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ABSTRACT

The United States Training and Employment Service General Aptitude Test Battery (GATB), first published in 1947, has been included in a continuing program of research to validate the tests against success in many different occupations. The GATB consists of 12 tests which measure nine aptitudes: General Learning Ability; Verbal Aptitude; Numerical Aptitude; Spatial Aptitude; Form Perception; Clerical Perception; Motor Coordination; Finger Dexterity; and Manual Dexterity. The aptitude scores are standard scores with 100 as the average for the general working population, and a standard deviation of 20. Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, when combined, predict job performance. Cutting scores are set only for those aptitudes which aid in predicting the performance of the job duties of the experimental sample. The GATB norms described are appropriate only for jobs with content similar to that shown in the job description presented in this report. A description of the validation sample is included. (AG)

TECHNICAL REPORT

ON

STANDARDIZATION OF THE GATB

AND

DEVELOPMENT OF APTITUDE TEST BATTERY

FOR

BOOKKEEPING-MACHINE OPERATOR I 1-02.01

B-209 or S-5

U. S. DEPARTMENT OF LABOR
Bureau of Employment Security
Washington, D. C.
March 1950

STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY AND DEVELOPMENT OF SELECTION APTITUDE TEST BATTERY B-209 or S-5 FOR BOOKKEEPING-MACHINE OPERATOR I 1-02.01

Summary

The General Aptitude Test Battery was administered to 60 Bookkeeping-Machine Operators I, 1-02.01, at the Pennsylvania Railroad Company, Philadelphia, Pennsylvania, in March 1946 and to 42 Bookkeeping-Machine Operators at the Detroit Bank, Detroit, Michigan, in April 1948. The criterion for the Pennsylvania Railroad sample was the ratio of the individual's production to the group average. The Detroit Bank sample was rated on a nine point scale. These samples were analyzed separately and in combination. On the basis of high means and low standard deviations for the combined sample as compared to the general population, correlations with criteria, and job analyses, the aptitudes Form Perception, Clerical Perception, Numerical Ability, and Finger Dexterity were selected for the aptitude battery for this occupation. The minimum scores which all applicants must meet to be referred as test selected applicants for this job are given in Table I.

TABLE I

Minimum Scores for Aptitude Test Battery B-1001 for Bookkeeping-Machine Operator I

Aptitude	Minimum Score
Q	110
P	105
N	100
F	95

Technical Report

I. Problem

This study was conducted for the purpose of developing a selection battery for Bookkeeping-Machine Operators and to obtain data for further standardization of the General Aptitude Test Battery.

II. Population

This study is based on two samples of Bookkeeping-Machine Operators, one employed by the Pennsylvania Railroad and the other employed by the Detroit Bank. The Pennsylvania Railroad sample consists of 60 female Bookkeeping-Machine Operators employed in Philadelphia. All persons hired for this position must know how to type and are given a typing test. Employees must take an arithmetic test consisting of addition and multiplication problems which are done by hand. High school graduates are preferred and all employees must be vouched for either by someone in the company or by another person, such as a high school principal.

The Detroit Bank sample consists of 42 female Bookkeeping-Machine Operators. The company requires applicants to be high school graduates and at least 18 years of age. They are given an intelligence test and required to pass it with a score that would put them in the high normal group. All employees included in this group had been satisfactorily employed for at least three months. Table II shows the means (M), standard deviations (σ) and ranges of the age, education and experience for both samples, and for the total sample.

TABLE II

Means (M), Standard Deviations (σ) and Ranges of Age, Education, and Experience

Bookkeeping-Machine Operator I 1-02.01

Pennsylvania R. R. (N = 60)	M	σ	Range
Age (yrs.)	22	1.9	19-30
Education (yrs.)	12	.8	9-15
Experience (mos.)	24	12.0	3-45
Detroit Bank (N = 42)			
Age (yrs.)	23.0	6.0	19-48
Education (yrs.)	12.0	.6	10-14
Experience (mos.)	31.0	25.9	3-143
Total Sample (N = 102)			
Age (yrs.)	22.6	4.2	19-48
Education (yrs.)	12.1	.7	9-15
Experience (mos.)	27.1	19.4	3-143

The mean of 12.1 and standard deviation of .7 for education for the total sample indicate that the companies closely adhere to the policy of hiring high school graduates. The mean age of 22.6 and standard deviation of 4.1 may indicate that the companies prefer younger workers for this job.

Job Description

The job description for the Pennsylvania Railroad Company sample follows:

Bookkeeping-Machine Operator I 1-02.01

Job Summary: Keeps a permanent record of financial transactions, using an electric bookkeeping machine. Assembles material to be recorded and manipulates keys on the machine to typewrite written data and make automatic calculations; records all debit and credit relations between customer and company.

Work Performed:

1. Sets up machine for operation. Clears machine by pressing the proper keys to remove results of previous operations; adjusts all mechanisms, such as tabular positions, according to the columns or desirdd arrangement of the forms. Stacks records, such as freight way bills, pay drafts, or abstracts in convenient racks or compartments, and inserts blank billing sheets on bed of machine.

2. Transcribes written data. Records information such as customers' names and addresses, dates, tonnage, or mileage, using a standard typewriter keyboard with touch typing, and taking care that all information is tabulated in the proper column of the billing form.

3. Makes computations and records figures. Transcribes such figures as prices, deposits, charges, or money due, and operates machine to add, subtract, or multiply in order to compute such data as total payments due, amount earned, deductions, or discounts. Sets the machine to tabulate automatically and record such data on the form sheets. Uses knowledge of bookkeeping methods to assign, compute, and tabulate data correctly under the appropriate designations and columns of the form sheets.

The job description for the Detroit Bank sample follows:

Works in branch office of bank, performing the necessary sorting, journalizing, ledger posting, balancing, canceling and filing operations, required to service customer's accounts and further main office and other branch office banking activities related

to operations of own branch. Operates bookkeeping machine, adding machine, check canceling device, typewriter and ledger equipment to accomplish bookkeeping operations. Assists other members of staff in performing general duties.

General Intelligence (G), Clerical Perception (Q), Numerical Ability (N), and Finger Dexterity (F) are involved in performing the duties described above. These abilities are required for accuracy in perceiving and transcribing figures (Q), performing computations properly (N), operating machines skillfully and accurately (F) and for exercising judgment in performing all operations (G).

III. Experimental Battery

All the tests in the General Aptitude Test Battery were administered to the Pennsylvania Railroad Company sample; and all but Part E were administered to the Detroit Bank Sample.

IV. Criteria

The criterion for the Pennsylvania Railroad sample was production ratios determined by the Chief Clerk and Assistant Chief Clerk, who were the second-line and first-line supervisors respectively. The production ratios were based on the units of work done per hour during the month of February, 1946. The group average was set by obtaining the general performance of the group. The individual's production ratio was obtained by dividing the individual average on the particular work by the group average. All the examinees in this sample were doing the same type of calculation. The mean of these ratios is 101.367 and the standard deviation is 16.809.

The criterion for the Detroit Bank sample was ratings which were on a nine point scale ranging from 6 for very poor to 2 for very good. When the data were processed the ratings were divided into three categories, the A group being ratings 2-2.5, the B group ratings from 3-4, and the C group ratings from 4.5-6. There were 6, 26 and 10 workers in groups A, B, and C respectively. The mean of the ratings is 3.5 and the standard deviation is 1.03.

V. Statistical and Qualitative Analysis

Since both groups perform substantially the same work, and are similar in age, education, experience and test performance, they have been combined wherever possible into one total sample.

Means, standard deviations, and correlations with the criteria were calculated for both test and aptitude scores for each sample separately, and the combined sample where possible. After examining the results it was decided to set up the battery on the basis of aptitude scores. Therefore, the results for aptitudes only are being shown.

Tables III and IV show the means, standard deviations and correlations of the aptitude scores with the criteria. The correlations shown for the Pennsylvania Railroad sample are product-moment (r); those shown for the Detroit Bank sample are product-moment correlations corrected for broad categories ($_{c}r$). The means and standard deviations are directly comparable to the general population norms with a mean of 100 and a standard deviation of 20. Table IV shows the combined aptitude means and standard deviations of the two samples.

TABLE III

Correlations with Criteria (r and $_{c}r$), Means (M), and Standard Deviations (σ) for Aptitudes Measured by the General Aptitude Test Battery

Bookkeeping-Machine Operator I 1-02.01

Pennsylvania Railroad Company Sample
(N = 60)

Aptitude	r	M	σ	B-1002 M
G Intelligence	.166	109	12	104
V Verbal Aptitude	.070	109	13	102
N Numerical Aptitude	.314*	113	15	107
S Spatial Aptitude	.033	103	17	99
P Form Perception	.365**	118	16	115
Q Clerical Perception	.289*	124	15	122
A Aiming	.159	114	16	
T Motor Speed	.126	114	16	116
F Finger Dexterity	.240	116	16	112
M Manual Dexterity	.121	105	18	102

Detroit Bank Sample
(N = 42)

Aptitude	$_{c}r$	M	σ
G Intelligence	.175	113	11
V Verbal Aptitude	-.074	110	12
N Numerical Aptitude	-.029	118	12
S Spatial Aptitude	.331*	111	13
P Form Perception	.364*	126	17
Q Clerical Perception	.181	123	17
A Aiming	.503**	114	15
T Motor Speed	.333*	109	17
F Finger Dexterity	.193	110	19
M Manual Dexterity	.280	91	17

* Significant validity coefficients (2 or more times their standard error)
** Very significant validity coefficients (3 or more times their standard error)

TABLE IV

Means (M) and Standard Deviations (σ)
for the Aptitudes measured by
the General Aptitude Test Battery

Bookkeeping-Machine Operator I 1-02.01

Combined Sample

(N = 102)

Aptitude		M	σ	B-[illegible]-A- M
G	Intelligence	111	12	105
V	Verbal Aptitude	110	13	109
N	Numerical Aptitude	115	14	119
S	Spatial	106	16	122
P	Form Perception	121	17	115
Q	Clerical Perception	123	16	121
A	Aiming	114	16	
T	Motor Speed	112	17	114
F	Finger Dexterity	114	18	110
M	Manual Dexterity	99	19	96

On the basis of the job analysis, aptitude G seems important to the job since it requires the worker to be able to use bookkeeping methods. Q seems necessary since the job involves much copying of figures and names accurately and rapidly. N also is apparent in the job since the job deals principally with computations of numbers. In the actual operating of the machine F seems to be present. The Bookkeeping-Machine Operator uses touch typing for which F is important.

The highest means of the combined sample (table IV) are for the aptitudes Q, P, N, F, and A. All the aptitudes show smaller standard deviations than the general population, indicating that the sample is a relatively homogeneous group.

In the Pennsylvania Railroad sample P has a very significant correlation coefficient with the criterion and Q and N have significant correlation coefficients. The correlation coefficient of F with the criterion is almost twice its standard error ($r = .240$, $\sigma_r = .122$) and therefore warrants further consideration of F for the selection battery.

In the Detroit Bank sample A, T, S and P have significant correlations with the criterion. According to the job analysis data, we would expect to find higher correlations with the criterion than those obtained for G, N and Q. Perhaps these low correlations are partly due to the fact that workers in this sample were screened with an intelligence test and the ranges of ability on G, N and Q are rather narrow. The Pennsylvania Railroad criterion was actual production whereas the criterion for the Detroit Bank sample was ratings. Since ratings are a more subjective measure of job proficiency, more weight has been given to the correlation coefficients of the Pennsylvania Railroad sample in setting up the selection battery.

Since Q, N, and F all appear in the job analysis, have high mean scores in the combined sample, and have significant correlations with the criterion in the Pennsylvania Railroad sample they were included in the selection battery. Although P is not apparent in the job analysis, P was added to the battery because it had the second highest mean (121), high correlation (.365) with the criterion in the Pennsylvania Railroad sample and raised the predictive value of the battery for this sample.

Although A and F have equal means in the combined sample, F was included in the battery rather than A because F was indicated as more important in the job analysis and had greater predictive value for the Pennsylvania Railroad sample. A added nothing to the predictive value of F for the Pennsylvania Railroad sample and therefore was not included in the battery. S was not included, although it had significant correlation with the Detroit Bank sample criterion, because of its comparatively low mean score and because it did not appear from the job analysis to be important. G had about the same predictive value as N, but had a lower mean score and lower correlation with the criterion in the Pennsylvania Railroad sample. G added nothing to the predictive value of N for the Pennsylvania Railroad sample.

The minimum scores selected for the aptitudes in the battery were set approximately one standard deviation below the mean of the combined sample. The minimum scores are:

108 for Q
104 for P
100 for N
96 for F

An individual must equal or exceed the minimum scores for all four aptitudes to be considered a test selected applicant.

For the tetrachoric correlation coefficient of the Pennsylvania Railroad, the criterion was split at approximately one half a standard deviation below the mean. Those with criterion scores of 94 or more were considered "high" and the remainder of the sample as "low." Table V shows the distribution on which this tetrachoric correlation coefficient is based.

TABLE V

Number of Workers in High and Low Criterion Groups of Pennsylvania Railroad Sample that Pass and Fail Aptitude Test Battery

		Battery	
		Fail	Pass
Criterion	High	7	29
	Low	16	8

The tetrachoric correlation calculated on the basis of the figures shown in Table V is .749 with a standard error of .209. This correlation coefficient, which is 3.6 times its standard error, indicates a highly significant relationship between the aptitude test battery and the criterion for the Pennsylvania Railroad sample.

The Detroit Bank sample is on the whole very satisfactory in their work, judging from the facts that their mean rating is not at the middle of the 9 point scale (2-6) but is 3.5, that the ratings cluster closely around the mean, and that only 7 workers were rated 5 or poorer. The number of workers rated in the 5 category was too small for tetrachoric correlational purposes, and the number in both the 4 and 5 categories was too large for designation of a "low" group. It was not possible to split the 4 category as the workers were not ranked within each category. Since there was no convenient breaking point between "high" and "low" proficiency workers, no tetrachoric correlation was computed for the Detroit Bank sample.

VI. Conclusions

On the basis of job analyses, mean scores, standard deviations, correlation coefficients, and their combined predictive efficiency, Aptitudes Q, P, N, and F with minimum scores of 108, 104, 100 and 96 respectively, should be used as a selection battery for Bookkeeping-Machine Operator I, 1-02.01. It is recommended that this be established as a national battery.