PREDICTING SELF-REPORTED AND OFFICIAL DELINQUENCY

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SUMMARY

In the Cambridge Study in Delinquent Development, 411 boys have been followed up from age 8 to age 25. In this chapter, the prediction of juvenile convictions (between ages 10 and 16), adult convictions (between ages 17 and 20), juvenile self-reported delinquency (at age 14-15), and adult self-reported delinquency (at age 18-19) is studied. The extent to which these four measures can be predicted by data obtained from records, from parents, from teachers, from peers, and from the boys themselves by age 10 is investigated. Five methods of selecting and combining variables were compared, and the boys were divided into construction and validation samples. It is difficult to identify a group with much more than a 50% chance of delinquency, and conversely difficult to identify more than 50% of the delinquents. The more sophisticated multiple regression, predictive attribute analysis, and logistic regression techniques were if anything worse than the simpler Burgess and Glueck methods, although (except in the case of juvenile self-reported delinquency) the Burgess and Glueck methods were not markedly more efficient than the best single predictor. It is suggested that it is more feasible to predict not delinquency in general but the most persistent or 'chronic' offenders who account for a significant proportion of all crime.

Predicting Self-Reported and Official Delinquency

The primary aims of this chapter are as follows: (1) to investigate how far it is possible to predict offending by juveniles (age 10-16) and young adults (age 17-20) in a prospective longitudinal survey; (2) to compare the predictions of self-reported and official delinquency; (3) to compare the efficiency of five of the most commonly used methods of combining variables into a prediction instrument: the Burgess points score, the Glueck method, multiple linear regression, predictive attribute analysis, and logistic regression; and (4) to investigate some of the practical implications of the results, especially in relation to incapacitation.

Some of the previous attempts to predict delinquency have been reviewed in the introduction by Farrington and Tarling, which also shows that most criminological prediction studies have aimed to predict recidivism among officially criminal groups (especially of parolees) rather than the onset of delinquency in a relatively normal sample. As stated in the introduction, the best known attempt to predict delinquency was carried out by Glueck and Glueck (1950), who claimed remarkable success in identifying future delinquents. However, the Gluecks' research was retrospective rather than prospective, so that the measures could have been biased by a knowledge of who was delinquent; used rather extreme groups of delinquents and non-delinquents; had an artificially high prevalence of delinquents (50%); and capitalized heavily on chance, by not having both construction and validation samples. All four of these pitfalls are avoided here.

In any research with official delinquents, it is difficult to know whether delinquent behavior is being predicted or selection for official processing. In an attempt to separate out these two factors, this chapter investigates the prediction of delinquency as measured by (1) official convictions, and (2) self-reports. The self-report method has been used extensively in recent years,

and most modern delinquency research (and theorizing) is based on it. The key question with both self-reports and official convictions is the extent to which they are valid measures of delinquent behavior. Unfortunately, the major method of investigating validity has been to compare self-reports with official convictions (see e.g. Farrington, 1973; Hindelang, Hirschi and Weis, 1981). Generally, juveniles who have been arrested or convicted have a high likelihood of admitting the offenses involved. For example, West and Farrington (1977) found that only 6% of convicted youths denied being convicted, and only 2% of unconvicted youths claimed to have been convicted. Furthermore, among unconvicted youths, large numbers of admitted offenses predicted future convictions (Farrington, 1973).

It seems plausible to argue that self-reports and official convictions are both reasonably valid measures of delinquent behavior, although subject to different biases. If a factor predicts both, it might be argued that it is a predictor of offending behavior rather than of the willingness to self-report or of the likelihood of being selected for official processing. It is a pity that validation studies have not yet been attempted comparing both self-reports and official records with a more direct measure of offending, for example based on observation (see Buckle and Farrington, 1983). The present research is the first study of the prediction of self-reported offending in comparison with the prediction of official convictions. As stated in the introduction, criticisms of the Gluecks induced many criminologists (and especially delinquency researchers) to treat the prediction of delinquency as a taboo topic. Virtually all modern delinquency research emphasizes explanation rather than prediction.

The present chapter is the first comparison of the major methods of selecting and combining variables into a prediction instrument using delinquency data. All the existing comparisons (reviewed in the introduction) are based on recidivism data, and there is no guarantee that results obtained in predicting

recidivism will hold in predicting delinquency. A comparison of two methods (the Glueck technique and multiple regression) was carried out by La Brie (1970), who concluded that they were equally efficient. However, he did not have a validation sample. The five methods used here are described more fully in the introduction or in the chapter by Tarling and Perry.

A simple measure of predictive efficiency is used in this chapter. The simplest prediction problem is when predicted and non-predicted groups are compared with delinquent and non-delinquent outcomes. In this case, percentages might be used to measure predictive efficiency, but it is difficult to know which percentages to choose. For example, should the focus be on the percentage of the predicted group who become delinquents or on the percentage of delinquents who were predicted? These two percentages may be negatively related. It may be possible to achieve a high percentage of the predicted group becoming delinquents by predicting a small extreme group, but this will probably be at the cost of a low percentage of delinquents being predicted.

In the present research, as far as possible, approximately the same proportion of the sample was predicted to be delinquents as actually became delinquents (about one quarter). This meant that the percentage of the predicted group who were delinquents was about the same as the percentage of delinquents who were predicted. All predictor variables and prediction instruments were dichotomized into the 'worst' quarter and the remaining three-quarters, in the interests of comparability and to avoid capitalizing on chance in the selection of cutoff points (cf. Simon, 1971). The phi correlation (derived from χ^2, adjusted for sample size) was used as the major summary measure of predictive efficiency, but the percentage of the predicted group becoming delinquents is also given, since this is often more meaningful.

The Cambridge Study in Delinquent Development

The present analyses use data from the Cambridge Study in Delinquent Development, which is a prospective longitudinal survey of 411 males. Data collection began in 1961-62, when most of the boys were aged 8, and ended in 1980, when the

youngest person was aged 25 years 6 months. The major results of the survey can be found in four books (West, 1969, 1982; West and Farrington, 1973, 1977), and a concise summary is also available (Farrington and West, 1981).

At the time they were first contacted in 1961-62, the boys were all living in a working class area of London, England. The vast majority of the sample was chosen by taking all the boys aged 8-9 who were on the registers of six state primary schools which were within a one mile radius of a research office which had been established. There were other schools in the area, including a Roman Catholic school, but these were the ones which were approached and which agreed to cooperate. In addition to 399 boys from these six schools, 12 boys from a local school for the educationally subnormal were included in the sample, in an attempt to make it more representative of the population of boys living in the area.

The boys were almost all white caucasian in appearance. Only 12, most of whom had at least one parent of West Indian origin, were black. The vast majority (371) were being brought up by parents who had themselves been reared in the United Kingdom or Eire. On the basis of their fathers' occupations, 93.7% could be described as working class (categories III, IV, or V on the Registrar General's scale), in comparison with the national figure of 78.3% at that time. This was therefore, overwhelmingly a white, urban, working class male sample of British origin.

The boys were interviewed and tested in their schools when they were aged about 8, 10, and 14, by male or female psychologists. They were interviewed in the research office at about 16, 18, 21, and 24, by young male social science graduates. Up to and including age 18, the aim was to interview the whole sample on each occasion, and it was always possible to trace and interview a high proportion. For example, at age 18-19 , 389 of the original 411 (94.6%) were interviewed. Of the 22 youths missing at this age, 6 were abroad, 10 refused to be

interviewed, and in the other 4 cases the parent refused on behalf of the youth. The interviews at later ages were with subsamples only.

In addition to interviews and tests with the boys, interviews with their parents were carried out by female social workers who visited their homes. These took place about once a year from when the boy was about 8 until when he was aged 14-15 and in his last year of compulsory education. The primary informant was the mother, although the father was also seen in the majority of cases. Most of the parents were cooperative. At the time of the final interview, when the boys were 14-15, information was obtained from the parents of 399 boys (97.1%). The boys' teachers also filled in questionnaires about their behavior in school, when the boys were aged about 8, 10, 12, and 14. Again, the teachers were very cooperative, and at least 94% of questionnaires were completed at each age.

It was also possible to make repeated searches in the central Criminal Record Office in London to try to locate findings of guilt sustained by the boys, by their parents, by their brothers and sisters, and (in recent years) by their wives. These searches continued until March 1980, when the youngest sample member was aged 25 years 6 months. The criminal records of the boys who have not died or emigrated are believed to be complete from the tenth birthday (the minimum age of criminal responsibility in England and Wales) to the twenty-fifth birthday.

The Cambridge Study is unique in having such frequent contacts with the subjects and their families over such a long period, and in measuring a large number of variables derived from a wide variety of sources (the boys themselves, their parents, their teachers, their peers, and criminal, educational, employment, social services, and medical records). Many variables were measured before any of the boys were officially convicted, therefore avoiding the problem of retrospective bias. This rich dataset is ideal for investigating the extent to which delinquency can be predicted.

Measures of Delinquency

The emphasis in the present chapter is on juvenile delinquency (age 10-16) and young adult offending (age 17-20), since interview information for the whole sample is available only up to age 18-19. About 20% of the boys (84) became juvenile official delinquents, because they were found guilty in a court of an offense normally recorded in the Criminal Record Office and committed between their tenth and seventeenth birthdays. Slightly more boys (94) were convicted as young adults, that is for offenses committed between their seventeenth and twenty-first birthdays. Minor nonindictable offenses (e.g. motoring infractions) were excluded in arriving at these figures. The included offenses were mainly crimes of dishonesty, principally theft, burglary, and taking motor vehicles. As might have been expected, these two convicted groups overlapped considerably, since 51 of the juvenile official delinquents were also adult official delinquents. (After these analyses were completed, one further adult official delinquent was discovered.)

In an attempt to obtain information about delinquent behavior as well as about convictions, the boys were given self-reported delinquency questionnaires at various ages. At ages 14 and 16, each boy was asked to say whether or not he had committed each of 38 delinquent and fringe-delinquent acts. As a measure of juvenile self-reported delinquency, each boy was scored according to the total number of different acts he admitted at either or both ages. For ease of comparison with the 84 juvenile official delinquents, the 80 boys with the highest self-report scores, all of whom admitted at least 21 different acts, were grouped together and called the juvenile self-reported delinquents. The 97 adult self-reported delinquents were defined according to those who admitted the most acts in the questionnaire given at age 18-19, for ease of comparison with the 94 adult official delinquents. Just about half of the juvenile self-reported delinquents (41) were also juvenile official delinquents, and just about half of the adult self-reported delinquents (49) were also adult official delinquents.

Predictors of Delinquency

Unlike most criminological prediction studies, the choice of predictor variables in this research was determined not by their availability in official records but by their alleged theoretical importance (in 1961) as causes of delinquency (see Farrington and West, 1981). Twenty-five variables were included in this analysis. These were all factors measured by the time a boy was aged 10-11, and so they were genuinely predictive of the four criterion variables, juvenile and adult official delinquency, and juvenile and adult self-reported delinquency. As mentioned earlier, each variable was dichotomized. A predictor variable was only included in the analysis if the proportion of boys coded 'not known' on it was 5 per cent or less. On most variables, there were no missing cases. Because this was a predictive rather than a theoretical exercise, no attempt was made to use variables which were all theoretically independent. (For theoretical analyses, see Farrington, 1983b.)

Three of the predictors were derived from records, namely criminality of parents, sibling delinquency, and secondary school allocation (a measure of educational achievement). Four were behavioral measures, namely troublesomeness (rated by teachers and peers), conduct disorder (rated by teachers and parents), daring (rated by peers and parents), and nervous-withdrawn (rated by parents and supplemented by medical records). Seven family background variables were based on the home interviews with parents carried out by psychiatric social workers, namely family income, housing, family size (supplemented by school records and interviews with the boys), social class (rated on the Registrar General's scale), parental child-rearing behavior (which reflected cruel, passive, or neglecting attitudes, erratic or harsh discipline, and marital disharmony), temporary or permanent separations (for reasons other than death or hospitalization), and the uncooperativeness of the parents toward the social workers. Six variables were derived from tests completed by the boys, namely extraversion, neuroticism and

lying (from the New Junior Maudsley Inventory), vocabulary (from the Mill Hill test), nonverbal IQ (from the Progressive Matrices test) and psychomotor clumsiness (from the Porteus Mazes, the Spiral Maze, and the Tapping Test). A measure of the popularity of each boy was obtained from a peer rating, and his height and weight were also measured. Finally, there were two combined ratings constructed by the researchers in advance of knowledge about delinquency, namely 'acting out' and 'social handicap' (see West, 1969, pp.54, 67).

Construction and Validation Samples

As explained in the introduction by Farrington and Tarling, the estimate of predictive efficiency obtained in the sample used to construct a prediction instrument is usually misleadingly high. It is desirable to obtain a more accurate estimate of the predictive efficiency in the population by applying the prediction instrument to a different (validation) sample. For the purposes of the present chapter, the total sample of 411 boys was divided into two halves using a table of random numbers, producing a construction (C) sample of 205 and a validation (V) sample of 206.

It had been anticipated that the C and V samples would not differ significantly in proportions of delinquents. This was true with juvenile official delinquency (19.1%in C, 22.1% in V), juvenile self-reported delinquency (20.5% in C, 18.6% in V), and adult official delinquency (21.6% in C, 24.5% in V). However, 19.9% of the C sample became adult self-reported delinquents, in comparison with 30.1% of the V sample, a statistically significant difference ($\chi^2 = 4.83$, $p < .05$. All values of χ^2 quoted in this chapter have 1 d.f.). The random allocation, therefore, was not very satisfactory in the case of adult self-reported delinquency, although it is only to be expected that one in 20 randomly chosen pairs of samples would be significantly different at $p = .05$.

Relationship between Predictors and Delinquency

Table 1 summarizes the relationship between each of the 25 predictors and each of the four delinquency measures, separately for the construction (C) and validation (V) samples. In addition to the 25 variables described above,

juvenile official and self-reported delinquency were used as predictors with the criteria of adult official and self-reported delinquency. The strength of each relationship was measured by the phi correlation, which was derived from the value of χ^2 (corrected for continuity) calculated from the 2 x 2 table relating the predictor to the criterion. The maximum value of phi depends on the marginal totals, and is often considerably less than 1 (see Farrington, 1983b). Hence, seemingly low values of phi often reflect considerable differences between delinquent and non-delinquent groups. For example, in the C sample, 42.9% of 49 boys rated troublesome became juvenile official delinquents, in comparison with 11.6% of the remaining 155 (χ^2 = 21.5, $p < .001$, phi = .32). Turning the percentages around, 53.8% of 39 juvenile official delinquents were rated troublesome, in comparison with 17.0% of the remaining 165.

- Table 1 about here -

There was a considerable amount of variation between the two samples. To take an extreme case, low IQ was significantly related to juvenile official delinquency in the C sample (phi = .24, $p < .001$), but not in the V sample (phi = .05). Relationships in the total sample have been given elsewhere (e.g. West and Farrington, 1973, pp.209-214 for juvenile official delinquency).

Eight variables were significantly related to juvenile official delinquency in both samples (troublesomeness, conduct disorder, acting out, daring, criminal parents, social handicap, low income, and low vocabulary), but only three to juvenile self-reported delinquency (troublesomeness, daring, and social handicap). Apart from delinquency measures, eight variables were significantly related to adult official delinquency in both samples (troublesomeness, acting out, criminal parents, delinquent siblings, social handicap, large family size, poor housing, and low school allocation), but only two to adult self-reported delinquency (troublesomeness and daring). The fact that social background measures such as

low family income and large family size are more closely related to official convictions than to self-reported delinquency has been noted elsewhere (Farrington, 1979a). Nearly 40% of the relationships studied for Table 1 were statistically significant (80 out of 208), far in excess of the chance expectation of 5%.

Methods of Combining Predictors

As mentioned earlier, the aim in this chapter is to compare the efficiency in predicting delinquency of five of the most commonly used methods of selecting and combining predictors, namely the Burgess method, the Glueck method, multiple regression, predictive attribute analysis, and logistic regression. It is not argued that these methods are the best which could be used, nor even that in all cases their use with these kinds of criminological data is justifiable. The selection and combination of predictors (often to produce an 'experience' or 'base expectancy' table) is based on the assumption that a composite variable will predict a criterion more efficiently than a single predictor, but this assumption has rarely been subjected to empirical test (cf. Brown, 1978). For example, the best predictor of reconviction is usually the number of previous convictions, and it is important to know the extent to which the prediction could be improved by combining previous convictions with other variables. This kind of question will be investigated here.

The Best Single Predictor

Table 2 shows the results of all the prediction exercises, beginning with the best single predictor. In order for the selection and combination of predictors to be worthwhile, a composite prediction instrument should be considerably more efficient than the best single predictor. The best predictor of juvenile official delinquency in the C sample was troublesomeness (see Table 1). As already mentioned, 42.9% of those rated troublesome became juvenile official delinquents, leading to a phi correlation of .32. These figures are shown in Table 2. In the V sample, 47.6% of 42 boys rated troublesome became juvenile official

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delinquents, in comparison with 15.4% of the remaining 162 (χ^2 = 18.3, p < .001, phi = .30). The best single predictor of juvenile official delinquency in the V sample was not troublesomeness but daring.

Table 2 about here

In the case of juvenile self-reported delinquency, the best single predictor in the C sample was criminal parents. Of the 55 boys with criminal parents, 38.2% became juvenile self-reported delinquents, in comparison with 14.0% of the remaining 150 (χ^2 = 13.0, p < .001, phi = .25). However, parental criminality was not significantly predictive in the V sample (28.6% of 49 as opposed to 15.5% of 155: χ^2 = 3.39, not significant, phi = .13). As might perhaps have been expected, the best predictor of adult official delinquency in the C sample was juvenile official delinquency (64.1% of the 39 juvenile delinquents being adult delinquents, in comparison with 11.5% of the remaining 165: χ^2 = 48.5, p < .001, phi = .49). Juvenile official delinquency was also a highly significant predictor in the V sample, but the best predictor of adult official delinquency in this sample was juvenile self-reported delinquency. Again, as expected, the best predictor of adult self-reported delinquency in the C sample (but only just) was juvenile self-reported delinquency (51.2% of 41 as opposed to 11.6% of 155: χ^2 = 29.5, p < .001, phi = .39). However, it was again true that the best predictor in the C sample was not also the best predictor in the V sample. The best predictor of adult self-reported delinquency in the V sample was juvenile official delinquency.

The Burgess Method

The simplest method of selecting and combining predictors is that generally ascribed to Burgess (1928). In this, each person is given a score of 1 or 0 on each of a number of predictors, depending on whether he falls into a category with an above or below average delinquency rate. In using this method, the most important questions which need to be resolved centre on the number of predictors to be chosen and on what to do about predictors which are closely intercorrelated.

Burgess' score was based on virtually all the predictors he had available, but in Ohlin's (1951) use of this method he included only predictors which were associated with the criterion and not closely intercorrelated. The method used here was something of a compromise between Burgess and Ohlin. Each prediction score was based on the half-dozen or so factors which were the most closely related to each criterion, disregarding intercorrelations between them. Each boy was scored 1 or 0 on each variable, depending whether the category in which he fell was associated with an above or below average delinquency rate. If a boy was not known on one or more variables, his score on the others was increased pro rata. For example, if a boy scored 3 points on 5 variables and was not known on the other, his final score would be $3 \times (^{6}/5)$ or 3.60.

The 7 best predictors of juvenile official delinquency in the C sample (all significant at $p = .001$) were troublesomeness, conduct disorder, acting out, criminal parents, social handicap, low IQ, and poor parental behavior (in that order). Each was given a weight of 1.0 in arriving at a prediction score. Two boys in the construction sample had the maximum score of 7, and both were juvenile official delinquents, as were 6 of the 8 boys with the next highest score of 6. As with all other variables, the prediction scores were dichotomized into the 'worst' quarter (the group identified as potential delinquents) and the remaining three-quarters. Of the 49 boys in the C sample with prediction scores of more than 2 points, 46.9% became delinquents, in comparison with 10.3% of the remainder ($\chi^2 = 30.0$, $p < .001$, phi = .38).

Table 2 shows that, in the C sample, the Burgess method was a slight improvement on the best single predictor of troublesomeness, since the percentage of the identified group becoming delinquents increased from 42.9 to 46.9, and the phi correlation increased from .32 to .38. Of the 51 boys in the V sample scoring more than 2 points, 45.1% became delinquents, in comparison with 14.4% of the remainder ($\chi^2 = 19.2$, $p < .001$, phi = .31). Table 2 shows that this was very

little improvement over the predictive power of troublesomeness alone in the V sample. Of the 7 best predictors in the C sample, poor parental behavior and low IQ were not significantly predictive in the V sample. Two of the three best predictors in the V sample, daring and psychomotor clumsiness, were not among the 7 best predictors in the C sample, and in fact psychomotor clumsiness was not significantly predictive in the C sample.

These analyses were repeated with juvenile self-reported delinquency, adult official delinquency, and adult self-reported delinquency. Table 2 shows that the Burgess method was a considerable improvement over the best single predictor in predicting juvenile self-reported delinquency in the V sample. This was because the best single predictor in the C sample (criminal parents) was not significantly related in the V sample. Of the 6 best predictors chosen to make up the prediction score on the basis of their relationships with juvenile self-reported delinquency in the C sample (criminal parents, low vocabulary, daring, low IQ, troublesomeness, and social handicap), three were still significantly predictive in the V sample (see Table 1). The Burgess method was little better than the best single predictor in predicting adult official delinquency, and somewhat worse in predicting adult self-reported delinquency.

These results suggest that, where there is known to be a good single predictor (as juvenile official delinquency is known to be a good predictor of adult official delinquency), little is gained by the Burgess method. When the existence of a good single predictor is less obvious, the Burgess method is likely to be better than the best single predictor. On the other hand, it must be pointed out that, apart from juvenile official and self-reported delinquency, no factors measured between ages 10 and 16 were included in the prediction of adult official and self-reported delinquency. It is possible that later factors combined with the best single predictor by the Burgess method would have produced an improved prediction.

The Glueck Method

The method of selection and combination of factors used by Glueck and Glueck (1950) is somewhat more complex than the Burgess method, although Kirby (1954) reported that Burgess and Glueck prediction scores correlated .9. The Gluecks advocated that a prediction table should be based on about 5 factors which most significantly distinguished between delinquents and non-delinquents. If possible, the factors should be mutually exclusive and independent, although the Gluecks (1950, p.259) said that, 'even if there is some overlapping of the factors, the value of the resulting instrumentality for prediction purposes is not impaired.' In deriving prediction scores, each category of each variable is weighted according to the percentage of boys in that category who are delinquents.

In my use of the Glueck method, exactly the same predictors were chosen as in the Burgess method. Only the weightings were different. For example, in deriving a prediction score for juvenile official delinquency, a boy's total would be incremented by .116 if he was rated not troublesome, and by .429 if he was rated troublesome. This was because, in the C sample, 11.6% of the non-troublesome groups became delinquents, and 42.9% of the troublesome group. As explained in the previous section, where a boy was not known on one or more of the factors contributing to the prediction score, his total on the other factors was increased pro rata.

Table 2 shows the efficiency of the Glueck predictions. For example, 46.0% of the 50 boys with the highest prediction scores in the C sample became juvenile official delinquents, in comparison with 10.4% of the remaining 154 (χ^2 = 28.7, $p < .001$, phi = .38). The comparable figures in the V sample were 46.0% of 50 in comparison with 14.3% of 154 (χ^2 = 20.3, $p < .001$, phi = .32). Looking at the values of phi in the V sample, the Glueck method is generally superior to the Burgess method and to the best single predictor, although whether the imp-improvement in predictability justifies the extra effort involved in weighting according to percentages is doubtful.

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Multiple Linear Regression

The Burgess and Glueck methods have been criticized for being subjective and arbitrary, and for not taking sufficient account of the intercorrelations between predictors. With the increasing availability of statistical packages of computer programs such as SPSS, the most common technique now used for selecting and combining predictors is probably multiple linear regression, popularized by Mannheim and Wilkins (1955). With a dichotomous dependent variable, this is mathematically identical to discriminant analysis (see e.g. Feldhusen, Aversano and Thurston, 1976). As stated in the introduction, the problem with multiple regression is that its statistical assumptions are often violated by criminological data.

The forward stepwise multiple regression technique available in SPSS was used to obtain weights here. In this, predictor variables are added one at a time, at each stage adjusting the weights of all the variables in the equation to produce the greatest possible increase in the multiple correlation between the actual and predicted values of the criterion. The multiple correlation approaches its maximum possible value when only a small number of predictors are included in the equation, and the addition of more predictors does not greatly increase it. As an example, in predicting juvenile official delinquency in the C sample, the multiple correlation was .58 with all predictors in the equation. However, a multiple correlation of .51 was achieved with only 5 predictors, and one of .55 with 8 predictors. The analysis was carried out under two conditions: (1) allowing all variables to enter the equation, and (2) adopting an arbitrary stopping point, such that a predictor was only included in the equation if its addition produced an increase in the multiple correlation of at least .01. (This corresponded to an increase significant at the .10 level.) The figures shown in Table 2 are for the multiple regression with a stopping point. For juvenile delinquency in the C sample, only 8 predictors were included.

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Multiple regression was more efficient than the Burgess or Glueck methods in predicting delinquency in the C sample. For example, using prediction scores based on only the 8 predictors included in the equation up to the stopping point, 54.0% of the 50 boys with the highest scores became juvenile official delinquents, in comparison with 7.8% of the remaining 154 (χ^2 = 49.2, $p < .001$, phi = .49). The efficiency was even greater for multiple regression without a stopping point (phi = .52). However, predictions in the V sample based on multiple regression were usually inferior to those based on the Glueck method, and this was especially true for multiple regression without a stopping point. It seems likely that multiple regression is too sensitive to variations which are specific to a particular sample and which probably reflect error or essentially chance effects. Allowing more variables to enter the equation merely adds more error to it.

Predictive Attribute Analysis

Predictive attribute analysis is a hierarchical splitting technique which can be used with dichotomous variables, and it has been described by MacNaughton-Smith (1965). Its advantages over multiple regression are that it does not depend on such restrictive statistical assumptions about the variables involved, and that non-linear interactions are automatically investigated. If a factor was positively related to the criterion in one part of the sample and negatively related in another, this would be detected by predictive attribute analysis but not easily by multiple regression, at least not in its standard usage. There seems to be no readily available computer program to carry out predictive attribute analysis, and so it has not been used a great deal (see Gottfredson, Gottfredson and Garofalo, 1977; Wilkins and MacNaughton-Smith, 1964). It is described in the chapter by Tarling and Perry.

In assessing the value of predictive attribute analysis, it is interesting to investigate the incidence of non-linear interactions. In the Cambridge Study in Delinquent Development, they were extremely rare. In the C sample, each of

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the four criteria was related to each of the 25 predictors, separately at both values of each of the other predictors. In only 39 out of 2,400 cases was there a phi correlation greater than + .10 at one value of a third variable and less than - .10 at the other. In only 4 cases were the two phi correlations greater than + .15 and less than - .15. These results agree with those of Beverly (1964) in showing the rarity of non-linear interaction effects.

The clearest example of an interaction was the relationship between juvenile self-reported delinquency and secondary school allocation, controlling for vocabulary. When vocabulary was low, the boys with low secondary school allocation were less likely to become juvenile self-reported delinquents (25.0% of 36 as opposed to 52.0% of 25: $\chi^2 = 3.57$, $p < .10$, phi = - .24). In contrast, when vocabulary was high, the boys with low secondary school allocation were more likely to become juvenile self-reported delinquents (40.0% of 20 as opposed to 10.1% of 119; $\chi^2 = 10.1$, significance test not valid, phi = .27). If these results are not to be attributed to chance, they may reflect (a) an association between underachievement (high vocabulary and low school allocation) and delinquency, and (b) the inability of those with the lowest verbal skills (low vocabulary and low school allocation) to report accurately.

As usual, an attempt was made to identify about 50 boys as potential delinquents, choosing the categories which included the highest percentages who were delinquents. For example, for juvenile official delinquency in the C sample, these were (1) 8 troublesome boys with delinquent siblings, (2) 22 troublesome boys with no delinquent siblings but who were said to be acting out, and (3) 33 boys who were not troublesome but who had criminal parents. This produced a total of 63 identified boys, of whom 27 were delinquents (42.9%).

Table 2 shows that the efficiency of predictive attribute analysis was rather similar to that of multiple regression. Predictive attribute analysis was usually superior to the Glueck method in the C sample and inferior in the

V sample. The results obtained with adult official delinquency are artefactual in the sense that the identified group were all juvenile official delinquents. There was a very large shrinkage between the C and V samples for juvenile self-reported delinquency, and this agrees with Simon's (1971) finding that this technique can have very large or very small shrinkages in comparison with others.

Logistic Regression

As pointed out in the introduction, logistic regression has rarely been used in criminology, although it is more suitable than multiple regression, for example. One practical problem in using it arises from the available computer package (GLIM) used here, which is far less developed than SPSS.
While using GLIM, it is necessary to investigate the contribution of each predictor to the equation rather laboriously, whereas the analogous testing procedure in stepwise multiple regression is done automatically by SPSS. Fortunately, with dichotomous variables, multiple and logistic regression tend to select the same predictors for the equation. Therefore, in order to reduce the time taken over the logistic regression analyses, they were only carried out with variables identified (as significant at $p = .10$) in the multiple regression analyses.

Table 2 shows that, on the basis of the average phi correlation in validation samples, the logistic regression was the least efficient technique, despite its theoretical attractions. This was primarily because of the large shrinkage seen in the analysis of juvenile official delinquency. It seemed that logistic regression became less efficient in the validation sample as the number of predictors included in the equation increased, and the same phenomenon was observed with multiple regression. These techniques may capitalize too heavily on chance when more than 4 or 5 predictors are included in the equation. However, the difference between the best technique (Glueck, average phi in V samples .33) and the worst (logistic regression, .27) was not very great.

Further Comparisons

It was recommended in the introduction that researchers should not just present summary measures of predictive efficiency but should give some indication of the distribution of the criterion over different prediction scores. Table 3 shows the percentage delinquent in various percentile ranges of prediction scores. The percentile ranges reflect the skewed (J-shaped) distributions of most prediction scores, with a large number bunched at the bottom end (boys not identified as potential delinquents on any predictor making up the instrument). For example, in using the Burgess technique in predicting juvenile official delinquency in the validation sample, 9 of the 20 boys (45.0%) with the highest scores were delinquents, in comparison with 14 of the next 31 (45.2%), 10 of the next 51 (19.6%), and 12 of the lowest 102 (11.8%). (Where scores were tied, boys were selected in order of identification number.)

- Table 3 about here -

The interest in Table 3 is to see the extent to which extremely high prediction scores identify a vulnerable group. Even with an extreme category, it seems to be impossible to identify a group of whom more than 50% become juvenile delinquents. The predictions of adult delinquency were better, but this was probably because of the availability of measures of juvenile delinquency as predictors.

Implications for Delinquency Prevention

To a statistically significant degree, although with perhaps a 50% false positive rate, juvenile delinquency can be predicted. What can be done to prevent it? Any attempt to prevent delinquency should be based on explanatory rather than predictive research. Our study involved both, and placed most emphasis on early environment and upbringing. The educationally retarded children from poor, socially handicapped, criminal families were especially at risk of committing

delinquent acts. This suggests that, even at the cost of taking a little away from the more fortunate members of society, scarce welfare resources should be concentrated on this vulnerable group. It can be argued that current attempts to prevent and treat delinquency occur much too late in a person's life. If delinquency is part of a larger syndrome beginning in childhood and continuing into adulthood, as our research suggests, special help and support in the first few years of life is most likely to be successful.

What options are there for the criminal justice system? Our research suggests that convictions do not have their intended (individual deterrent or reformative) effects. Boys who were first convicted between ages 14 and 18 had significantly increased delinquent behavior (as measured by self-report) by the later age, in comparison with unconvicted boys matched on delinquent behavior at age 14. A similar result was obtained for first convictions between 18 and 21 (see Farrington, 1977; Farrington, Osborn, and West, 1978).

As pointed out in the introduction, there has been a great deal of recent interest in incapacitation as a penal policy. The Cambridge Study data are useful in investigating incapacitation, because of the availability of self-reports of offending and official convictions of a fairly representative sample (as opposed to a sample of detected offenders, on which most of the existing incapacitation research is based).

During the interview at age 18-19, the boys were asked how many of certain specified crimes they had committed in the previous 3 years. For example, the 389 boys interviewed reported a total of 342 burglaries. During this 3 year period, 28 of the boys (7.2%) had been convicted of a total of 35 offenses of burglary, suggesting that the probability of a burglary leading to a conviction was 10.2%. These 28 convicted boys reported committing 136 burglaries, or 39.8% of the total admitted by the whole sample. They also reported 223 acts of dam-

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aging property (35.7% of the total of these admitted), 111 of stealing from vehicles (24.3% of the total), 88 of taking and driving away vehicles (20.8%), and 194 of shoplifting (16.0%).

It might therefore be predicted that, if there had been a mandatory sentence of 3 years incarceration for every convicted burglar aged 15-18, the total numbers of crimes in these categories would have decreased substantially. There are methodological problems with this argument (see e.g. Blumstein, Cohen, and Nagin, 1978). There is also a substantial practical problem. Of the 28 boys convicted of burglary, only 7 actually were given institutional sentences for it. Of the remainder, 9 received probation, 6 received a fine, and 6 were given a discharge. Of the 7 institutionalized youths, 4 were sent to a detention center, which would have involved 2 months incarceration each. The other 3 (two going to borstal and one to an approved school) probably were incarcerated for a total of 36 months (see Langan and Farrington, 1983). The total incarceration actually experienced by these 28 burglars, therefore, was about 44 months. To incarcerate all 28 for 3 years each would mean increasing the average daily population incarcerated by a factor of about 22, which is clearly impossible.

Slightly more realistically, imagine that the total amount of incarceration for burglary could be doubled from 44 to 88 months. Each boy convicted of burglary committed an average of about 1.6 burglaries per year. Therefore, doubling the incarceration might possibly have prevented about 6 of the total 342 burglaries reported - less than 2%. The implications of this analysis are that the probability of conviction for burglary is too low and the number of burglaries committed by unconvicted boys is too high for a penal policy of incapacitation to be effective in reducing the burglary rate significantly.

The Chronic Offenders

Incapacitation is likely to have its greatest possible effect on the crime rate if it is applied selectively to the most persistent offenders, as Greenwood (1982) argued. The research of Wolfgang, Figlio and Sellin (1972) showed that

about 6% of their fairly representative sample were responsible for 52% of all the recorded offenses up to age 18. Each of these boys, called the 'chronic' offenders, had been arrested at least 5 times. They accounted for even greater proportions of the violent crimes (71% of the homicides, 73% of the forcible rapes, 70% of the robberies, and 69% of the aggravated assaults). The key question is the extent to which the chronic offenders can be predicted at an early age (see Blumstein and Moitra, 1980).

In the present study, the boys were divided into those with 0, 1, 2, 3, 4-5, and 6 or more convictions between the tenth and twenty-fifth birthdays (see Farrington, 1983a). The 23 'chronic offenders' with 6 or more convictions (5.8% of the sample, or 17.4% of all the convicted youths) amassed a total of 230 convictions, an average of 10 each. They accounted for almost exactly half (49.1%) of the total number of 468 convictions of this sample. They also accounted for substantial proportions of the self-reported offenses at age 18-19 (32.2% of all taking and driving away vehicles, 30.4% of all burglaries, 23.7% of all shop-liftings, and 20.8% of all thefts from cars).

How far could the chronic offenders have been predicted at age 10? Their numbers are really too small to carry out special predictive analyses with construction and validation samples. However, all of them were first convicted as juveniles, and they might be regarded as extreme examples of juvenile official delinquents. Therefore, the previously completed predictive analyses of juvenile/official delinquents should give a reasonable indication of the predictability of the chronic offenders. The Burgess method was scrutinized, since it was the simplest, least likely to capitalize on chance, and about as efficient as any other. As stated earlier, the Burgess scale was based on 7 predictors, each weighted 1.0. Three were measures of bad behavior (troublesomeness, conduct disorder, acting out), one reflected a deprived background (social handicap), and the others were criminal parents, poor parental child rearing behavior, and low IQ.

Taking the construction and validation samples together, 55 boys scored 4 or more out of 7 points on this scale. These included the majority of the chronic offenders (15 of the 23), 22 other convicted boys (up to the twenty-fifth birthday), and 18 unconvicted ones. The predictive efficiency was similar in the construction and validation samples. In the construction sample, 30 boys scored 4 or more, comprising 8 chronic offenders, 11 other convicted boys, and 11 unconvicted ones. In the validation sample, 25 boys scored 4 or more, including 7 chronic offenders, 11 other convicted youths, and 7 unconvicted ones. These results suggest that, to a considerable extent, the chronic offenders can be predicted at age 10.

Conclusions

Returning to the major aims of this chapter, it was difficult to identify a group with much more than a 50% chance of juvenile delinquency, and conversely this meant that it was difficult to identify more than 50% of the juvenile delinquents. It was easier to predict official convictions than self-reported delinquency, and easier to predict adult offending than juvenile delinquency. The more sophisticated multiple regression, predictive attribute analysis, and logistic regression techniques were if anything worse than the simpler Burgess and Glueck methods, although in most instances the Burgess and Glueck methods were not markedly more efficient than the best single predictor.

There are several possible reasons for the relative inefficiency of delinquency prediction. One is that relevant predictor variables were not measured. However, as already mentioned, attempts were made in this project to measure all variables which were alleged (in 1961) to be causes of delinquency, and information was obtained from the boys themselves, from their parents, from their teachers, from their peers, and from official records. A second possible reason is that the measures of the predictor and criterion variables contained too much error

and, because of the dichotomizing, were too insensitive. A third possible reason is that delinquency depends on events which occur after age 10 or which are essentially unpredictable or due to chance.

How could the efficiency of delinquency prediction be improved? The comparisons of different prediction methods suggest that it will not be improved by devising and using more sophisticated mathematical methods of selecting and combining variables into a prediction instrument, at least with our present methods of measurement. It may be that advances in predictive efficiency will only follow the development of more valid, reliable, and sensitive measurement techniques. Whether predictive efficiency would be greater, and whether the more sophisticated methods would perform better, in larger samples is uncertain. The results of Babst, Gottfredson and Ballard (1968), with a construction sample of over 3,000, and of Ward (1968), with a construction sample of 1,600, are not in favor of this proposition.

It seems to be more realistic and feasible to predict not delinquency in general but the most persistent or 'chronic' offenders who account for a significant proportion of all crime. If these people could be identified at the time of their first convictions, they could be subjected to special preventive measures. A policy of incapacitation could not be pursued, because it would require an enormous increase in the institutional population to have a significant effect on the crime rate. It would be cheaper, and it might be more effective, to provide more welfare help and support for these boys and their families at the earliest possible stage.

Table 1

Summarizing the Relationships between Predictors and Delinquency Measures

Predictors at 8-10	Juvenile Official Delinquency		Juvenile Self-Reported Delinquency		Adult Official Delinquency		Adult Self-Reported Delinquency	
	C	V	C	V	C	V	C	V
Troublesomeness	.001	.001	.01	.01	.001	.001	.05	.01
Conduct Disorder	.001	.05	ns	.05	.001	ns	ns	ns
Acting Out	.001	.05	ns	.05	.05	.01	.01	ns
Daring	.001	.001	.01	.001	ns	.001	.01	.05
Criminal Parents	.001	.01	.001	ns	.001	.001	.01	ns
Delinquent Siblings	.05	ns	ns	.001	.01	.001	ns	ns
Social Handicap	.001	.05	.05	.01	.01	.01	ns	.01
Low Family Income	.05	.05	ns	.05	ns	.001	ns	ns
Large Family Size	ns	.01	ns	ns	.01	.001	ns	ns
Poor Housing	.01	ns	ns	ns	.01	.05	ns	ns
Poor Parental Behavior	.001	ns	ns	.05	ns	.05	ns	ns
Separations	.01	ns	ns	ns	.05	ns	ns	ns
Uncooperative Family	.01	ns	ns	ns	.05	ns	ns	ns
Low IQ	.001	ns	.01	ns	ns	.05	ns	ns
Low Vocabulary	.01	.05	.001	ns	ns	.05	ns	ns
Low School Allocation	.05	ns	ns	ns	.01	.05	ns	ns
High Extraversion	ns	ns	ns	.05	ns	ns	ns	ns
High Lie Score	ns	ns	ns	ns	ns	.05*	ns	ns
Psychomotor Clumsiness	ns	.001	ns	ns	ns	ns	ns	ns
Juvenile Official Delinquency**					.001	.001	.001	.001
Juvenile Self-Reported Delinquency**					.001	.001	.001	.001

Notes

(1) The figures show the significance levels of the phi correlations, derived from χ^2 in 2 x 2 tables.

(2) All significant correlations were positive (the boys in the 'worst' quarter were more likely to be delinquent than the remainder) except for the one marked *.

.../over

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Table 1 - Notes (continued)

(3) There were about 200 boys in each of the construction (C) and validation (V) samples (see text).

(4) ** Juvenile official and self-reported delinquency, of course, were not measured at 8-10.

(5) The following predictors were not significantly related to any criterion variable in any sample: nervous-withdrawn, low social class, high neuroticism, unpopular, low height, low weight.

Table 2

The Efficiency of Predicting Delinquency

Method	Juvenile Official Delinquency		Juvenile Self-Reported Delinquency		Adult Official Delinquency		Adult Self-Reported Delinquency		Average Over Delinquency Measures	
	19.1 C	22.1 V	20.5 C	18.6 V	21.6 C	24.5 V	19.9 C	30.1 V	20.3 C	23.8 V
Best Single Predictor	42.9 (.32)	47.6 (.30)	38.2 (.25)	28.6 (.13)	64.1 (.49)	57.8 (.40)	51.2 (.39)	61.1 (.31)	49.1 (.36)	48.8 (.29)
Burgess Method	46.9 (.38)	45.1 (.31)	42.2 (.27)	37.5 (.25)	52.7 (.45)	58.3 (.42)	45.5 (.33)	52.4 (.24)	46.8 (.36)	48.3 (.31)
Glueck Method	46.0 (.38)	46.0 (.32)	46.0 (.34)	36.0 (.24)	54.0 (.44)	60.0 (.46)	48.1 (.41)	53.1 (.28)	48.5 (.39)	48.8 (.33)
Multiple Regression	54.0 (.49)	33.3 (.14)	45.3 (.35)	35.3 (.23)	55.6 (.43)	56.9 (.42)	49.1 (.43)	57.7 (.35)	51.0 (.43)	45.8 (.29)
Predictive Attribute Analysis	42.9 (.39)	41.1 (.27)	48.0 (.37)	24.5 (.09)	64.1 (.49)	57.8 (.40)	46.6 (.42)	55.7 (.38)	50.4 (.44)	44.8 (.29)
Logistic Regression	50.0 (.43)	27.5 (.06)	40.4 (.26)	38.0 (.27)	62.5 (.48)	59.1 (.41)	55.3 (.48)	56.0 (.32)	52.1 (.41)	45.2 (.27)

Notes

The figure in each cell shows the percentage of the identified group who became delinquents (official or self-reported). In all cases, the identified group are about 50 of about 200 in each of the construction (C) and validation (V) samples. The phi correlations are given in brackets. With N = 200, phi = .14 is significant at p = .05, and phi = .23 is significant at p = .001.

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Table 3

Percentage Delinquent Versus Prediction Scores in Validation Samples

Criterion and Method	Percentage Delinquent in Percentile Score			
	0-50	51-75	76-90	91-100
Juvenile Official Delinquency				
Burgess	11.8	19.6	45.2	45.0
Glueck	9.8	23.5	41.9	50.0
Multiple Regression	13.7	27.5	29.0	40.0
Predictive Attribute Analysis	10.8	25.5	35.5	50.0
Logistic Regression	17.6	25.5	22.6	35.0
Juvenile Self-Reported Delinquency				
Burgess	8.8	17.6	35.5	45.0
Glueck	11.8	15.7	29.0	45.0
Multiple Regression	9.8	19.6	25.8	50.0
Predictive Attribute Analysis	13.1	20.0	23.3	30.0
Logistic Regression	8.8	19.6	35.5	40.0
Adult Official Delinquency				
Burgess	7.8	25.5	51.6	65.0
Glueck	4.9	27.5	51.6	75.0
Multiple Regression	8.8	23.5	54.8	60.0
Predictive Attribute Analysis	21.8	14.0	26.7	60.0
Logistic Regression	9.8	25.5	41.9	70.0
Adult Self-Reported Delinquency				
Burgess	16.5	33.3	41.4	73.7
Glueck	15.5	35.4	44.8	68.4
Multiple Regression	19.6	20.8	55.2	68.4
Predictive Attribute Analysis	18.6	25.0	58.6	57.9
Logistic Regression	19.6	25.0	51.7	63.2

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