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The Prediction of Trainee Success in Manpower Development and Training Programs

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THE PREDICTION OF TRAINEE SUCCESS IN MANPOWER DEVELOPMENT AND TRAINING PROGRAMS

by

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INTRODUCTION

This study is a direct result of the investigator's three-year exposure to the problems of selection and placement under the Manpower Development and Training Act (MDTA). From July 1962 until June 1965 the investigator was employed as a Personnel Methods Technician for the Michigan Employment Security Commission in Muskegon, Michigan. In this capacity he wrote the initial proposals for Muskegon's MDTA programs during this period. He also implemented the selection of trainees and the placement of graduates for each of twenty MDTA programs. During this time approximately seven hundred trainees were selected for these Muskegon training programs. The cost of these programs amounted to approximately two million dollars.

This research project was undertaken by a private citizen and should not be construed as being an official report of either the United States Department of Labor, or the United States Department of Health, Education and Welfare.

HISTORICAL BACKGROUND

A decade ago formal retraining programs were almost unknown. Today they receive much attention from industry and State and Federal government. Manpower training or retraining is the upgrading or the changing of a worker's skills so that the worker can meet the present skill demands of business and industry. Training is the process, while the end result is employment. Today's concern with manpower training can best be understood by examining it from a historical perspective.

In the late 1950's a rise in the number of unemployed began to occur. This rise was due to these changes in our economy: large industrial establishments moved out of some cities; defense contracts began to dry up; technological changes took place; and automation began to grow. Increased improvements in science and technology, popularly called automation, had begun a new "technological revolution" (U. S. Department HEW, 1965). Two consequences of this technological revolution came into focus during the early 1960's. First, some jobs were eliminated by machines. Second, new kinds of jobs were being created. The economy continued to grow, but a growing disparity existed between the skills of the labor force and the skills needed by the labor market. Demand for skilled labor remained high, but the supply of correctly skilled labor diminished.

The demand for improved skills in the labor force became aggravated by another social phenomenon. The population explosion after World War II began sending its first waves of youth into the labor force. In the one year of 1964 more young people entered our labor force than had entered in the previous ten years (U. S. Department H.E.W., 1965). These are some of the reasons why, during the 1960's for the first time in the history of the United States, there was an all-time high in numbers of job vacancies and also a high number of unemployed (as shown by the unemployment rate of 4.0% to 5.5%).

In 1960 and 1961 two of the first formal retraining programs were undertaken. In the first case, Armour and Co. set aside one-half million dollars for retraining its workers (Auman, 1962). After the Oklahoma City plant was closed, 433 workers were idled. Of these, 170 applied for retraining, but only 58 passed necessary tests. In the second case, the State of Connecticut engaged in retraining under its Community Action Plan (Auman, 1962). In this program, 2,143 workers were called in for interviewing with these results: 593 did not show up, 560 were rejected for training, 401 were not interested, 248 failed the tests, 257 quit before completing training, and only 84 workers completed training.

In 1961, the Federal government passed the Area Redevelopment Act. This act included some minor provisions for short term training programs in depressed areas.

In 1962, the Federal government passed the Manpower Development and Training Act. This entire act was focused on training members

of the labor force who are unemployed. This law was expanded by amendments during 1963, and again continued and expanded by amendments in April 1965. Three hundred thousand people will have been trained under institutional MDTA programs during the first three years of its existence. An additional eighty-five thousand people will have been trained by private industry under MDTA sponsored on-the-job training programs (U. S. Department H.E.W., , 1965).

The first MDTA programs in Muskegon, Michigan began in September 1962. At that time 40 men were enrolled in woodworking machine and metalworking machine classes.

Three years later the MDTA programs in Muskegon had 921 trainees referred to training. This number included 354 graduates, 249 dropouts, and 318 currently enrolled. Eighty-six per cent (86%) of the graduates were employed, and seventy-four per cent (74%) of these graduates were employed in training-related occupations.

This study was undertaken using 320 male trainees referred to ten Muskegon MDTA programs. The objective of this study was to identify items in each trainee's record which could differentiate between success and failure. These items could then be weighted and used to predict potential success or failure of future applicants for training. On the basis of this information, potentially unsuccessful trainees could be eliminated from training at the time of trainee selection.

PROBLEM

The 249 dropouts from Muskegon MDTA programs constituted a serious problem. These 249 dropouts amounted to twenty-seven per cent of all trainees referred to Muskegon training programs.

The national average of MDTA dropouts is approximately twenty-five per cent (U. S. Department H.E.W., 1965). Because the cost of vocational training as conducted under MDTA is high, any trainee who drops out without successfully mastering the occupation is a costly loss. The direct cost of dropouts is a result of their weekly training allowance paid while they were enrolled. Another cost of droputs is due to gaps in the training class, since facilities have been designed to train a full class.

A review of recent literature predicting trainee success or failure in vocational training showed a few small gains being made in reduction of dropouts through better selection. Compared to the wealth of information on prediction of academic success, a real shortage of research in this area exists.

Strength of measured interest on vocational interest tests was found to be predictive of subsequent success in Navy vocational training (Gordon, 1962). Previous grades and experience were found to be predictive of medical intern performance (Richards, 1962). A combination of achievement and intelligence tests was found to be predictive of dropouts in trade school courses, but little predictive

value was found in an investigation of biographical data (Patterson, 1956). The subject's ability to follow instructions in a test situation was found to be predictive of success in military recruit training (Stern, 1961). Intelligence, prior grade level, and arithmetic achievement were found to be predictive of trainee success at the Michigan Veterans Vocational School (Graybiel, 1959). Only one research program was found that related to prediction of MDTA trainees' success, but this research was not yet completed (Chernick, 1965).

Concern on a national level exists over the number of dropouts from MDTA programs. As stated by the U. S. Department of Health, Education and Welfare (1965):

> "It is mandatory that we check this problem closely, find out why dropouts occur, and strive to reduce the rate."

The investigator has tried to attack this problem through better initial selection based on prediction of future trainee success in training. The research problem was stated as:

> Can test and non-test information available on a training applicant at the time of selection be used to accurately predict the applicant's future training success or failure?

METHOD

One group of trainees (N=224) was used to determine which variables would make the best predictors and what optimum weight should be associated with each predictor. These trainees had ended training before April 1965 under the Manpower Development and Training Act in Muskegon, Michigan. The second group of trainees (N=96) was made up of Muskegon MDTA trainees that ended training after April 1965. This second group of trainees was used to cross-validate results obtained with the first group of trainees.

Because no single occupational class was large enough for this study, trainees were picked from several related occupational classes (see Table 1). Members of both groups were adult males, ages 19 to 50, from the Muskegon area. All members of both groups were trained in skilled, blue-collar, manipulative occupations (see Table 1). None of the training classes used included basic education (reading, writing, arithmetic).

Each trainee who completed his occupational training (graduated) was rated by the instructor on a three point scale: very good, standard, or poor. The instructors were asked to give their subjective evaluation of each of their graduating trainees. This evaluation was based on the trainees' performance during from twenty to fifty weeks of training.

To set up a practical selection procedure, a simple pass-fail criterion group dichotomy was used. Since reliability of instructor

TABLE 1

OCCUPATIONAL CLASSES INCLUDED IN SAMPLE GROUPS

Initial Group (N=224)		Cross-Validation Group (N=96)	
Class	Number	Class	Number
Turret Lathe (Setup)	35	Wood Machine Operator	25
Metal Machine Operator	23	Auto Mechanics	25
Wood Machine Operator	75	Truck Mechanics	21
Auto Mechanics	20	Auto Body Repairman	25
Truck (Diesel) Mechanics	23		
Auto Body Repairman	48		
Total	224	Total	96

ratings was not obtained, and because the ratings did not affect the number of significant predictor variables, all graduates (regardless of instructor rating) were counted in the successful group. Even poor graduates were assumed to be operating at a higher skill level upon graduation than before entering training.

Trainees who did not graduate were determined to have dropped with good cause or without good cause by either the training facility (Muskegon Community College) or the selection facility (Michigan Employment Security Commission) (see Table 2). Being dropped with good cause usually occurred when a trainee became ill or when he quit to become employed. Being dropped without good cause usually occurred when a trainee had poor attendance, poor progress or when a trainee terminated without a stated reason.

The trainees falling in criterion classification group 4 were eliminated (see Table 2). These were the trainees that dropped with good cause. It was decided that these trainees could not be called either good or bad selections. They dropped for a reason that did not exist at the time of selection, i.e. illness, employment. They might have gone on to become drops without good cause, and they also might have gone on to become good graduates had they continued their training. For this reason, drops with good cause were identified, but not used in any further analysis. All graduates vs. drops without good cause made up the good-bad criterion (see Table 3).

Eighteen test and non-test predictors were identified for each trainee (see Table 2). The eight non-test predictors were biographical.

TABLE 2

PREDICTORS AND CRITERION CLASSIFICATIONS

A. Non-Test Predictors

1. Weekly Training Allowance
2. Age
3. Marital Status
4. Number of Dependents
5. Physical Handicaps
6. Veteran Status
7. Formal Education
8. Unemployment Compensation Recipient

B. Test Predictors

9. Minimum Test Norms (GATB)*
10. Intelligence (GATB)
11. Verbal Aptitude (GATB)
12. Numerical Aptitude (GATB)
13. Spatial Aptitude (GATB)
14. Form Perception (GATB)
15. Clerical Perception (GATB)
16. Motor Coordination (GATB)
17. Finger Dexterity (GATB)
18. Manual Dexterity (GATB)

C. Criterion Classifications

1. Very good graduate
2. Standard graduate
3. Poor graduate
4. Dropout with good cause
5. Dropout without good cause

*General Aptitude Test Battery

The ten test predictors were based on test scores obtained in the General Aptitude Test Battery (GATB). This test was administered to each trainee by the Michigan Employment Security Commission before his enrollment into MDTA training. The reliability coefficients of various aptitudes were found to vary for males between .80 and .93, with median reliability of .88 (U. S. Department of Labor, 1962). One set of validity coefficients was obtained by correlating scores on the GATB with scores on the American Council on Education Psychological Examination (ACE). The results were as follows: general intelligence, .79; verbal aptitude, .76; numerical aptitude, .57; spatial aptitude, .47; form perception, .37; and clerical perception, .42. All of these correlations are significant at the .05 level of confidence (U. S. Department of Labor, 1962).

The ninth predictor, minimum test scores, was recorded as a "yes" or "no", meaning the trainee did or did not meet the minimum test scores used for his occupational training area on the GATB. While most trainees did meet the required minimum, there were some exceptions made to this procedure. Some trainees were enrolled even if their GATB scores were lower than the minimum for that occupation. The ninth predictor would show if trainees with low occupational GATB scores were more apt to be unsuccessful trainees.

The tenth through the eighteenth predictors were the sub-tests on the General Aptitude Test Battery. These sub-tests are as follows: Intelligence, Verbal Aptitude, Numerical Aptitude, Spatial

Aptitude, Form Perception, Clerical Perception, Motor Coordination, Finger Dexterity, and Manual Dexterity.

The data on the initial group of trainees (N=224) were analyzed with the help of the Western Michigan University Computer Center. The first task in this analysis was to determine which, if any, of the eighteen predictors significantly differentiated between the criterion groups.

The significant predictor items were combined into an optimum prediction formula using a multiple regression equation. The multiple correlation obtained with the initial group was then evaluated using the index of forecasting efficiency (Guilford, 1956). The same significant predictor items were then used with the cross-validation group (N=96) in the same multiple regression equation.

RESULTS

Each of eighteen test and non-test prediction variables (see Table 2) was compared with the good-bad criterion in order to isolate usable predictors. Only five of these eighteen prediction variables (see Table 3) were shown to be significant positive predictors (.05 level of confidence) with the initial group (N=224). As seen in Table 3, age, general intelligence and spatial aptitude were significant at the .01 confidence level when comparing the extreme good-bad criterion groups of very good grads vs. drops <u>without</u> cause.

The five "best" prediction variables (based on the t-test used on initial group - see Table 3) were then used with the initial group to set up a multiple regression equation. These same five prediction variables and the obtained multiple regression equation prediction variables were also used with the second or cross-validation group (see Table 4).

The intercorrelation of the five prediction variables for the initial group (see Table 5) showed high relationships among the three GATB measures (intelligence, verbal, spatial). Correlation with the good-bad criterion (see Table 5) showed age, intelligence and spatial aptitude to be the best prediction variables.

Several prediction variables that had face validity did not survive the screening process. These variables which were discarded

TABLE 3

t-SCORES AND LEVEL OF SIGNIFICANCE OBTAINED WITH "BEST" PREDICTION VARIABLES

Initial Group (N=224)

Prediction Variables	Criterion Groups		
	Very good grads vs. drops without cause	Good and standard grads vs. poor grads and drops without cause	All grads vs. drops without cause (This criterion group used throughout study)
Age	3.597**	2.155*	3.223**
Unemployment Compensation Recipient	1.918	1.852	2.117*
General Intelligence (GATB)	3.159**	3.380**	2.251*
Verbal Aptitude (GATB)	2.484*	2.126*	1.862
Spatial Aptitude (GATB)	3.406**	3.078**	2.294*

*Significant at .05 level of confidence
**Significant at .01 level of confidence

TABLE 4

DESCRIPTIVE DATA ON "BEST" PREDICTION VARIABLES

Initial Group (N=224)

	Mean	S. D.	Variance
Age	28.9	7.699	59.28
Unemployment Compensation	.28	.451	.20
Intelligence	99.8	18.287	334.42
Verbal	91.7	25.609	655.83
Spatial	106.5	25.284	639.27

Cross-Validation Group (N=96)

	Mean	S. D.	Variance
Age	26.9	7.844	61.54
Unemployment Compensation	.24	.428	.18
Intelligence	97.0	11.622	135.08
Verbal	90.2	10.846	117.65
Spatial	107.1	15.831	250.62

TABLE 5

INTERCORRELATIONAL MATRIX FOR THE INITIAL GROUP (N=224)

	Age	U.C.	Intell.	Verbal	Spatial	Good-Bad Criterion
Age	1.00	-.01	.08	.18	-.08	.20
Unemployment Compensation		1.00	.11	.07	.11	.14
Intelligence			1.00	.61	.74	.20
Verbal				1.00	.52	.16
Spatial					1.00	.20
Good-Bad Criterion						1.00

because they did not demonstrate a statistically significant relationship to the training success measure were: level of formal education, amount of weekly allowances, number of dependents, and ability to meet minimum GATB norms.

All graduates vs. drops <u>without</u> cause made up the good-bad criterion, and age, Unemployment Compensation recipient, intelligence, verbal aptitude and spatial aptitude made up the prediction variables.

The multiple regression equation for the initial group was:

$$X_1 = -.153 \text{ plus } .013x_2 \text{ plus } .124x_3 \text{ plus } .001x_4 -.001x_5 \text{ plus } .003x_6$$

X_1 is the new prediction score; x_2 is the age score; x_3 is the Unemployment Compensation score; x_4 is the Intelligence score; x_5 is the verbal score; and x_6 is the spatial score.

The resulting multiple correlation for the initial group was .325 with a standard error of estimate of .439. An F-test of this multiple correlation revealed F=4.22. This was significant at the .01 level of confidence.

The same criterion and the same prediction equation were also used with the cross-validation group. The resulting multiple correlation for the cross-validation group was -.06. This correlation was not significant at the .05 level of confidence.

The data in Table 6 were obtained by inspection of the computer print-out. These data are provided to demonstrate that the cross-validation group did not show any statistically significant relationship between the prediction variables and the criterion. The only

TABLE 6

LEVEL OF SIGNIFICANCE FOR PREDICTION VARIABLES USING CROSS-VALIDATION GROUP (N=96)

Prediction Variables	Per Cent of Drops Without Cause Above the Mean	Per Cent of All Graduates Above the Mean	t-score
Age	33%	50%	1.475
Unemployment Compensation	37%	16%	-2.006*
Intelligence	50%	45%	-.354
Verbal Aptitude	48%	55%	.590
Spatial Aptitude	37%	59%	1.947

*Significant at the .05 level of confidence.

significant correlation is a negative correlation for the prediction variable called Unemployment Compensation Recipient. None of the prediction variables found to be statistically significant with the initial group continued to be significant when used with the cross-validation group.

DISCUSSION

The obtained multiple correlation with the initial group was .325. Although this correlation was significant at the .01 level of confidence, it was too small to be of value in a practical sense. If each applicant were assigned a prediction score on the basis of the regression weights, there would be almost no improvement in selection. Too many potentially successful trainees would have been predicted as unsuccessful, and too many potential failures would have been predicted as successful trainees.

Using Guilford's index of forecasting efficiency (1956), the five prediction variables used with the initial group would only improve prediction by 5.5%. This gain is not a very large or useful one. There are situations where such a prediction gain would be valuable; however, in selection programs for MDTA trainees, this would not be a practical prediction tool.

Because the investigator hoped to develop a useful prediction tool with the initial group, a cross-validation group was used to check the findings made with the initial group. The prediction tool developed with the initial group had only minimal practical significance. The investigator hoped that the cross-validation group would reaffirm the small but positive correlation between the five prediction variables and actual success or failure in MDTA training.

The multiple correlation coefficient obtained with the cross-validation group was -.06. This correlation coefficient was not significant based on an F-test for significance. The low level of prediction with the second or cross-validation group is illustrated by the data in Table 6.

The intelligence, age, spatial aptitude and verbal aptitude variables showed no signficant relationship to trainee success. Since intelligence was one of the most significant predictors with the initial group, such results were not at all expected with the cross-validation group. The investigator can find no explanation for such a low correlation. Future studies are required to explore why intelligence was not a significant predictor with the cross-validation group.

The different unemployment percentages in Muskegon, Michigan during the two time periods created a difference between the two sample populations used in this study. Unemployment averaged 4.8 per cent, while the initial group members were being selected and trained (September 1962 - March 1965). Unemployment averaged only 3.9 per cent while the cross-validation group members were being trained (April 1964 - September 1965). This is a drop of 20% in the average number of umemployed from the initial to the cross-validation group.

It is possible that trainees with good potential abilities were not able to find employment during the initial period, and so they enrolled in training classes and became successful trainees.

Since unemployment was low during the cross-validation period, the trainees during this time had good abilities but poor motivation, or they had poorer abilities. This might account for the success of the prediction variable called Unemployment Compensation Recipient with the initial group (they wanted to work), and the failure with the cross-validation group (they did not want to work).

This might also explain the fact that intelligence was not a predictor with the cross-validation group. Many of those with good intelligence in the initial group wanted work, but could not find work. They then became successful trainees. Those with good intelligence during the cross-validation group time had motivation problems that kept them from working and kept them in training. They then became unsuccessful trainees due to poor motivation.

It must be remembered that this study was done using training success or failure as the good-bad criterion. It would have been more valuable to use eventual employment success or failure as the criterion of success, but this was beyond the scope of this study.

SUMMARY

An investigation was conducted of the records of 320 Manpower Development and Training Act trainees enrolled in MDTA classes in Muskegon, Michigan from September 1962 until September 1965. The purpose of this investigation was to determine if the pre-enrollment information available in the records would provide practical predictors of training success to be then utilized in future selection of trainees.

Correlations were obtained between eighteen test and non-test predictor variables and the criterion of successful graduation or unsuccessful drop without cause. It was found that age, Unemployment Compensation Recipient, intelligence, verbal aptitude and spatial aptitude were significantly related to training success of the initial group (N=224).

These five prediction variables were used to find a multiple correlation coefficient for the initial group (N=224). The same prediction equation was also used with a cross-validation group (N=96).

The multiple correlation between the predictor battery and training success with the initial group, while significant beyond the .01 level of confidence, was found to improve the original selection efficiency by only 5.5%. The multiple correlation with a cross-validation group was not significant. No practical selection tool was developed for the prediction of trainee success in Manpower Development and Training Programs.

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