General Aptitude Test Battery was published in 1945. The GATB has been a valuable clinical instrument for the Employment Service as well as a research instrument. The GATB is the nucleus of the basic testing battery used by the Employment Service Offices in each of the fifty states.

The 1962 bibliography of the GATB includes some 547 published references. A breakdown of these references indicates the wide use at all levels of public institutions.

⁸Frank Parsons, Choosing A Vocation, (Boston: Houghton Mifflin Co., 1909), p. 165.

⁹Clark I. Hull, Aptitude Testing, (New York: World Book Company, 1928).

¹⁰Walter Van Dyke Bingham, Aptitudes and Aptitude Testing, (New York: Harper & Brothers, 1937).

¹¹Donald E. Super and John O. Crites, Appraising Vocational Fitness, (New York: Harper and Row Publishers, 1962).

Twenty-five articles refer to the use of GATB in the secondary schools and thirty-nine are directed at college level programs. The 175 validity studies published by the Department of Labor are indicative of the practical use of the battery.¹² The 1968 American Personnel and Guidance program presented by Stephen Bemis indicated some five hundred specific validity studies using the GATB.¹³

Droege's research providing norms for GATB usage in high school programs as low as the ninth grade¹⁴ and the use of the GATB in the Manpower Development Training Act is supportive information to continue the use of the GATB in those areas.¹⁵

The extent of published information for vocational educational programs other than the inference from the above studies is rather sparse. A published study of the GATB by Samuelson in the Journal of Educational Research for the

¹²U.S. Department of Labor, Guide to the Use of the General Aptitude Test Battery, Section III: Development, (Washington D.C.: U.S. Government Printing Office, 1962), pp. 197-217.

¹³Stephen E. Bemis, "The General Aptitude Test Battery Faces a New Challenge," APGA 1968 Detroit Convention Abstracts, (Washington D.C.: American Personnel and Guidance Association, 1968), p. 134.

¹⁴Robert C. Droege, "GATB Norms for Lower High School Grades," Personnel and Guidance Journal, XXXIX (September, 1960), pp. 30-35.

¹⁵Robert C. Droege, "Validity of USES Aptitude Test Batteries for Predicting MDTA Training Success," Personnel and Guidance Journal, XLVI (June, 1968), pp. 984-89.

Salt Lake Vocational School area provides a report indicating the validity of the GATB as a predictor of success in vocational programs.¹⁶

¹⁶Cecil O. Samuelson, "The G.A.T.B. in Predicting Success of Vocational School Students," Journal of Educational Research, L (November, 1956), pp. 175-82.

CHAPTER III

METHOD OF INVESTIGATION

The outline of the procedures for the selection of the variates, the sample population, and the statistical techniques used in this investigation are presented in this chapter.

Selection of variates

The entrance examination battery of the Department of Vocational Technical Training of Kansas State College of Pittsburg consist of a multi-aptitude battery and a measure of academic potential or general learning. The Henmon-Nelson Test of Mental Ability is used as the measure of general learning by the Department of Vocational Technical Training and was not investigated in this study. The General Aptitude Test Battery (called the GATB) is composed of twelve tests that are reported measures of nine aptitudes that have been found to be important for successful performance in a varied range of occupations by the United States Employment Service of the U.S. Department of Labor. Four of the twelve tests are apparatus tests and the other eight are paper and pencil tests. Seven of the eight paper and pencil tests are multiple choice tests. The tests of the GATB are:

Part 1--Name Comparison

This test consists of two columns of names. The examinee inspects each pair of names, one in each

column, and indicates whether the names are the same or different. Measures Clerical Perception.

Part 2--Computation

This test consists of a number of arithmetic exercises requiring the addition, subtraction, multiplication, or division of whole numbers. Measures Numerical Aptitude.

Part 3--Three-Dimensional Space

This test consists of a series of exercises containing a stimulus figure and four drawings of three-dimensional objects. The stimulus figure is pictured as a flat piece of metal which is to be either bent, or rolled, or both. Lines indicate where the stimulus figure is to be bent. The examinee indicates which one of the four drawings of three-dimensional objects can be made from the stimulus figure. Measures Intelligence and Spatial Aptitude.

Part 4--Vocabulary

This test consists of sets of four words. The examinee indicates which two words have either the same or opposite meanings. Measures Intelligence and Verbal Aptitude.

Part 5--Tool Matching

This test consists of a series of exercises containing a stimulus drawing and four black-and-white drawings of simple shop tools. The examinee indicates which of the four black-and-white drawings is the same as the stimulus drawing. Variations exist only in the distribution of black and white in each drawing. Measures Form Perception.

Part 6--Arithmetic Reason

This test consists of a number of arithmetic problems expressed verbally. Measures Intelligence and Numerical Aptitude.

Part 7--Form Matching

This test consists of two groups of variously shaped line drawings. The examinee indicates which figure in the second group is exactly the same size and shape as each figure in the first or stimulus group. Measures Form Perception.

Part 8--Mark Making

This test consists of a series of squares in which the examinee is to make three pencil marks, working as rapidly as possible. The marks to be made are short lines, two vertical and the third a horizontal line beneath them. Measures Motor Coordination.

Part 9--Place

The equipment used for this test and for Part 10 consists of a rectangular wooden board (Pegboard) divided into two sections, each section containing 48 holes. The upper section contains 48 cylindrical wooden pegs. The examinee removes the wooden pegs from the holes in the upper part of the board and inserts them in the corresponding holes in the lower part of the board, moving two pegs simultaneously, one in each hand. This performance is done three times, with the examinee working rapidly to move as many of the pegs as possible during the time allowed for each of the three trials. Measures Manual Dexterity.

Part 10--Turn

The equipment described under Part 9 is also used for this test. For Part 10 the lower section of the board contains the 48 cylindrical pegs. The examinee removes a wooden peg from a hole, turns the peg over so that the opposite end is up, and returns the peg to the hole from which it was taken, using only his preferred hand. The examinee works rapidly to turn and replace as many of the 48 cylindrical pegs as possible during the time allowed. Three trials are given for this performance. Measures Manual Dexterity.

Part 11--Assemble

The equipment used for this test and for Part 12 consists of a small rectangular board (Finger Dexterity Board) containing 50 holes, and a supply of small metal rivets and washers. The examinee takes a small metal rivet from a hole in the upper part of the board with his preferred hand and at the same time removes a small metal washer from a vertical rod with the other hand; examinee puts the washer on the rivet, and inserts the assembled piece onto the corresponding hole in the lower part of the board using only his preferred hand. The examinee works rapidly to move and to replace as many rivets and washers as possible during the time allowed. Measures Finger Dexterity.

Part 12--Disassemble

The equipment used for this test is the same as that described for Part 11. The examinee removes the small metal rivet of the assembly from a hole in the lower part of the board, slides the washer to the bottom of the board, puts the washer on the rod with one hand and the rivet into the corresponding hole in the upper part of the board with the other (preferred) hand. The examinee works rapidly to move and replace as many

rivets and washers as possible during the time allowed. Measures Finger Dexterity.¹

The nine aptitudes measured by the GATB are defined:

Aptitude G--Intelligence

General learning ability. The ability to "catch on" or understand instructions and underlying principles; the ability to reason and make judgments. Closely related to doing well in school. Measured by Parts 3, 4, and 6.

Aptitude V--Verbal Aptitude

The ability to understand meaning of words and to use them effectively. The ability to comprehend language, to understand relationships between words and to understand meanings of whole sentences and paragraphs. Measured by Part 4.

Aptitude N--Numerical Aptitude

Ability to perform arithmetic operations quickly and accurately. Measured by Parts 2 and 6.

Aptitude S--Spatial Aptitude

Ability to think visually of geometric forms and to comprehend the two-dimensional representation of three-dimensional objects. The ability to recognize the relationships resulting from the movement of objects in space. Measured by Part 3.

Aptitude P--Form Perception

Ability to perceive pertinent detail in objects or in pictorial or graphic material. Ability to make visual comparisons and discriminations and see slight differences in shapes and shadings of figures and widths and lengths of lines. Measured by Parts 5 and 7.

Aptitude Q--Clerical Perception

Ability to perceive pertinent detail in verbal or tabular material. Ability to observe differences in copy, to proofread words and numbers, and to avoid perceptual errors in arithmetic computation. Measured by Part 1.

Aptitude K--Motor Coordination

Ability to coordinate eyes and hands or fingers rapidly and accurately in making precise movements

¹U.S. Department of Labor, Guide to the Use of the General Aptitude Test Battery, Section III: Development, (Washington, D.C.: U.S. Government Printing Office, 1962), pp. 13-14.

with speed. Ability to make a movement response accurately and swiftly. Measured by Part 8.

Aptitude F--Finger Dexterity

Ability to move the fingers, and manipulate small objects with the fingers, rapidly or accurately. Measured by Parts 11 and 12.

Aptitude M--Manual Dexterity

Ability to move the hands easily and skillfully. Ability to work with the hands in plaging and turning motions. Measured by Parts 9 and 10.²

A student's performances on the tests of the GATB are transformed into standard scores for each of the aptitudes. The standard score mean of 100 and the standard deviation of 20 are representative of the group performance of the standardization population of 4,000 people on the GATB.³

Selection of individuals

The general objectives of the Department of Vocational Technical Training of Kansas State College of Pittsburg are outlined in the information bulletin:

General objectives of the Department of Vocational Technical Training are to:

1. Develop skill in the use of tools and machines and in the modification of materials of the particular trade selected as an occupation.
2. Promote safety consciousness, desirable health practices and good citizenship as applied to industry and community living.
3. Develop the ability to interpret drawings and to express ideas accurately by means of shop sketches, drawings, and diagrams.

²Ibid., pp. 14-15.

³Ibid., p. 24.

4. Develop a strong interest in industrial affairs and methods of production.
5. Provide specialized training for persons who do not desire to spend four years acquiring a college degree.
6. Provide specialized training for persons who have selected a vocation, acquired some practical experience and feel the need for further training.
7. Provide training for severely handicapped persons who desire physical and vocational rehabilitation.
8. Increase the technical information of students in the particular vocation selected as an occupation.
9. Provide training and retraining for persons displaced from their previous occupational pursuits as a result of technological changes.⁴

The ten course specialties of the department include Air-Conditioning and Refrigeration, Auto Body Repair, Auto Mechanics, Cabinet and Furniture Making, Cosmetology, Drafting Technology, Electricity, Machine Shop, Radio and Television Repair, and Welding.

The two criteria for students included in the study group under investigation were:

1. Students were enrolled in the Department of Vocational Technical Training of Kansas State College of Pittsburg during the time period of May 1, 1960 through June 30, 1964.

2. Students had complete test results for the GATB on file in the Testing Office of Kansas State College of

⁴Kansas State College of Pittsburg, Department of Vocational Technical Training, (Pittsburg, Kansas: KSC-Pittsburg, 1963), p. 3.

Pittsburg. Table I indicates the number of students in each course specialty of the Department of Vocational Technical Training included in this study. A non-major section was added to include students enrolled in this classification.

Statistical techniques for analysis

A verification of the test data card from the Testing Office and the student record file from the Department of Vocational Technical Training was completed before the data were transferred to IBM punch cards. This was a laborious clerical method involving constant checking and rechecking. The data in the IBM cards were then printed and rechecked before the statistical analysis was initiated.

The two statistical techniques used in this study were Bartlett's Test of Homogeneity of Variances and the single classification model for analysis of variance.

The null hypothesis. There are no significant differences between the student population groups of the major areas of study or specialty groups within the Vocational Technical Training Department of Kansas State College of Pittsburg on the (GATB) measures of aptitude.

Level of confidence. The statistical level of confidence for this investigation was established at .01.

Test for homogeneity of variance. The statistical technique used to establish the homogeneity of variance for the samples of this study was Bartlett's Test of Homogeneity. If the

TABLE I

THE NUMBER OF STUDENTS IN EACH COURSE SPECIALTY OF THE
 VOCATIONAL TECHNICAL TRAINING DEPARTMENT OF KANSAS STATE
 COLLEGE OF PITTSBURG WITH GATB RESULTS FROM
 MAY 1, 1960 TO JUNE 30, 1964.

Area	Course Specialty	Number
Air C.	Air-Conditioning and Refrigeration	68
A. Body	Auto Body Repair	38
A. Mech.	Auto Mechanic	120
Cos.	Cosmetology	146
Draft.	Drafting Technology	84
Elec.	Electricity	49
Furn.	Cabinet and Furniture Making	30
Mach.	Machine Shop	65
T.V.	Radio and Television Repair	57
Weld.	Welding	74
Non.	Non-Major (Students enrolled with no declared major)	81
Total		812

numbers of the sample are different the sampling statistic

B' is given by the formula: $B' = 2.306 \left[(\log \bar{s}^2)(N-k) - \sum (n_i - 1)(\log s_i^2) \right]$.

The constant used to convert Napierian logarithms to common logarithms was 2.3026. The unweighted arithmetic mean of the variances of the sample was \bar{s}^2 . The total number of observations in the specialty groups was N . The number of specialty groups was k . The number of students in each specialty group was n . A correction factor C makes the interpretation of the statistic B' more exact to chi square. The formula for the correction factor was

$$C = 1 + \frac{1}{3(k-1)} \left(\sum \frac{1}{n_i - 1} - \frac{1}{N - k} \right)^2$$

The actual routine computations for this study were completed with the use of the IBM 1620 computer in the Computer Center of Kansas State College of Pittsburg. A program for the IBM 1620 provided a more efficient manner of handling the numerous data for this study.⁶

Analysis of variance. The single classification model for analysis of variance was the statistical technique used in this study to establish the significance of the differences of the measures of central tendency for the various course specialties of the Vocational Technical Training Department

⁵J. P. Guilford, Fundamental Statistics in Psychology and Education, (New York: McGraw-Hill Book Company, Inc., 1956), pp. 242-244.

⁶1620 General Program Library, Homogeneity of Variance, (UCKBL 0032) 6.0.035.

on each GATE aptitude. This model assumed the homogeneity of variance for the samples under investigation.

The three necessary components computed from the basic data for use in the analysis of variance were the total sum of squares, the between-groups sum of squares, and the within-groups sum of squares for each aptitude investigation. The total sum of squares was calculated by the formula:

$$\Sigma x_t^2 = \Sigma (\Sigma X^2)_s - \frac{(\Sigma X)^2}{N}.$$

The between-groups sum of squares was calculated from the formula:

$$\Sigma x_b^2 = \Sigma \frac{(\Sigma X)_s^2}{n_s} - \frac{(\Sigma X)^2}{N}.$$

The within-groups sum of squares was calculated from the

formula:
$$\Sigma \Sigma x_s^2 = \Sigma (\Sigma X^2)_s - \frac{\Sigma (\Sigma X)_s^2}{n_s}.$$

The total number in the aptitude under investigation was N.

The number within each specialty was n_s . The number of specialty groups in each aptitude under investigation was k.

The degrees of freedom associated with each sum of squares was: total sum of squares=N-1

within-groups sum of scores= n_s-1

between-groups sum of scores=k-1

The mean square for the within-groups and between-groups sum of scores was found by dividing the sum of square by their degrees of freedom. The calculation of the ratio of the mean square between-groups and the mean square within-

groups was the obtained F value that was evaluated using the F distribution.⁷

Analysis of variance with heterogenous variance. Snedecor reported a method for the calculation of a pair of weighted mean squares and testing their ratio against the F-distribution. The following steps report this method for analyzing the raw data for the groups with heterogenous variance.

A weight for each sample of the specialty groups in the aptitude under investigation was calculated by dividing the number in each group by their variance. The formula for this weight was $w_i = \frac{n_i}{s_i^2}$.

The weighted mean for the k samples was then computed by dividing the total sum of the products of each sample mean and the sample weight by the total sum of the weights for all samples. The formula for the weighted mean was

$$\bar{x}_w = \frac{\sum (\bar{x}_i)(w_i)}{\sum w_i}.$$

The deviation for each sample mean from the weighted mean was then determined and squared. The formula for the weighted sum of squares was $SS_w = \sum (w_i)(\bar{x}_i - \bar{x}_w)^2$.

The mean square for the weighted sum of squares was then obtained by dividing the weighted sum of squares by the

⁷J. P. Guilford, Fundamental Statistics in Psychology and Education, (New York: McGraw-Hill Book Company, Inc., 1956), pp. 257-267.

number of the samples less one. The formula for the mean squares for the weights was $MS_W = \frac{SS_W}{k-1}$.

The weight for each sample was then divided by the total of all the weights. This adjusted weight for each sample was then subtracted from one for each sample. The obtained difference was then squared and divided by the number in each sample less one. The summation for all samples of this value was then obtained as a within-groups weight. The formula for the within-groups weight was $W_W = \sum \frac{\left(1 - \frac{w_i}{\sum w_i}\right)^2}{n_i - 1}$

The within-groups or error mean square was obtained from the formula $MS_e = 1 + \frac{2(k-2)}{k^2-1}(W_W)$.

F was obtained in the usual ratio form. The degrees of freedom for each mean square was obtained by:

$$\begin{aligned} \text{weighted d.f.} &= k-1 \\ \text{error d.f.} &= \frac{1}{\frac{3}{k^2-1}} \end{aligned}$$

The computer program for the IBM 1620 computed Barlett's Test of Homogeneity and the weighted analysis of variance for heterogenous variance in the same operation.⁹

⁸George W. Snedecor and William G. Cochran, Statistical Methods Applied to Experiments in Agriculture and Biology, (Ames, Iowa: Iowa State University Press, 1956), pp. 287-89.

⁹1620 General Program Library, Homogeneity of Variance, (UCKEL 0032) 6.0.035.

CHAPTER IV

RESULTS OF THE STUDY

This chapter reports the findings of the investigation of the GATB aptitude measurement in the specialty areas of the Vocational Technical Training Department of Kansas State College of Pittsburg.

The original hypothesis that there are differences in the aptitudes of students as measured by the General Aptitude Test Battery in the ten course specialties of the Vocational Technical Training Department of Kansas State College of Pittsburg was restated in null hypothesis form for statistical inference. The null hypothesis for the investigation of the variability of the students' scores was that there are no differences in the variances exhibited in the GATB aptitude measures of students in the ten course specialties of the Vocational Technical Training Department. The null hypothesis for the investigation of the measures of central tendency was that there are no differences in the mean scores of the GATB aptitudes of students in the ten course specialties of the Vocational Technical Training Department.

The assessment of the measures of central tendency and the variability of the aptitudes for each of the specialty areas of the Vocational Technical Training Department are

reported in terms of arithmetic means and standard deviations in Table II and Table III.

Homogeneity of variance

The statistical technique used to analyze the measures of variability for the specialty areas of the Vocational Technical Training Department of Kansas State College of Pittsburg was Bartlett's Test of Homogeneity of Variance.

The tested null hypothesis of homogeneity of variance for the specialty areas of the Vocational Technical Training Department for each aptitude measure was accepted or refuted at the .01 level of confidence as follows:

Aptitude G-Intelligence: accepted.

Aptitude V-Verbal Aptitude: accepted.

Aptitude N-Numerical Aptitude: accepted.

Aptitude S-Spatial Aptitude: refuted.

Aptitude P-Form Perception: accepted.

Aptitude Q-Clerical Aptitude: refuted.

Aptitude K-Motor Coordination: refuted.

Aptitude F-Finger Dexterity: refuted.

Aptitude M-Manual Dexterity: refuted.

The results of Bartlett's Test of Homogeneity of Variance indicated that there are differences in the variability of the GATB measures of Spatial Aptitude, Clerical Aptitude, Motor Coordination, Finger Dexterity, and Manual Dexterity for the specialty groups of the Vocational

TABLE II

THE ARITHMETIC MEANS OF THE GATB APTITUDES FOR THE SPECIALTY AREAS OF THE VOCATIONAL
TECHNICAL TRAINING DEPARTMENT OF KANSAS STATE COLLEGE OF PITTSBURG.

Area	G	V	N	S	P	Q	K	F	M
Air C.	98.04	91.75	98.82	102.48	99.20	99.41	92.64	90.16	93.64
A. Body	96.18	90.92	89.60	109.02	99.68	99.50	90.60	85.68	89.76
A. Mech.	102.86	93.91	98.89	114.10	101.07	97.89	91.79	92.83	97.41
Cos.	99.89	97.13	98.35	107.49	112.94	112.24	102.71	103.10	98.28
Dreft.	106.65	94.35	105.07	119.20	115.04	106.16	98.41	91.47	95.96
Elec.	100.63	93.79	98.22	113.44	100.71	100.04	92.14	91.12	95.61
Furn.	93.56	89.96	92.10	100.20	91.33	92.33	81.16	82.40	82.80
Mach.	100.89	91.53	96.20	116.04	102.29	96.60	92.72	88.96	92.52
T.V.	100.82	94.38	97.63	107.98	93.82	96.63	87.66	91.68	90.70
Weld.	97.50	91.90	93.40	108.55	99.33	97.05	89.77	89.62	92.09
Non.	98.17	92.65	97.06	108.81	106.01	102.92	97.82	96.32	98.03
Total	100.26	93.59	97.71	110.18	103.97	101.68	94.28	93.15	94.81

TABLE III

THE STANDARD DEVIATIONS OF THE GATB APTITUDES FOR EACH SPECIALTY AREA OF THE VOCATIONAL
TECHNICAL TRAINING DEPARTMENT OF KANSAS STATE COLLEGE OF PITTSBURG.

Area	G	V	N	S	P	Q	K	F	M
Air C.	14.52	12.45	14.36	24.47	15.96	10.71	15.87	21.20	19.67
A. Body	16.58	12.97	15.86	19.17	17.19	15.96	12.88	28.03	25.75
A. Mech.	13.53	11.81	14.13	16.87	15.49	12.47	17.41	19.02	22.43
Cos.	14.37	13.12	14.78	19.52	19.93	15.43	25.91	18.78	18.80
Draft.	12.34	11.67	12.87	16.98	17.04	10.33	18.76	30.54	27.33
Elec.	16.86	12.81	14.64	17.59	12.63	13.18	16.96	20.93	22.62
Furn.	16.59	15.91	16.61	21.68	19.93	14.35	24.23	31.10	29.24
Mach.	14.04	11.95	13.09	18.07	16.09	11.39	23.38	26.30	27.82
T.V.	14.05	14.21	17.29	16.13	18.37	14.68	23.92	25.10	21.67
Weld.	16.42	14.33	15.30	20.44	16.85	10.65	21.97	23.41	25.26
Non.	14.43	12.12	16.35	22.24	18.15	14.55	26.92	20.33	21.82
Total	14.32	12.91	15.27	20.50	18.64	14.42	22.36	23.91	23.57

Technical Training Department. The GATB measures of Intelligence, Verbal Aptitude, Numerical Aptitude, and Form Perception are not statistically different in their dispersions of scores for the specialty areas of the Vocational Technical Training Department. Table IV reports the obtained values of chi square for Bartlett's test for each aptitude.

Analysis of central tendency

The analysis of the group measures of central tendency for the aptitudes in the specialty areas of the Vocational Technical Training Department of Kansas State College of Pittsburg used two models for the statistical analysis.

The tested null hypothesis of no differences in the means of the specialty groups for the GATB aptitudes was accepted or refuted at the .01 of confidence as follows:

Aptitude G-Intelligence: refuted.

Aptitude V-Verbal Aptitude: accepted.

Aptitude N-Numerical Aptitude: refuted.

Aptitude S-Spatial Aptitude: refuted.

Aptitude P-Form Perception: refuted.

Aptitude Q-Clerical Perception: refuted.

Aptitude K-Motor Coordination: refuted.

Aptitude F-Finger Dexterity: refuted.

Aptitude M-Manual Dexterity: accepted.

The analysis of variance model for aptitudes with the assumption of homogeneity of variance established by

TABLE IV

CHI SQUARE VALUES OBTAINED FROM BARTLETT'S TEST OF
HOMOGENEITY OF VARIANCE FOR THE GATB APTITUDES FOR
SPECIALTY AREAS OF THE VOCATIONAL TECHNICAL TRAINING
DEPARTMENT OF KANSAS STATE COLLEGE OF PITTSBURG.

Aptitude	Chi Square	Significance
G - Intelligence	12.59	N.S.
V - Verbal Aptitude	10.54	N.S.
N - Numerical Aptitude	11.71	N.S.
S - Spatial Aptitude	24.83	Sig.
P - Form Perception	20.28	N.S.
Q - Clerical Perception	36.91	Sig.
K - Motor Coordination	64.33	Sig.
F - Finger Dexterity	52.16	Sig.
M - Manual Dexterity	31.84	Sig.
Expected Chi Square value with 10 d.f. for the .01 level is 23.20.		

Bartlett's test indicated that statistical differences exist in the measures of central tendency for the specialty areas of the Vocational Technical Training Department on the GATB measures of Intelligence, Numerical Aptitude, and Form Perception. No statistical difference exists between the means of the specialty groups of the Vocational Technical Training Department for Verbal Aptitude. Table V reports the result of the analysis of variance for the GATB aptitudes as follows: Intelligence, Verbal Aptitude, Numerical Aptitude, and Form Perception.

The analysis of variance for aptitudes with heterogeneous variance indicated that differences exist in the group measures of central tendency for the specialty areas of the Vocational Technical Training Department on the GATB measures of Spatial, Clerical Perception, Motor Coordination, and Finger Dexterity. No statistical difference in the measures of central tendency existed for Manual Dexterity in the specialty groups of the Vocational Technical Training Department. Table VI reports the results of the analysis of variance for the GATB measures of Spatial, Clerical Perception, Motor Coordination, Finger Dexterity, and Manual Dexterity.

TABLE V

ANALYSIS OF VARIANCE FOR THE MEASURES OF CENTRAL TENDENCY
FOR THE GATB APTITUDES OF THE SPECIALTY AREAS OF THE
VOCATIONAL TECHNICAL TRAINING DEPARTMENT OF KANSAS STATE
COLLEGE OF PITTSBURG WITH HOMOGENEOUS VARIANCES.

Source	Sum of Squares	df	Mean Square	F	Significance
<u>Aptitude G - Intelligence</u>					
Between	7,310.81	10	731.08	3.68	Sig.
Within	159,094.67	801	198.62		
Total	166,405.48	811			
<u>Aptitude V - Verbal Aptitude</u>					
Between	3,377.23	10	337.72	2.05	N.S.
Within	131,762.27	801	164.50		
Total	135,139.50	811			
<u>Aptitude N - Numerical Aptitude</u>					
Between	9,870.57	10	987.06	4.41	Sig.
Within	179,189.72	801	223.71		
Total	189,060.29	811			
<u>Aptitude P - Form Perception</u>					
Between	38,589.38	10	3,858.94	12.71	Sig.
Within	243,171.97	801	303.59		
Total	281,761.35	811			
Expected F at the .01 level of confidence is 2.35.					

TABLE VI

ANALYSIS OF VARIANCE FOR THE MEASURES OF CENTRAL TENDENCY
FOR THE GATB APTITUDES OF THE SPECIALTY AREAS OF THE
VOCATIONAL TECHNICAL TRAINING DEPARTMENT OF KANSAS STATE
COLLEGE OF PITTSBURG WITH HETEROGENEOUS VARIANCES.

Source	Mean Square	df	F	Significance
<u>Aptitude S - Spatial Aptitude</u>				
Error	1.02	252.35	5.21	Sig.
Weighted	5.31	10.00		
<u>Aptitude Q - Clerical Perception</u>				
Error	1.02	252.51	14.01	Sig.
Weighted	14.29	10.00		
<u>Aptitude K - Motor Coordination</u>				
Error	1.02	255.81	4.16	Sig.
Weighted	4.24	10.00		
<u>Aptitude F - Finger Dexterity</u>				
Error	1.02	248.69	5.03	Sig.
Weighted	5.13	10.00		
<u>Aptitude M - Manual Dexterity</u>				
Error	1.02	249.93	1.74	N.S.
Weighted	1.77	10.00		
Expected F at the .01 level of confidence is 1.87.				

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

SUMMARY

This study analyzed the measures of variability and the central tendency of students' performances on the aptitudes of the General Aptitude Test Battery within the various specialty areas of the Vocational Technical Training Department of Kansas State College of Pittsburg. The raw data for this study were collected from the test results of students enrolled in the Vocational Technical Training Department from May 1, 1960 to June 30, 1964. Students included in this study had complete GATB test data on file in the Testing Service Office of Kansas State College of Pittsburg. The sample population for this study consisted of 812 students.

Bartlett's Test of Homogeneity of Variance and the single classification model for analysis of variance were the statistical techniques used to analyze the data for this study. The statistical level of confidence for this study was .01.

The tested null hypothesis of no differences in the variability of the students' aptitude scores for the specialty areas of the Vocational Technical Training Department of Kansas State College of Pittsburg was refuted at the

statistical level of confidence for the GATB measures of Spatial Aptitude, Clerical Perception, Motor Coordination, Finger Dexterity, and Manual Dexterity. The tested null hypothesis of homogeneity of variance for the GATB aptitude measures of the specialty areas of the Vocational Technical Training Department was accepted at the statistical level of confidence for Intelligence, Verbal Aptitude, Numerical Aptitude, and Form Perception.

The tested null hypothesis of no differences in the mean GATB aptitude scores for students in the various specialty areas of the Vocational Technical Training Department of Kansas State College of Pittsburg was accepted at the statistical level of confidence for Verbal Aptitude and Manual Dexterity. The tested null hypothesis of no differences in the mean aptitude GATB scores for students in the various specialty areas of the Vocational Technical Training Department was refuted at the statistical level of confidence for Intelligence, Numerical Aptitude, Spatial Aptitude, Form Perception, Clerical Perception, Motor Coordination, and Finger Dexterity.

CONCLUSIONS

The performances of students in the various specialty areas of the Vocational Technical Training Department of Kansas State College of Pittsburg included in this study were

distributed in a similar manner on the Verbal Aptitude measure of the GATB. The mean performances of the student groups in the specialty areas of the Vocational Technical Training Department on the Verbal Aptitude measure of the GATB were not statistically different to discriminate between the specialty areas in the department.

The students performances on the GATB measures of Intelligence, Numerical Aptitude, and Form Perception were distributed in a homogeneous manner within the various specialty areas of the Vocational Technical Training Department. The mean score performances of students on the GATB measures of Intelligence, Numerical Aptitude, and Form Perception were significantly different to differentiate between the specialty areas of the department.

The dispersion of students scores on the Manual Dexterity measure of the GATB was statistically different in the various specialty areas of the Vocational Technical Training Department of Kansas State College of Pittsburg. The mean performances of the student groups on the GATB measure of Manual Dexterity were not statistically different to differentiate between the specialty areas of the department. The GATB measures of Spatial Aptitude, Clerical Perception, Motor Coordination, and Finger Dexterity were not distributed in a similar manner within the various specialty areas of the Vocational Technical

Training Department. The mean performances for the specialty area students of the Vocational Technical Training Department on the GATB measures of Spatial Aptitude, Clerical Perception, Motor Coordination, and Finger Dexterity were statistically different to discriminate between the specialty areas.

The dispersions of student performances on the GATB measures of Intelligence, Verbal Aptitude, Numerical Aptitude, and Form Perception in the various specialty areas of the Vocational Technical Training Department of Kansas State College of Pittsburg were similar in their distribution. The GATB measures of Spatial Aptitude, Clerical Perception, Motor Coordination, Finger Dexterity, and Manual Dexterity in the specialty areas of the department were significantly different in their distribution.

The mean performances of the students in the specialty areas of the Vocational Technical Training Department of Kansas State College of Pittsburg for the GATB measures of Verbal Aptitude and Manual Dexterity were not statistically different to differentiate between the specialty areas. The aptitude of Intelligence, Numerical Aptitude, Form Perception, Spatial Aptitude, Clerical Coordination, Motor Dexterity, and Finger Dexterity of the GATB were different in their mean performances and discriminated between the specialty areas of the department.

RECOMMENDATIONS

Two major recommendations arise from this study of the measures of variability and the measurement of the central tendency for the GATB aptitudes of the specialty areas of the Vocational Technical Training Department of Kansas State College of Pittsburg.

1. The Vocational Technical Training Department continues to use the General Aptitude Test Battery for their basic testing program.

2. Predicative studies equating academic and vocational success be initiated utilizing the GATB for each of the specialty areas of the Vocational Technical Training Department.

APPENDIX

APTITUDE G - INTELLIGENCE

THE RAW DATA SUM OF SCORES AND SCORES SQUARED FOR EACH
SPECIALTY AREA OF THE VOCATIONAL TECHNICAL TRAINING
DEPARTMENT OF KANSAS STATE COLLEGE OF PITTSBURG.

Area	Number	Sum of Scores	Scores Squared
Air C.	68	6,667	667,764
A. Body	38	3,655	361,720
A. Mech.	120	12,343	1,291,403
Cos.	146	14,584	1,486,774
Draft.	84	8,959	956,743
Elec.	49	4,931	509,864
Furn.	30	2,807	270,608
Mach.	65	6,558	674,257
T.V.	57	5,747	590,475
Weld.	74	7,215	723,151
Non.	81	7,952	797,305
Total	612	81,418	8,330,064

APTITUDE V - VERBAL APTITUDE

THE RAW DATA SUM OF SCORES AND SCORES SQUARED FOR EACH
SPECIALTY AREA OF THE VOCATIONAL TECHNICAL TRAINING
DEPARTMENT OF KANSAS STATE COLLEGE OF PITTSBURG.

Area	Number	Sum of Scores	Scores Squared
Air C.	68	6,239	582,821
A. Body	36	3,455	320,353
A. Mach.	120	11,269	1,074,883
Cos.	146	14,181	1,402,361
Draft.	84	7,925	759,029
Elec.	49	4,596	438,931
Furn.	50	2,699	250,145
Mach.	65	5,950	553,740
T.V.	57	5,380	519,078
Weld.	74	6,801	639,998
Non.	81	7,505	707,101
Total	812	76,000	7,248,440

APTITUDE N - NUMERICAL APTITUDE

THE RAW DATA SUM OF SCORES AND SCORES SQUARED FOR EACH
SPECIALTY AREA OF THE VOCATIONAL TECHNICAL TRAINING
DEPARTMENT OF KANSAS STATE COLLEGE OF PITTSBURG.

Area	Number	Sum of Scores	Scores Squared
Air C.	68	6,720	678,094
A. Body	38	3,405	314,657
A. Mech.	120	11,867	1,197,481
Cos.	146	14,359	1,444,125
Draft.	84	8,826	941,269
Elec.	49	4,813	483,237
Furn.	50	2,763	262,751
Mech.	65	6,252	612,675
T.V.	57	5,565	560,350
Weld.	74	6,912	662,905
Non.	81	7,862	784,754
Total	812	79,344	7,942,298

APTITUDE S - SPATIAL APTITUDE

THE RAW DATA SUM OF SCORES AND SCORES SQUARED FOR EACH
SPECIFIC AREA OF THE VOCATIONAL TECHNICAL TRAINING
DEPARTMENT OF KANSAS STATE COLLEGE OF PITTSBURG.

Area	Number	Sum of Scores	Scores Squared
Air C.	66	5,969	754,916
A. Body	30	4,143	465,637
A. Mech.	120	13,692	1,596,412
Cos.	143	15,694	1,742,619
Draft.	84	10,013	1,217,769
Elec.	49	5,412	629,099
Furn.	30	3,006	315,304
Mach.	65	7,543	896,515
T.V.	57	6,155	679,456
Weld.	74	8,033	902,918
Non.	61	8,814	999,119
Total	812	89,474	10,199,764

APTITUDE P - FORM PERCEPTION

THE FOLLOWING DATA SUM OF SCORES AND SCORES SQUARED FOR EACH
SPECIALTY AREA OF THE VOCATIONAL TECHNICAL TRAINING
DEPARTMENT OF KANSAS STATE COLLEGE OF PITTSBURG.

Area	Number	Sum of Scores	Scores Squared
Air C.	68	6,746	686,534
A. Body	38	3,788	388,826
A. Mech.	120	12,128	1,254,603
Cos.	146	16,489	1,920,289
Draft.	84	9,664	1,136,160
Elec.	49	4,935	504,822
Furn.	30	2,740	262,163
Mach.	65	6,649	696,969
T.V.	57	5,348	520,992
Weld.	74	7,351	751,201
Non.	31	8,587	937,011
Total	612	84,425	9,059,570

APTITUDE Q - CLERICAL PERCEPTION

THE FOLLOWING DATA SUM OF SCORES AND SCORES SQUARED FOR EACH
SPECIALLY AREA OF THE VOCATIONAL TECHNICAL TRAINING
DEPARTMENT OF KANSAS STATE COLLEGE OF PITTSBURG.

Area	Number	Sum of Scores	Scores Squared
Air C.	68	6,760	679,818
A. Body	38	3,781	385,895
A. Mech.	120	11,747	1,168,587
Cos.	146	16,387	1,874,066
Draft.	84	8,917	955,598
Elec.	49	4,902	498,918
Furn.	30	2,770	261,933
Mach.	65	6,279	614,991
T.V.	57	5,508	544,545
Weld.	74	7,182	705,417
Non.	81	8,337	875,194
Total	812	82,570	8,564,962

APTITUDE K - MOTOR COORDINATION

THE RAW DATA SUM OF SCORES AND SCORES SQUARED FOR EACH
SPECIALTY AREA OF THE VOCATIONAL TECHNICAL TRAINING
DEPARTMENT OF KANSAS STATE COLLEGE OF PITTSBURG.

Area	Number	Sum of Scores	Scores Squared
Air C.	68	6,300	600,770
A. Body	38	3,443	318,241
A. Mech.	120	11,015	1,047,425
Cos.	146	14,996	1,638,277
Draft.	84	8,267	843,140
Elec.	49	4,515	430,118
Furn.	30	2,435	215,249
Mech.	65	6,027	594,360
T.V.	57	4,997	470,652
Weld.	74	6,643	632,067
Weld.	61	7,923	833,741
		76,561	7,624,040

APTITUDE F - FINGER DEXTERITY

THE RAW DATA SUM OF SCORES AND SCORES SQUARED FOR EACH
SPECIALLY AREA OF THE VOCATIONAL TECHNICAL TRAINING
DEPARTMENT OF KANSAS STATE COLLEGE OF PITTSBURG.

Area	Number	Sum of Scores	Scores Squared
Air C.	68	6,131	583,336
A. Body	38	3,256	308,834
A. Mech.	120	11,140	1,077,551
Cos.	146	15,053	1,603,496
Draft.	64	7,684	781,208
Elec.	49	4,465	428,775
Furn.	30	2,472	232,712
Mech.	65	5,782	559,325
T.V.	57	5,226	515,036
Weld.	74	6,632	634,913
Non.	61	7,802	784,970
Total	812	75,643	7,510,156

APTITUDE M - MANUAL DEXTERITY

THE FOLLOWING SUM OF SCORES AND SCORES SQUARED FOR EACH
SPECIALTY AREA OF THE VOCATIONAL TECHNICAL TRAINING
DEPARTMENT OF KANSAS STATE COLLEGE OF PITTSBURG.

Area	Number	Sum of Scores	Scores Squared
Air C.	38	6,368	622,619
A. Body	38	3,411	331,370
A. Mach.	120	11,689	1,199,037
Cos.	146	14,349	1,461,841
Draft.	84	8,061	836,306
Elec.	49	4,685	473,008
Furn.	30	2,484	231,326
Mach.	65	6,014	606,719
T.V.	57	5,170	495,691
Weld.	74	6,815	674,826
Non.	61	7,941	817,035
Total	812	78,987	7,749,778

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