DEVELOPMENT AND OPERATIONAL USE OF PREDICTION METHODS IN CORRECTIONAL WORK1

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This paper summarizes the development and validation of several devices purporting to predict behavior of California prisoners and Youth Authority wards following their release under parole supervision. The utility of these devices for studies of treatment effects will be described. Some current attempts to improve prediction will be reported, and two practical operational uses will be discussed.

DEVELOPMENT OF THE PREDICTION DEVICES

A number of investigators have used a variety of methods in attempting development of useful parole prediction measures. These are well summarized by Mannheim and Wilkins (23), who, while studying the British Borstal System used a multiple linear regression method.

Three separate prediction devices, called "Base Expectancy Measures", were developed from sample studies of California adult male and female prison populations, and of the male California Youth Authority population. Adult male subjects were 873 men, selected (under a procedure assumed to approximate random selection) from all who were released to California parole supervision in 1956 (11). Adult women studied were 695 persons released to California parole supervision between July 1, 1955 and June 30, 1958 (9), and Youth Authority wards were all 11,435 boys released to California parole supervision in 1956 through 1958.

In each of these three studies, a multiple linear regression analysis was completed, with a dichotomous parole adjustment criterion (scored 0 or 1) as the dependent variable. The parole adjustment criterion definitions may be summarized as follows:

For the adult male subjects, "favorable parole adjustment" was considered to have occurred if and only if the subject was not classified as a parole violator by reason of return to prison, sentence to 90 days or more in jail, or identification as a parole violator at large (absconder) before two years following release. For adult women, "favorable adjustment" was said to have occurred if and only if the subject was not returned to prison from parole over a two year follow-up period.

For Youth Authority wards, "favorable adjustment" was identified with absence of revocation of parole or with discharge from a suspended parole status within 15 months of parole exposure.

The forms shown in Figures 1, 3, and 5 summarize the prediction methods.

In each case, the resulting prediction equations employ predictor items selected from a larger pool of independent variables selected for study. Following calculation of a correlation matrix and the regression coefficients, the proportion of variance in the dependent variable attributable to inclusion of each independent variable was calculated. By this means, predictor items failing to add appreciably to \mathbb{R}^2 (the coefficient of determination) were dropped.^{1,2} For definitions of predictor items see (3) (8) and (9).

1. As illustration, the following procedure was followed in the case of construction of the Base Expectancy formula for women (CDC-BE-CIW 62A): After calculation of the matrix of Pearson Product Moment Correlation Coefficients in the usual way, the Gaussian Multipliers were computed following the procedure given by Ostle (24). These were then used to calculate the regression coefficients, the sum of squares attributable to regression, and the sum of squares of deviations from regression. The ratio of these two sums of squares equals R^2 . The sum of squares for each additional regression term (and the proportion of variance added by its inclusion) was calculated following the procedure given by Bennett and Franklin (2).

2. A number of individuals and institutions provided help or consultation in conducting these analyses. Appreciation is expressed to Leslie Wilkins, Deputy Director, Research Unit, British Home Office; Professor Robert V. Oakford, Department of Industrial Engineering, Stanford University, and the Stanford Computation Center; William P. Anderson, Chief of User Services, Western Data Processing Center, University of California at Los Angeles; Gordon Rowe, Extension Economist, University of California, Berkeley, and the University of California Computation Center.

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FIGURE 1 CALCULATION OF BASE EXPECTANCY SCORES (MEN)



FIGURE 3 CALCULATION OF BASE EXPECTANCY SCORES (WOMEN)









CALCULATION OF BASE EXPECTANCY SCORES CALIFORNIA YOUTH AUTHORITY

	<u>IF</u>	ADD
A.	CRIME VS. PERSONS	9
	CRIME VS. PROPERTY	0
в.	COUNTY GROUP ONE	10
	Two	5
	THREE	0
c.	AGE AT FIRST ADMISSION	
	16 OR OLDER	12
	15	6
	14 OR YOUNGER	0
þ.	COURT OF MOST RECENT COMMITMENT	
	JUVENILE	6
	ADULT	0
ε.	AGE AT RELEASE	
	18 OR OLDER	10
	7	4
	16 OR YOUNGER	0
F.	ADMISSION STATUS	
	IST ADMISSION OR RETURN WITH NEW	
	CONNITMENT	8
	RETURN WITHOUT NEW COMMITMENT	0
G.	PRIOR RECORD	
	NO PRIOR COMMITMENT AND NO MORE THAN	
	TWO PRIOR DELINGUENT CONTACTS	13
	NO PRIOR COMMITMENT AND THREE OR MORE	
	PRIOR DELINQUENT CONTACTS	5
	PRIOR COMMITMENTS	ó
	TOTAL POSSIBLE SCORE	68







TABLE I BASE EXPECTANCY SCORES FOR MEN (FORM CDC BE 61B) AND NUMBER AND PERCENT WITH FAVORABLE PAROLE ADJUSTMENT

BASE EXPECTANCY	NUMBER		PERCENT		
SCORE	FAVORABLE	UNFAVORABLE	FAVORABLE	TOTA	
92-100	26	4	87	30	
73-91	90	29	76	119	
63-72	89	49	64	138	
44-62	183	162	53	345	
34-43	81	83	49	164	
15-33	39	95	29	134	
0-14	I	6	14	7	
TOTAL	509	428	54	937	

	FAVORABLE	UNFAVORABLE	TOTAL
MEAN	57.36	46.79	52.53
S.D.	17.80	17.32	18.34
DIFFEREN	E BETWEEN ME	ANS =	10.57
		P <	.0001
BISERIAL	.36		
POINT BIS	SERIAL CORREL	ATION COEF.	•29

TABLE 11 BASE EXPECTANCY SCORES FOR WOMEN (FORM CDC BE CIW 62A) AND NUMBER AND PERCENT WITH FAVORABLE PAROLE ADJUSTMENT

	NUMBER		PERCENT		
RAW SCORE	FAVORABLE	UNFAVORABLE	FAVORABLE	TOIAL	
98-100	21	0	100	21	
79-97	50	11	62	61	
68-78	109	24	82	133	
50-67	96	48	67	144	
37-49	75	64	54	139	
17-36	41	35	54	76	
0-16	1	2	33	3	
TOTAL	393	184	68	577	

	FAVORABLE	UNFAVORABLE	TOTAL
MEAN	62.06	50.35	58.32
5.U.	19.36	16.36	19.23
DIFFERENCE	BETWEEN MEA	NS _ ₽ <	11.71
BISERIAL C	ORRELATION (COEFFICIENT	•37

TABLE III

BASE EXPECTANCY SCORES FOR BOYS (CALIFORNIA YOUTH AUTHORITY) AND NUMBER AND PERCENT WITH FAVORABLE PAROLE ADJUSTMENT

BASE EXPECTANCY	NUMBER		PERCENT		
SCORE	FAVORABLE	UNFAVORABLE	FAVORABLE	TOTAL	
56-68	161	36	82	197	
48-55	400	154	72	554	
41-48	634	434	59	1068	
33-40	751	691	52	1442	
25-32	508	638	44	1146	
18-24	178	304	37	482	
0-17	70	173	29	243	
TOTAL	2702	2430	53	5132	

	FAVORABLE	UNFAVORABLE	TOTAL	
MEAN	55.20	43.16	51.18	
S.D.	22.55	20.29	22.53	
DIFFERE	NCE BETWEEN N	EANS =	12.04	
		P	< .0001	
BISERIAL CORRELATION COEFFICIENT				
POINT B	APPLAL CORRE		~	

VALIDATION STUDIES

Results of application of these measures to validation samples are summarized in Figures 2, 4, and 6 and Tables I, II, and III.¹ Adult men and women subjects, released to California parole supervision, were 937 men released in 1956 and 577 women released between July 1, 1958 and June 30, 1960. The men were selected from all releasees during that period (under a procedure assumed to approximate random selection) while the women were all who were released. Youth Authority wards were all 5,132 boys released in 1960. In each case "favorable parole adjustment" is a decreasing function of Base Expectancy Scores.

These or similar prediction methods have demonstrated validity in samples released in different years, in cross validation samples (3) (9) (10) (11) (12) (13), in samples released to different geographical areas and at different seasons of the year (20), and in samples released from different institutions (16). These devices have been called "Base Expectancies" because they provide a base for further research by quantifying our expectations. They do this by summarizing our experience. All Correctional workers know that parolees are not equally likely to violate the conditions of their parole. A "Base Expectancy" is a statement of the expected parole success rate for a given group; and this statement is made on the basis of past experience with other similar groups.

THE ROLE OF BASE EXPECTANCIES IN STUDYING TREATMENT EFFECTS

What kinds of treatment help what kinds of inmates in attaining favorable parole adjustment?

To test the large number of null hypotheses generated by this general question, experimental arrangements according to classical experimental design are needed. This is the best test of treatment effects, particularly if the experiment is replicated.

But a number of considerations argue for consideration of an alternative approach. Besides problems associated with representative sampling of subjects and treatments and with attempts to control all variables but one,¹ there is the question of which treatments to study by experimental designs. There are so many differing programs in correctional work, all actively supported by ardent advocates, it is not administratively feasible to test them all through this kind of research design.

A study of decisions, as proposed by Wilkins (25)(26), is an alternative with promise of provision of helpful information to the correctional decision-maker. Briefly, the outline for this approach to studying treatment effects is as follows:

Base Expectancies, like those discussed above, defined as the probability of favorable outcome, are needed for each person before assigned to treatment. When persons are assigned specific kinds of treatments, then is the actual outcome more or less favorable than expected? We wish to find treatments that improve the chances of favorable outcomes, and we will therefore be pleased if the Base Expectancy is made <u>invalid</u> by treatment helpful to the inmate.

^{1.} In Figures 2 and 4 and in Tables I and IT, Base Expectancy scores are arbitrarily grouped in terms of the standard deviations; i.e., Group $F\leq-2\sigma$, E=-10 to -2σ , $D=-.5\sigma$ to -1σ , $x=-.5\sigma$ to $.5\sigma$, $C=.5\sigma$ to 1σ , $B=1\sigma$ to 2σ , and $A\geq 2\sigma$. Base Expectancy Scores in Figure 6 and Table III are grouped by dividing all possible scores by seven.

^{1.} See Brunswick, E. <u>Systematic and Representative Design of Psychological Experiments.</u> Berkeley: Univ. of Calif. Press, 1949 (6).

If the outcome following treatment can be predicted not only before treatment but <u>regardless</u> of treatment, it is very hard to argue that this treatment makes any difference with respect to this outcome. 1 It may be, however, that persons assigned to one treatment tend to succeed (or fail) significantly more often than expected from analysis of the "kinds of risks" assigned the treatment. If the validity of the expectancy has been established on other groups such differences must be due to either treatment or factors associated with treatment, or both.

Further research, using experimental designs, can identify the source of the difference. Meanwhile, correctional decision-makers can be given knowledge of the relationship (or lack of it) between treatment and outcome.

A study of all 8,723 boys committed to the California Youth Authority by juvenile courts and later released to California parole supervision in 1956, 1957, and 1958 illustrates the procedure suggested above (4). Subjects were classified by institution of release, year of release, and a Base Expectancy categorization. Chi square tests were employed to test the hypothesis that parole adjustment is independent of institution of release. The classification by Base Expectancy scores was assumed to control for selection factors known before institution assignment.

The null hypothesis was supported in the case of 5 of the 8 institutions studied.² This was interpreted as indicating that the observed differences in violation rates among releasees of these institutions were satisfactorily explained by the "type of inmate" assigned the institution. Of the three remaining institutions, releasees of the reception center clinics and forestry camps did significantly better, and releasees of one institution did significantly worse, than expected. These differences were attributed to unknown selection factors and/or treatment. the effects of which could not be completely isolated on the basis of these data. Further research is needed to identify the bases for the differences found.

THE CLINICAL VS. STATISTICAL PREDICTION CONTROVERSY

Twenty years ago a psychologist observed "the statistician and the case study investigator can make mutual gains if they will quit quarreling with each other and begin borrowing from each other" (22). It is time we heeded this advice. As pointed out by de Groot (7), there is more to be gained through efforts to improve statistical prediction <u>via</u> clinical prediction than through continuation of arguments or comparisons of predictive accuracy of the two approaches. Further, subjective judgment and statistical prediction should be cooperative--rather than competitive--functions in a single decision process (11).

Since prediction of outcomes is always uncertain, at best we can deal with probabilities. Any prediction strategy will misclassify some persons. The statistician (correctly) regards this as "error" and he usually can state with some confidence its probable limits. The clinician, however, may (correctly) regard this as individuality or uniqueness (of personality or situation) beyond that measured by the statistical prediction method.

This suggests a way to improve our predictive ability and hence our decisions. Give the decision-maker the statistical prediction device. He can add any information believed relevant and arrive at his best predictive statement. If it can be demonstrated that prediction is improved by this process, we can then attempt to identify the information used. Then the statistician can include it in a new, more adequate tool.

One recent study attempted to not only compare but also to <u>combine</u> subjective predictions with the Base Expectancy score (13). The validity of the objective method (Figure 1) with Base Expectancy scores obtained by clerks was compared (for the same 283 subjects) with subjective ratings (based on pre-release interviews) by an associate superintendent and also with his ratings of clinical council (psychiatric) reports. The two subjective prediction ratings and the Base Expectancy scores all were related significantly to parole outcomes (in the expected direction), though the clerks were much better predictors.

When the subjective and objective ratings were combined, however, the subjective ratings added nothing to the predictive accuracy of the simple check list. Correlation coefficients describing the relationship between prediction scores and the parole outcome were .20 for the associate superintendent ratings, .21 for the clinical council ratings, and .48 for the Base Expectancy scores. Multiple correlation of all combinations of the three measures failed to increase the value or R beyond .48. But the fact that the subjective ratings in this study did not improve prediction does not mean this may not occur if other methods are used or

^{1.} Aside from possible "masking effects"; recent research demonstrates this possibility (1) (17) (18) (19).

^{2.} Data and analyses supporting this contention are contained in Beverly, R. F., "An Analysis of Parole Performance by Institution of Release," Research Report No. 22, Sacramento: Dept. of the Youth Authority, April 1961 (4).

other persons make them. The method provides a way to test and utilize helpful subjective judgments.

Base Expectancy scores are now routinely collected in the Reception-Guidance Centers of the California Department of Corrections. In addition to obtaining the information needed, clinicians make a subjective estimate of expected parole outcome. These data can lead to improvement of prediction along the lines suggested above.

SOME FURTHER EFFORTS TOWARD IMPROVED PREDICTION

Attempts to identify additional predictive information include, in the California Youth Authority, completion of a Home Visit Research Schedule during one of the agency's earliest contacts with each case (5). The schedule was developed to tap a number of areas particularly accessable during the parole agent's initial home visit. When 900 releasees were later followed on parole, a number of items differentiated favorable and unfavorable parole adjustment (significant at the five percent level of confidence as determined by Chi square tests).¹

For example, boys later classified as attaining a favorable parole adjustment were, at the initial home visit, reported less often to have had histories of truancy or other "serious or persistent" school misbehavior from ages eight to fifteen. Less often they were rated as markedly disliking school. Those later classed as parole violators were less often involved with other persons in the offense leading to commitment, and more often there was a record of broken homes. Boys who had lived three or more years at their current address tended to fall in the favorable group.

These items have been tested with a validation sample of 1035 wards. A number of the items, (including those mentioned above) held up. Most of the remaining items showed a trend consistent with the results of the first sample.

When the two samples were combined, twentyfive items were significantly related to parole violation (six at the .05 level and nineteen at the .01 level), and showed consistent and substantial trends in the two samples.

Once Initial Home Visit information on all male first admissions to the California Youth Authority has been obtained for a full release cohort, these items along with those already in use will be used as the basis for a new base expectancy equation which will hopefully improve predictive efficiency. Additional research in progress obtains measures of personality just before release, attempts to identify program participation and institution adjustment indices with hypothesized relationships to parole performance, and seeks improvement of outcome measures used (14) (15).

OPERATIONAL USES OF BASE EXPECTANCIES

The devices reported provide tools useful in both individual case decisions and agency program decisions (15). If their limitations are understood, then they can be used to advantage when combined with other relevant information about the individual.

A recent screening of the entire California prison population, first by Base Expectancy scores, then by clinical criteria, has been accomplished (8). The result was a small group of men referred for parole consideration at a date earlier than originally scheduled. Also, each man and woman appearing before the parole authority now has a Base Expectancy score in addition to the information otherwise collected for assistance in the release decisions.

Minimal supervision case loads of both male and female parolees have been established for persons classed as having a high probability of successful parole completion; and experience has demonstrated that these cases may be given less supervision with no increase in the parole violation rate (21). This enables parole workers to deploy their forces from areas where help is less needed to concentrate efforts where it might be more helpful.

POTENTIAL USE OF PREDICTION METHODS IN OTHER AREAS OF CORRECTIONAL WORK

While this paper, and most other work involving prediction methods in corrections, has focused on the problem of parole behavior prediction, the same method may profitably be employed in efforts to increase our predictive ability in other areas.

For example, a study of 864 adult men released to California parole supervision in 1956 was completed to explore problems of prediction of time to be served (under indeterminate sentencing) in prison and on parole. Using eight predictor variables including the legal offense, a rating of its "severity", age, and prior record, a multiple correlation coefficient of .64 was obtained with the number of months served in the institution. Four of these items in combination correlated .60 with number of months granted on parole. These Time Served Expectancy Measures have not yet been tested in validation samples, but they suggest the feasibility of the approach. Such measures can be helpful in program planning, in description of the paroling decision, and in program studies.

^{1.} This sample consists of the first 900 boys released following initiation of the home visit Research Schedule; therefore the sample is biased by restriction to those serving relatively short institution terms, and these results are viewed as suggestive only.

Whether either multiple regression or discriminant function methods can be helpful in such areas as prediction of institution adjustment, of response to psychotherapy, of escape, or of specific kinds of delinquency behavior after release remains to be investigated.

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