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Risk and dangerousness

ALEC BUCHANAN[1]

From the Department of Forensic Psychiatry, Institute of Psychiatry, London

ABSTRACT

The task of improving the ability of clinicians to predict which of their patients will be violent has come to be seen as one of establishing the relative merits of actuarial and clinical prediction. The meaning of these terms is unclear. 'Clinical' is usually defined by exclusion, that is, as something other than actuarial. The term 'actuarial' is often used to refer to the techniques of risk prediction in financial services. In the psychiatric and psychological literature relating to the assessment of dangerousness, three further meanings have emerged. That whereby actuarial refers to any mathematical means of combining information is the most widely accepted. Whichever definition is employed, the conclusion of most reviews has been that the future is actuarial. It is argued here that, while mathematical approaches have been successful in showing that risk factors for violence in the general population apply also to the mentally disordered, important questions remain unanswered. Mathematical methods address only one form of probability, that which arises from chance. A development of another form of probability, that which arises from causes, offers the prospect of improved risk assessment in psychiatry. It also offers a definition of clinical prediction that is not based on exclusion.

INTRODUCTION

Dr Boyd, the former Medical Director of the Canadian maximum security hospital, Penetanguishene, was fond of reassuring his listeners that only 10% of the patients who were detained there would kill again (Greenland, 1980). The difficulty, he added, was that no one could tell him who the 10% were. Most British forensic psychiatrists know the story, which has been retold in a number of the articles on dangerousness over the last 20 years. They do not know Dr Boyd, however. In the British version the narrator is Dr Patrick McGrath, formerly medical director of Broadmoor Hospital (see MacCulloch, 1996). The remark reflects a widespread belief that the important questions in risk assessment remain unanswered.

Good clinical management, in psychiatry and in other branches of medicine, involves taking risks (Holloway, 1997). No course of treatment, however prudent, is without its drawbacks. The benefits of discharging a depressed patient from hospital have to be weighed against the risk of suicide. The benefits of a course of drug treatment have to be weighed against the risk of side effects. Increasing rates of violent behaviour in the population as a whole combined with a reduction in the number of in-patient beds mean that the assessment of the risk of violence to others in the community will remain an essential part of clinical management in psychiatry (Mulvey & Lidz, 1995).

The task of improving the ability of clinicians to assess this risk has come to be seen as one of establishing the relative merits of actuarial and clinical methods. Advocates of actuarial prediction argue that clinical methods are merely informal (and therefore inferior) versions of actuarial ones (Lundberg, 1941; Sarbin, 1943, 1944) and describe clinical experience as 'a prestigious synonym for anecdotal evidence' (Grove & Meehl, 1996, p. 302). Advocates of clinical methods argue that information derived from groups can be of only limited value in predicting the behaviour of an individual (Allport, 1940). Recent reviews have concluded that the actuarial approach is to be preferred and, as a consequence, have emphasized the relative

[1] Address for correspondence: Dr Alec Buchanan, Department of Forensic Psychiatry, Institute of Psychiatry, De Crespigny Park, London SE5 8AF.

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value of refining actuarial techniques over improving clinical methods. This paper will examine the extent to which these conclusions are justified.

WHAT IS MEANT BY ACTUARIAL AND CLINICAL?

Statisticians use 'actuarial' to refer to the mathematical techniques they use to set insurance premiums, design pension schemes and calculate liabilities (Bowers *et al*. 1986; Everitt, 1995). The object is to transfer and pool risk and, hence, to manage uncertainty (Cummins *et al*. 1982). Projections are made from present to future conditions using a variety of models. Two state models, such as survival (or life table) analysis, are used in the calculation of premiums, reserves and surrender values (Broffitt, 1984; Bowers *et al*. 1986). Multiple state models are used in pensions and disability insurance (Elandt-Johnson & Johnson, 1980; Gerber, 1997). Observed probabilities are revised using parametric and non-parametric techniques to allow calculations of future risk in a process known as 'graduation' (London, 1985; Brockett, 1991).

The same words are used differently by different disciplines, however. In the psychological and psychiatric risk assessment literature three further meanings have emerged. None would be recognized by an actuary. Most commonly, actuarial is used to refer to any mathematical means of combining information (see, for instance, Meehl, 1954; Gough, 1963; Quinsey & Maguire, 1986; Harris & Rice, 1997; Webster *et al*. 1997). Two approaches are widespread (Sarbin *et al*. 1960). Experience tables provide estimates of risk for groups of individuals. Individuals are assigned to these groups, or 'reference classes', according to their scores on variables thought to affect the likelihood of violence (Hart, 1923; Reichenbach, 1938; Salmon, 1971). For the much quoted 'Baxstrom' group of patients, transferred from secure hospitals in the United States after their detention was deemed unconstitutional and followed-up for 4 years, being aged 50 or over and having a score on a scale of dangerousness of less than five led to a subject being assigned to a class with a probability of acting violently of 4·8% (Steadman & Cocozza, 1974).

The regression method, on the other hand, assigns weights to variables known to correlate with violence and a sum of these weights is then used to estimate risk for an individual. In England and Wales the Parole Board calculates a 'risk of reconviction' score for each prisoner (Copas *et al*. 1996). The score is generated by combining information that includes the prisoner's age when first convicted and the number of custodial sentences that he has received. A third actuarial method, that of 'indices of profile similarity' (Gough, 1963), generates a statistic intended to reflect the degree to which an individual matches a standard profile and has not been widely employed. Whichever actuarial method is used, predictions are made on the basis of information derived from groups and when different pieces of information are combined, this is done mathematically.

A second use of actuarial, in the psychological and psychiatric risk assessment literature, refers to a subset of the variables used in the prediction of violence (Hall, 1988; Otto, 1992; Litwack *et al*. 1993). There is no agreement as to what this subset consists. Researchers have described as actuarial, or dealt with using actuarial techniques, several variables that relate to a subject's clinical condition. These include the subject's anxiety level (Blomhoff *et al*. 1990), diagnosis (Bieber *et al*. 1988; Harris *et al*. 1993), alcohol use (Menzies & Webster, 1995), 'procriminal values' and any 'attitude unfavourable to convention' (Harris *et al*. 1993). A history of violence, usually an actuarial variable (Hall, 1988), is sometimes classified as clinical (Lidz *et al*. 1993).

Thirdly, some of those attempting to predict violence have used actuarial as a synonym for 'explicit' (Meehl, 1954, pp. 16, 17). Whether a mathematical prediction is the result of allocating individuals to reference classes or assigning weights to variables, it can be made transparent. The process by which weights are combined may be complicated by interaction between the variables associated with violence. The degree to which youth is associated with offending, for instance, appears to be less for people with psychopathic personalities (Harris *et al*. 1991). But, however complicated these interactions, the procedure by which the various pieces of information are combined can be described and replicated. Clinicians, on the other

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hand, are seldom required to describe in detail the processes by which they estimate risk. This has allowed their critics to argue that they are unsystematic (Pfohl, 1978) or merely employing an 'informal', and hence less efficient, version of the mathematical approach (Sarbin, 1943, p. 601). Like actuarial tables, so the argument goes, clinicians either allocate patients to reference classes or assign weights to variables and combine these weights mathematically. Unlike actuarial tables, they do not do it very well.

The debate as to how to improve the prediction of violence would benefit from the emergence of an unambiguous meaning of actuarial. Two of the uses described here seem unsuitable bases for any definition because the boundaries of the domains they describe are indistinct. If actuarial refers to a subset of variables, this subset will expand as more rating scales develop and more information is recorded quantitatively. Instruments already exist that permit the actuarial use of two variables previously regarded as belonging to the clinical domain, anger (see Novaco, 1994) and delusions (see Wessely *et al*. 1993). If actuarial refers to the extent to which the process of prediction is explicit, advocates of actuarial methods have argued, there is no reason why a useful procedure cannot be an explicit procedure. If a factor is important, a statistical table can be devised to take it into account (Sarbin, 1944). Given its widespread currency, actuarial seems likely to continue to be used in the risk assessment literature to describe a means of combining information. 'Mathematical' comes closer to describing what is being done, however, and makes clear that the procedures are different from those used in the management of financial services.

The psychiatric and psychological risk assessment literature usually defines clinical prediction only implicitly and by exclusion, as any means of prediction that is not purely mathematical (Sawyer, 1966). A minority of reviews use 'clinical' to refer to what clinicians do, leaving open the important questions of what this is and what it should be. Which method, the mathematical or the clinical, should those who have to assess the risk of violence use? While hybrid approaches have their advocates (Webster *et al*. 1994), the consensus has been that a choice has to be made (Grove & Meehl, 1996; see Harris & Rice, 1997 for a review) and that this choice should be mathematical (Monahan, 1984, 1996, 1997; Gottfredson, 1987; Faust & Ziskin, 1988; Dawes *et al*. 1989; Harris *et al*. 1994; Webster *et al*. 1994; Grove & Meehl, 1996; Harris & Rice, 1997).

Only in one respect has the role of clinicians not been challenged. Even if clinicians do as Sarbin suggests and generate their predictions by putting people into categories and then combining these categories mathematically, they must have some way of deciding whether a patient falls into a category. The algorithm that they use, whereby lack of remorse for past misdeeds, for instance, is a poor prognostic sign, may amount to an informal mathematical model, but the decision as to whether or not the patient is remorseful can hardly be mathematical (Meehl, 1954). This contribution of the clinician will become more important as the phenomena being measured become more unusual and the level of skill required to measure them increases. It is more difficult to record the presence or absence of delusions than to record someone's age. It remains to be seen, however, how much solace clinicians will derive from being told that someone will always be needed to fill in the forms.

HOW SUCCESSFUL HAS ACTUARIAL PREDICTION BEEN?

The success of mathematical prediction can be described in terms of its success, first, in identifying 'risk factors' for violence and, second, in developing instruments to measure risk. Studies have consistently demonstrated that the correlates of violence in the population at large, age, sex, socio-economic status, prior violence and substance abuse (Reiss & Roth, 1993), apply to the mentally disordered (Steadman & Cocozza, 1974; Thornberry & Jacoby, 1979; Janofsky *et al*. 1988; Klassen & O'Connor, 1988; Swanson *et al*. 1990; Link *et al*. 1992; Mulvey, 1994; Webster *et al*. 1994; Steadman *et al*. 1998). As drug use has become more prevalent the term 'co-morbidity' has been co-opted to describe the coexistence of substance abuse and psychosis, the effects of which, in terms of the risk of violence, appear to be cumulative. Few other associations have been replicated (Hart *et al*. 1993). Some inconsistencies, such as those

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between community studies, which suggest that schizophrenia increases the risk of violence (Swanson *et al*. 1990; Hodgins, 1992; Wessely *et al*. 1994) and institution-based research, where it appears to be protective (Harris *et al*. 1993; Lidz *et al*. 1993) can be explained in terms of the study populations (Borum, 1996). Schizophrenia makes people less likely to be violent if it is being compared with dissocial personality disorder. Many other inconsistencies remain to be explained, however, and crucial questions remain unanswered.

First, once someone has a diagnosis of schizophrenia, is violence more likely when they are describing psychotic symptoms? Several studies have suggested that it is (see Planansky & Johnston, 1977; Craig, 1982; Taylor, 1985) while one of the largest concluded that it is not (Häfner & Boker, 1973). Secondly, over what time periods can predictions be made? Some have suggested that doctors would do better to stick to the short term (Brizer & Crowner, 1989; Otto, 1992; Gunn, 1996). But the quality of prediction is difficult to measure when base rates are low. Most of the time a doctor's answer to his question 'Will my patient behave violently?' is, 'No'. This answer is more likely to be right if the period to which it refers is short. When base rates are taken into account, research fails to show that short-term predictions are better (Menzies *et al*. 1994; Mossman, 1994; Menzies & Webster, 1995). Mathematical methods have yet to provide clinicians with information of a quality to challenge the clinical judgement, for instance, that violence is likely if it has recently occurred and the circumstances, particularly the perpetrator's mental state, remain the same (Litwack & Schlesinger, 1987).

Instruments to measure risk have not been shown to be of value in routine clinical practice (Menzies *et al*. 1994; Monahan, 1997). This must be partly the result of their lack of flexibility (Holt, 1958). It is difficult to devise a scale that takes into account that predictors of one form of violence may be different from the predictors of other forms and that the predictors of repeat violence may be different from the predictors of the first assault (Mulvey *et al*. 1986). Holloway (1997) provides a list of 'risk decisions' made by a general psychiatrist in a typical day. The list includes a patient with a history of making threats with a knife who failed to attend the out-patient department, a former patient with a history of stabbing a psychiatrist who telephoned to ask for an urgent appointment and a neighbour who reported that a patient who had assaulted people while ill was now shouting in the street.

The list illustrates some of the difficulties that would attend the use of a mathematical instrument. The information available is often fragmentary and, to varying degrees, unreliable (see Monahan, 1981). The clinician has to be concerned with the risk of many different possible outcomes, the risk of each of which can vary independently. When the wife of a depressed and jealous man leaves him, for instance, the risk he poses to her may go down while the risk he poses to himself, and to others, increases. It may not be apparent whether the patient more closely resembles a member of a community sample, a psychiatric out-patient sample or an ex-secure hospital sample, for all of whom data are available. Finally, clinicians, like other people (Adams, 1995), respond to risk by acting. It is difficult to see how an instrument could be devised that takes into account the range of circumstances in which predictions are required and the effects of past and future clinical intervention. Similar difficulties attend the development of scales to predict deliberate self-harm (Kreitman & Foster, 1991) and suicide (Goldstein *et al*. 1991).

Mathematical approaches might have become more widely accepted had there been a consensus as to how to compare different methods of prediction. There are two reasons why simple measures, such as the ratio of correct to incorrect predictions, are unsatisfactory. The first is that clinicians, when asked to predict violence, tend to over-predict (see, for example, McNeil & Binder, 1991). Although it has been suggested that this is because they assess the risk incorrectly (Webster *et al*. 1994) it is more likely to stem from the relative consequences of the two types of mistake available. Clinicians would rather detain someone who will not be violent than release someone who will be. The second is that many of the commonly used indices of predictive success, indices such as 'percentage of false positives' (Hart *et al*. 1993), 'classification accuracy rate' (Borum, 1996) and positive predictive value, are sensitive to base rates (Baldessarini *et al*. 1983). Measured in these

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terms, the success of any procedure designed to predict violence will vary according to the rate of violence in the population.

Any index of comparison should address these two difficulties by being unaffected by a doctor's preference to err on the side of safety and by being base-rate invariant. Two, closely related, measures have been developed, the 'area under the curve' (AUC) derived from receiver operating characteristic analysis (see Fergusson *et al*. 1977; Hanley & McNeil, 1982; Verhulst & Koot, 1992; Altman & Bland, 1994) and the Mean Cost Rating (Duncan *et al*. 1953; Simon, 1971; Tarling, 1982). The AUC has now been used in empirical research (see Virkunnen *et al*. 1996) and in one detailed review, which suggested a modest improvement in the ability to predict violence over the last 20 years (Mossman, 1994).

THE LIMITS OF ACTUARIAL PREDICTION

Two conditions have to be fulfilled if the general psychiatrist is to be helped by a mathematical approach. First, he needs to have available to him research conducted using outcome measures similar to the one with which he is concerned, over a relevant time span that used, as independent variables, information that is available to him. A table providing estimates of the risk of interpersonal violence over a 5-year period, which uses as one of its predictors the number of convictions for violence, is of little use to a clinician who wishes to predict the risk of his patient committing arson before his next out-patient appointment and who does not have access to the patient's criminal record. Secondly, he needs to know that the research is relevant to his patient.

The previous section described the difficulties that limit the degree to which these conditions can be fulfilled. Many of these difficulties relate to the range of circumstances in which predictions are required. Some can be addressed by conducting research specific to each outcome measure and patient group (Farrington & Tarling, 1985; Monahan & Steadman, 1994; Mulvey & Lidz, 1995; Kraemer *et al*. 1997). The 'risk of reconviction' score used by the Parole Board in England and Wales, for instance, was introduced to replace an earlier measure (Nuttall *et al*. 1977; Ward, 1987) when the target population changed (Copas *et al*. 1996). Research has not increased the power of mathematical methods to predict offending on parole, however (Dean & Duggan, 1968), and there are theoretical reasons why it is inappropriate to adopt an exclusively mathematical approach.

First, mathematical methods make use of only one type of probability. David Hume thought that there were two types, one of which was founded on chance and the other of which arose from causes (Hume, 1739, p. 424). If one wishes to know the probability of an aircraft crashing during a flight one can review the statistics for aircraft of that type on that route. Alternatively, one can inspect the aircraft. The inspection may bring to light a fault of a type that causes aircraft to crash, which, in turn, leads the inspector to rate the chances of a crash much higher than the statistics would allow (see Lipton, 1991; Royal Society, 1992). Actuarial research, as at present conducted in psychiatry and psychology, is correlational and can only show an association between a risk factor and an act of violence. It does not offer an explanation in terms of cause (see Floud & Young, 1981).

Novelty does not imply immunity to scientific explanation (Bergmann, 1944). If the aircraft crashed, research into the reasons would not involve large scale epidemiological surveys. The presence of a broken turbine blade, a fractured weld or traces of explosive allow conclusions to be drawn without the allocation of a case to a reference class (Lee, 1981). If we understand why things happen we can make predictions without recourse to groups and past experience. An understanding of why someone acted violently in the past may allow the prediction of violence in circumstances where, perhaps through lack of information, no mathematical estimate is available. Because people often do what they intend, the clinician who discusses intentions may be able to predict events that have not happened before. This, a table cannot do.

The difficulty, of course, is that there is seldom a clinical equivalent of the broken turbine blade or the fractured weld. Explanations of human behaviour rarely show that an act was inevitable or even highly probable. They tend to show only that it was not impossible. They more

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often explain, not why something had to happen, but how it could have happened (Walker, 1977). It remains to be seen to what extent explanations of extreme violence in terms of Maier's catathymia (Wertham, 1937; Schlesinger, 1996) or of sadistic violence in terms of the acting out of an often rehearsed fantasy (MacCulloch *et al.* 1983) have general application.

That said, explanation in terms of cause are widely used. When a deluded patient who is wielding a knife and threatening violence is admitted to hospital this is not done because an unacceptable percentage of such patients have gone on to attack someone in the past. No mathematical table is available to demonstrate whether or not this is the case. He (or she) is admitted because the doctor thinks that the causes of violence in such situations often involve a wish to harm and the availability of weapons. The doctor is basing his (or her) judgement not solely on that form of Hume's probability that is founded on chance, but also on that part that arises from causes.

It is difficult to express mathematically the processes by which the doctor is reaching his (or her) decision. Maynard Keynes thought that some forms of probability could not be described numerically. He gave the example of several pieces of research that reached different conclusions and used different methods. Weighing the relevance of the difference pieces of information involved what he called 'the hidden element of direct judgement or intuition' (Keynes 1921, p. 63). Even those who diverge from Keynes, in acknowledging the possibility that probability can always be expressed as a number, agree with him that this number need not always be generated by statistical means (Cohen, 1977).

It is evident also that actuarial research, as currently conducted in psychiatry and psychology, needs explanations in terms of cause. Such research cannot be conducted without a decision as to which variables are likely to be important. This decision cannot be made on mathematical grounds and must come from an understanding of why acts of violence occur. Thus, we include in the list of variables to be investigated the patient's age, sex and criminal record. We do not include eye colour, middle initial or national insurance number. The greater the extent to which the items that make up a predictive scale reflect the causes of violence, the better that predictive scale is likely to be (Gottfredson, 1987; Simon, 1971).

The second reason to reject an exclusively mathematical approach relates to rare events. Contrary to the views of Theodore Sarbin, mathematical methods may not be able to analyse all of the information that needs to be considered. Capgras delusions are widely reported predictors of violence (Christodoulou, 1978; De Pauw & Szulecka, 1988; Shubsachs & Young, 1988; Tomison & Donovan, 1988; Silva *et al.* 1989). They are uncommon, however, and are not widely rated even in large surveys (World Health Organization, 1973). The resulting lack of statistical power means that no conclusions can be drawn from a failure to show a significant association between Capgras delusions and violence. To date, no epidemiologically sound study has investigated this and it is difficult to see how such a study ever can. Delusional mood may be associated with a feeling that one is under threat (Cutting, 1997) and might therefore be expected to show an association with violence (Häfner & Boker, 1973). As a transient phenomenon, however, it is not usually available to be captured on a scale (see Litwack *et al.* 1993).

The third reason why it is not appropriate to rely solely on mathematical methods is that they cannot establish to what extent a piece of research is relevant to the patient. Some studies will be more relevant than others (see Kraemer *et al.* 1977). There will never be available to the clinician a study that generated predictive weights for all of the characteristics of the patient and his circumstances of which he has knowledge and which randomized its subjects with respect to all of those characteristics of which the clinician is ignorant. The extent to which a study is relevant will be a product of the extent to which these conditions are fulfilled, yet there is no way of measuring this using actuarial techniques. This difficulty is not restricted to risk prediction in psychiatry (Jackson & Carter, 1992). All statements of statistical probability rest on the assumption that the circumstances in which we are required to predict resemble the circumstances of which we have prior knowledge (Andrews, 1981). The grounds for this assumption of resemblance cannot be statistical (see Hume, 1739, p. 391).

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CONCLUSION

Explanations of human behaviour, always incomplete, are essential to the practice of psychiatry. It has been argued here that they are also an essential part of risk assessment and that it is the attempt to provide explanations of this type that distinguishes clinical from mathematical prediction. Causal explanations have received little attention from researchers, in part because the variables are difficult to measure. This is a reason for changing the research approach, not one for examining different variables. Research to improve risk assessment should include efforts to understand the mechanisms through which violence by the mentally disordered occurs. These mechanisms may relate to the perpetrator and his mental state or to his (or her) treatment and supervision.

The future of mathematical methods is not in doubt. First, where the requirement is for a large number of predictions using a small amount of information they are well established. One example is their use by parole boards. Secondly, any system for predicting violent behaviour needs to be tested. Testing requires predicting the behaviour of large numbers of people and measuring the success of these predictions. This is a mathematical procedure. Finally, doctors are not usually asked to predict the occurrence of only one type of behaviour, the cause of which is understood. Where they are required to assess the risk of a wide range of behaviours the causes of which they do not know, professionals have little option but to adopt mathematical procedures informally, allocating weights to variables which research has shown to be associated with future offending.

Finally, the limits to the prediction of violence, described here, are limits to prediction as a whole, not just to mathematical methods. Over the last 20 years clinical methods have been no more successful at adding to limited list of variables that have consistently been shown to alter the risk of violence. Both approaches face the problem that rare events will always be more difficult to predict than everyday ones because as the base-rate of the behaviour being predicted falls so the ratio of mistakes to correct predictions increases (Hanley, 1979). Both approaches face the additional problem that there is no agreement as to the appropriate reaction to a given level of risk (see Paling & Paling, 1994). Undergraduates vary by a factor of 10000 with respect to the length of time they would spend in a state psychiatric hospital to avoid being attacked by a man with a knife (Mossman & Hart, 1993). Unless we accept the view that the present level of predictive accuracy is all that can be expected (Gordon, 1977), however, the present state of knowledge is not one that justifies the abandonment of any approach that offers the prospect of improving risk assessment in the future.

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