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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)

FINAL REPORT

TECHNICAL REPORT

ON

STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY

FOR

CANDY-WRAPPING-MACHINE OPERATOR (confection) 920.885-034

S-99

U. S. Employment Service in
Cooperation with
Pennsylvania State Employment Service

U. S. DEPARTMENT OF LABOR
Bureau of Employment Security
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STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY

FOR

CANDY-WRAPPING MACHINE OPERATOR (confection) 920.885

B-354 or 5-49

Summary

The General Aptitude Test Battery, B-1002A, was administered to a sample of 63 women employed as Candy-Wrapping Machine Operators II 7-68.831 by the D. L. Clark Co., Pittsburgh, Pennsylvania. The criterion consisted of rank order ratings, which were made by several supervisors, converted to linear scores and averaged. On the basis of mean scores, standard deviations, correlations with the criterion, job analysis data and their combined selective efficiency, Aptitudes P-Form Perception, F-Finger Dexterity and M-Manual Dexterity were selected for inclusion in the test norms.

GATB Norms for Candy-Wrapping Machine Operator (confection) 920.885

Table I shows, for B-1001 and B-1002, the minimum acceptable score for each aptitude included in the test norms for Candy-Wrapping Machine Operator 7-68.831.

TABLE I

Minimum Acceptable Scores on B-1001 and B-1002 for B-354 or 5-49

B-1001			B-1002		
Aptitude	Tests	Minimum Acceptable Aptitude Score	Aptitude	Tests	Minimum Acceptable Aptitude Score
P	CB-1-A CB-1-L	75	P	Part 5 Part 7	75
F	CB-1-O CB-1-P	95	F	Part 11 Part 12	90
M	CB-1-M CB-1-N	80	M	Part 9 Part 10	80

Effectiveness of Norms

The data in Table IV indicate that 11 of the 21 poor workers, or 52 percent of them, did not achieve the minimum scores established as cutting scores on the recommended test norms. This shows that 52 percent of the poor workers would not have been hired if the recommended test norms had been used in the selection process. Moreover, 31 of the 41 workers who made qualifying test scores, or 76 percent, were good workers.

TECHNICAL REPORT

I. Problem

This study was conducted to determine the best combination of aptitudes and minimum scores to be used as norms on the General Aptitude Test Battery for the occupation of Candy-Wrapping Machine Operator 920.885

II. Sample

The General Aptitude Test Battery, B-1002A, was administered during February and March 1956 to a sample of 66 women employed as Candy-Wrapping Machine Operators II 7-68.831 by the D. L. Clark Candy Company, Pittsburgh, Pennsylvania. There are 98 women employed on this job, but only 66 women were willing to participate in the study. Three of the 66 women were eliminated from the sample because of lack of criterion data. The final sample includes 63 women.

On-the-job training, which takes from 10 to 14 days, is given by the Forelady. There are no age requirements. The company prefers applicants with at least an eighth grade education. All of the women on this job must be at least 5'6" in height and 130 pounds in weight.

Hiring is done by means of an oral interview with the Superintendent of the Department and those selected are given a fifteen day trial on the job.

Table II shows the means, standard deviations, ranges, and Pearson product-moment correlations with the criterion for age, education and experience.

TABLE II

Means (M), Standard Deviations (σ), Ranges, and Pearson Product-Moment Correlations with the Criterion (r) for Age, Education and Experience

Candy-Wrapping Machine Operator 920.885
N = 63

	M	σ	Range	r
Age (years)	35.3	6.9	26-50	-.021
Education (years)	9.9	1.7	7-12	.015
Experience (months)	136.0	62.5	86-374	.125

There are no significant correlations with the criterion for age, education, or experience. Only one person in the sample has a seventh grade education, which is below the company's specified preference. The data in Table II indicated that this sample is suitable for test development purposes with respect to age, education and experience.

III. Job Description

Job Title: Candy-Wrapping Machine Operator 920.885

Job Summary: Wraps candy bars in an advertising wrapper, by operating and feeding a Candy-Wrapping Machine. Makes minor adjustments and maintains machine in good working order. Inspects candy bars and rejects those that are defective or improperly wrapped. Folds ready-cut box and carton blanks along scored lines. Packs candy bars in boxes or cartons and inserts packed boxes in cases for sealing and shipping. Usually works in crew of three.

Work Performed: Sets up Automatic Wrapping Machine: Receives oral or written instructions from Forelady as to machine and type of bar to be wrapped; carries, by hand, supplies from floor stock or stock room, such as wrapping paper, boxes, cardboard layer separators, cartons, reels of cardboard and glue to work station; pours and fills glue pot of machine; places reel of wrapping paper on machine spindle; lifts metal bar, by hand, to loosen machine rolls for insertion of wrapping paper; threads end of wrapping paper through rolls and guides; positions and threads wrapping paper under an electric eye to cut paper to designated length when beam is broken by a printed black square along edge of paper; adjusts paper back and forth, by hand, under electric eye until no part of advertising on wrapper is cut off, nor too much blank space shows when bar is wrapped; lowers metal bar to tighten rollers and hold paper in place securely; turns on electric eye and heating element to pre-heat Machine and Thyrotron Tube which operates paper cutter; places reel of thin cardboard on spindle; threads cardboard through series of rollers, guides, cutting blades, and forming rolls to shape, form and cut cardboard into trays and boats (candy bar holders) of required dimensions; starts machine by electric switch when heating element is warm enough (15 minutes) to make a good, adhesive bond to wrapping paper.

Feeds candy bars into machine for wrapping: Receives loose supply of stacked candy bars from Day Worker; feeds this supply of candy through machine until normal run of bars is received from conveyor; grasps three or more candy bars in each hand from shelf holding loose supply, or from one of the rows on the conveyor belt; places bars, one from each hand simultaneously, into slots of moving feed chain for wrapping; straightens bar in slot, by hand, if bar is turned on side or is upside down, to prevent jam in wrapping; skips the slot if the machine fails to form, cut and position cardboard tray or boat in the slot for the candy bar; inspects visually, candy bar for malformations and other defects, such as thin, crooked, broken, spotted, uncoated and wet bars,

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Feeds candy bars into machine for wrapping: Receives loose supply of stacked candy bars from Day Worker; feeds this supply of candy through machine until normal run of bars is received from conveyor; grasps three or more candy bars in each hand from shelf holding loose supply, or from one of the rows on the conveyor belt; places bars, one from each hand simultaneously, into slots of moving feed chain for wrapping; straightens bar in slot, by hand, if bar is turned on side or is upside down, to prevent jam in wrapping; skips the slot if the machine fails to form, out and position cardboard tray or boat in the slot for the candy bar; inspects visually, candy bar for malformations and other defects, such as thin, crooked, broken, spotted, uncoated and wet bars,

and permits defective bars to move down conveyor where they are removed by Day Worker for rework; notifies Forelady if bars are not thoroughly dry and too many defective ones are passing through conveyor; signals maintenance mechanic by turning on colored light over machine, or by turning on wall indicator, when machine breakdown or jam occurs, or when wrapping paper reel or cardboard reel needs to be replaced; requests Day Worker to replenish shelf with trays of candy bars when supply runs low; makes minor adjustments to equipment; cleans feeder chain, other parts of machine, and in and around work station, using broom, brush, metal scraper and airhose to remove adhering chocolate and candy crumbs.

Packs candy bars in boxes and cartons: Places a supply of assembled boxes, box tops, cartons, cardboard layer separators and advertising circulars within arm's reach of packing table; sits on stool in front of packing table at discharge end of wrapping machine; places an empty box or carton on small wooden shelf affixed 9" below level of packing table top, or positions box to best working height by placing container on one or two other boxes; slides 6 to 10 bars as they are discharged from wrapping machine onto packing table into empty box, using both hands to hold and guide bars into box; (the number of bars packed in containers depends upon overall dimensions as various size boxes and cartons hold from 6 to 120 bars.) Lays cardboard separators over each layer and/or between rows; lays thin pre-cut brown paper at bottom of box and over top layer of candy bars, according to packing instructions; packs one or more different bars in same box with regular run on special sale deals; inserts advertising circulars between layers and/or over top layer as instructed during sales campaign; inspects visually during the packing process, bars discharged from wrapping machine for broken bars and improper wrap, such as advertising off center, loose package, wrapping paper cut off center so that advertising is partly missing or too much blank space shows, wrapper improperly sealed, tray or boat missing from package, printing faded and incorrect date stamped on package; removes wrappers from broken bars and improperly wrapped bars; discards wrappers in waste paper drum, broken bars in scrap box for rework, and stacks good bars on cardboard trays for rewrapping; fits box top on filled candy box and drops box down chute for casing and shipping, or lays packed box or carton on table for removal to conveyor by Caser; requests Caser or Day Worker to replenish dwindling supplies; keeps glue pot filled; makes minor adjustments to machine by hand, to clear up wrapping jams and/or removes wrapping machine head to clean off adhering chocolate and crumbs with scraper and airhose, if bars come through with a loose wrap; signals for maintenance mechanic if major breakdown occurs; cleans off wrapping machine and area in and around work station at end of day.

Assembles boxes and cartons: Carries box and carton blanks, cardboard layer separators, dividers and other needed supplies and material from stock on floor or stockroom to designated work stations; opens flat, cutout cardboard and folds along scored lines to form boxes, cartons, and cases for packing and shipping candy bars; places formed boxes on table within reach of workers; supplies workers with cardboard layer separators, sheet paper, loose or packed candy bars for packing of

special deals and other materials as needed; places formed shipping cases on dolly; inserts boxes filled with candy bars, three to five at a time, into shipping cases until each case is filled; signals Day Worker to wheel loaded dolly to shipping floor; carries smaller cases packed with candy to conveyor belt leading to shipping room for sealing and shipping; sweeps in and around work station and brings pan with loosely wrapped bars to a Day Worker for salvage.

Prepares records: Prepares tally sheet and other office records, indicating the number of boxes, cartons and cases sent to shipper, by conveyors and by dolly; notes the numbers and types of bars wrapped and packed, the hours worked on the different bars and type of boxes or case candy was packed in for piece rate purposes; prepares report for office, noting time lost for machine breakdowns, lack of candy, or materials, and other work stoppages that are not worker's fault.

IV. Experimental Battery

All of the tests of the GATB, B-1002A, were administered to the sample group.

V. Criterion

The criterion consists of rank order ratings made by the Head Supervisor and four Floor Supervisors. The Head Supervisor rated the entire group. In addition, each woman in the sample was also rated by two of the Floor Supervisors with the exception of one woman who was rated by only one of the Floor Supervisors. Therefore, with the exception of one woman, who was rated only twice, each person in the sample received three ratings. These ratings were converted to linear scores and averaged. The average linear scores were used as the final criterion. A Pearson product-moment correlation coefficient was computed between the ratings of the Head Supervisor and the averaged ratings of the Floor Supervisors. The obtained correlation coefficient was .62.

VI. Statistical and Qualitative Analysis

Table III shows the means, standard deviations and Pearson product-moment correlations with the criterion for the aptitudes of the GATB. The means and standard deviations of the aptitudes are comparable to general working population norms with a mean of 100 and a standard deviation of 20.

TABLE III

Means (M), Standard Deviations (σ), and Pearson Product-Moment Correlations with the Criterion (r) for the Aptitudes of the GATB

Candy-Wrapping Machine Operator 920.885
N = 63

Aptitudes	M	σ	$_{c}r$
G-Intelligence	85.1	13.3	.281*
V-Verbal Aptitude	89.8	12.6	.345**
N-Numerical Aptitude	86.3	17.1	.245
S-Spatial Aptitude	83.2	13.8	.371**
P-Form Perception	91.1	18.1	.350**
Q-Clerical Perception	99.0	17.0	.284*
K-Motor Coordination	100.1	18.6	.283*
F-Finger Dexterity	102.2	15.7	.275*
M-Manual Dexterity	105.0	15.1	.146

** Significant at the .01 level
* Significant at the .05 level

The statistical results were interpreted in the light of the job analysis data. The job analysis indicated that the following aptitudes measured by the GATB appear to be important for this occupation:

Form Perception (P) - required in the visual inspection of candy bars before and after the packing process.

Motor Coordination (K) - required in using both hands to place candy bars in slots of a fast moving feeder chain in correct position for wrapping; also required in removing candy bars from conveyor.

Finger Dexterity (F) - required in picking up candy bars from moving conveyors, positioning them in trays and placing them in slots of a feeder chain in order to prevent jamming of wrapping head of machine; also required in removing loose, torn, or defective wrappers from candy bars, packing them in boxes and in the threading of wrapping paper and cardboard through a series of rolls and guides.

Manual Dexterity (M)-- required in using both hands to grasp six to ten candy bars in order to slide them from the packing table into boxes and cartons; also required in placing bars in correct position for wrapping, and in assembling boxes, cases and cartons to receive candy.

The highest mean scores were obtained in descending order of magnitude for Aptitudes M, F and K, respectively. All of the aptitudes have standard deviations of less than 20 with Aptitude V exhibiting the smallest standard deviation.

When N = 63, correlations of .323 and .248 are significant at the .01 level and the .05 level, respectively. Aptitudes V, S and P correlate significantly with the criterion at the .01 level and Aptitudes G, Q, K and F correlate significantly with the criterion at the .05 level of confidence.

Aptitudes P, K, F and M were considered for inclusion in the test norms on the basis of the qualitatitive and quantitative factors cited above: each of these aptitudes appeared to be important on the basis of job analysis data; Aptitudes P, K and F showed significant correlations with the criterion and Aptitudes K, F and M exhibited high mean scores. Tetrachoric correlations with the criterion were computed for several sets of trial norms consisting of various combinations of Aptitudes P, K, F and M and appropriate cutting scores. On the basis of the obtained results, the choice was narrowed down to two sets of trial norms, one set included Aptitudes P, F and M and the other set included Aptitudes K, F and M. The norms which were finally chosen were those which included Aptitudes P, F and M because they did a slightly more effective job of screening in the low criterion group and because it was believed that the norms should include a measure of form perception in view of the inspection duties involved in this job. Norms which included all four aptitudes, P, K, F and M, did not yield a significant tetrachoric correlation coefficient.

The cutting score for Aptitude P was set at one standard deviation below the mean score and rounded to the nearest five-point score level. The cutting score for Aptitudes F was set at one standard deviation below the mean score and rounded to the higher adjacent five-point score level. For Aptitude M the cutting score was set at one and one-half standard deviations below the mean score and rounded to the nearest five-point score level. Setting cutting scores at these levels yielded the best selective efficiency and resulted in cutting scores of 75, 90 and 80 for Aptitudes P, F and M, respectively.

Although there is some statistical evidence of significance for Aptitudes G, V, S and Q, none of these aptitudes appeared to be sufficiently important on the basis of job analysis data to warrant consideration for inclusion in the test norms. Therefore, Aptitudes G, V, S and Q were not included in the test norms.

VII. Concurrent Validity of Norms

For the purpose of computing the tetrachoric correlation coefficient between the test norms and the criterion and applying the Chi Square test, the criterion was dichotomized by placing one-third of the sample in the low group. Those workers who received an average linear score of 43 or more were placed in the high criterion group; those workers who received an average linear score of 42 or less were placed in the low criterion group.

Table IV shows the relationship between test norms consisting of Aptitudes P, F and M with cutting scores of 75, 90 and 80, respectively, and the criterion for Candy-Wrapping Machine Operator 920.885. Workers in the high criterion group have been designated as "good workers" and those in the low criterion group as "poor workers."

TABLE IV

Relationship between Test Norms Consisting of Aptitudes P, F and M with Cutting Scores of 75, 90 and 80, Respectively and the Criterion for Candy-Wrapping Machine Operator II 7-68.831

N = 63

	Non-Qualifying Test Scores	Qualifying Test Scores	Total
Good Workers	11	31	42
Poor Workers	11	10	21
Total	22	41	63

$r_{tet} = .42$ $\quad x^2 = 3.152$

$^{T}r_{tet} = .21$ $\quad P/2 < .05$

The data in the above table indicate a significant relationship between the test norms and the criterion for this sample.

VIII. Conclusions

On the basis of mean scores, correlations with the criterion, job analysis data and their combined selective efficiency, Aptitudes P, F and M with minimum scores of 75, 90 and 80, respectively, are recommended as B-1002 norms for the occupation of Candy-Wrapping Machine Operator 920.885. The equivalent B-1001 norms consist of P-75, F-95 and M-80.

IX. Determination of Occupational Aptitude Pattern

When the specific test norms for an occupation include three aptitudes, only those occupational aptitude patterns which include the same three aptitudes with cutting scores that are within 10 points of the cutting scores established for the specific norms are considered for that occupation. The only one of the existing 22 occupational aptitude patterns which meets these criteria for this study is OAP-16, which consists of P-75, F-80 and M-80 for B-1002. The selective efficiency of OAP-16 for this sample was determined by means of the tetrachoric correlation technique. A tetrachoric correlation of .54 with a standard error of .23 was obtained, which indicates a significant relationship between OAP-16 and the criterion for the experimental sample. The proportion of the sample screened out by OAP-16 was .21, which is within the required range of .10 to .60. Therefore, it is recommended that OAP-16 be used in counseling for the occupation of Candy-Wrapping Machine Operator 920.885.