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CRIMINAL EVIDENCE

Bayes' theorem and non-scientific evidence

R v Adams (No 2) The Times November 3 1997;

Following a re-trial the case of Dennis John Adams and the issue of Bayes' theorem returned to the Court of Appeal in October 1997.

The Background

The facts of this case are briefly as follows:

The victim was walking home after an evening out on April 6, 1991 when she was approached by a stranger who asked her the time. She saw his face very briefly before looking at her watch, he then raped her from behind. She reported the attack to the police and a DNA profile was obtained from a vaginal swab. The prosecution case was based solely on this DNA evidence.

In October 1993 the victim attended an identification parade but did not pick out Adams or anyone else. At committal proceedings she said that Adams did not look like the man who had attacked her. In her description the victim had said that her attacker was 20 to 25 years when Adams was 37 and at one stage during the course of her evidence the victim said Adams looked 40-42 years. In addition to this Adams gave an alibi, indicating that he had spent the night in question with his girlfriend.

The first trial:

Adams was convicted of rape in January 1995. At the trial the prosecution case rested entirely on expert evidence which indicated that the DNA profiles from Adams and the vaginal swab from the victim were compared and a visual match within one percent declared. The chance that a randomly chosen unrelated man would match the DNA profile from the semen on the vaginal swab was 1 in 200 million. The defence evidence consisted primarily of the 'non-identification' evidence of the victim, the testimony of Adams and the alibi evidence supported by the girlfriend's testimony.

The defence recognized that the jury may have difficulty in combining the quantitative DNA evidence with the qualitative defence evidence. In order to address this issue the defence, by agreement, called an expert to indicate to the jury how they might evaluate the non-scientific defence evidence in statistical terms by means of a mathematical theorem known as Bayes' theorem. This theorem is a recognized method of updating one's belief in the likelihood of a given hypothesis in the light of new evidence. When considering the potential application of this theorem to evidence in the criminal process it has generally been expressed in its odds form :

$$\text{Posterior odds} = \text{Prior odds} \times \text{Likelihood ratio}$$

The jury were instructed as to how they might attribute probabilities to the non-DNA evidence and how they might insert these figures into the above equation in order to attribute a quantitative value to the qualitative defence evidence and how that might then be combined with the DNA evidence.

The first appeal:

The grounds of this appeal were first, that the DNA evidence of the Crown was incapable on its own of establishing guilt; and secondly, that the judge had dealt inadequately with evidence of Bayes' theorem and its application to the facts of the case. On April 26, 1996 the Court of Appeal, ([1996] 2 Cr App R 467) quashed the conviction. The court rejected the first ground of appeal but concluded that the trial judge's directions on Bayes' theorem had left the jury without adequate guidance as to how to evaluate the DNA evidence in the light of the non-DNA evidence. The court observed, *per incuriam*, that it had grave doubt as to the appropriateness of presenting Bayes' theorem to a jury. The court felt that such evidence plunged the jury into inappropriate and unnecessary realms of theory and complexity, deflecting them from their proper task. This view was endorsed by the Court of Appeal in *Doheny* [1997] 1 Cr App R 369. The court felt unable to give an authoritative ruling in this matter as admissibility of Bayes' theorem was not a ground of appeal and the prosecution had not contested admissibility at the trial. The court ordered a re-trial.

The Re-trial

At the re-trial, as at the first trial, the prosecution case was based entirely on the DNA evidence. The expert again gave evidence of the match between the profile from the vaginal swab and that from Adam's blood sample and that there was a 1 in 200 million chance that a man unrelated to Adams would have the same profile (the random occurrence ratio). The defence called a statistician who criticised the figure presented by the Crown as overstating the evidence. These criticisms related to the small size of the database from which the figure was calculated, the fact that the prosecution expert had drawn in a band that had faded and that there had been a failure to include a proper correction figure to allow for sampling errors.

Despite the doubts of the Court of Appeal, at the re-trial the defence again presented Bayes' theorem to the jury as a means of looking at the non-DNA evidence in statistical terms. Indeed in this case they went further, supplying the jury with a questionnaire to facilitate their use of this theorem should they decide that they wished to do so.

The Appeal

On appeal the defence argued three points. Firstly, that in a case of this kind the prosecution should not be allowed to adduce statistical evidence regarding the random occurrence ratio of a DNA match unless the defence are allowed to call appropriate Bayesian evidence to show how such figures could be reduced in giving effect to the probabilities attached to non-scientific, non-DNA evidence. Secondly, in support of this it was submitted that the Bayesian approach is logical, sound and approved by expert opinion. Thirdly, it was submitted that in this case, as evidence of the Bayesian

approach had been presented to the jury, the judge should have directed the jury fully and not encouraged them to apply their common sense in contradistinction to the Bayesian approach.

With regard to the first submission the court held that there could be no possible ground of objection in principle to the prosecution presenting DNA evidence based as it is or as it should be on empirical statistical data, the data and deductions being available for the defence to criticise and challenge. However, the court did not accept that this then meant that the defence were free to adduce evidence in support of the Bayesian approach to non-scientific, non-DNA evidence as had occurred in this case. The court held, having had the opportunity to consider the evidence in this case and in the light of the court's previous concern regarding the admissibility of such evidence, endorsed in *Doheny*, that they regarded reliance on evidence of this kind as a recipe for confusion, misunderstanding and misjudgement. The court did not consider that a jury would be assisted in its task by reference to a very complex approach which they were unlikely to understand fully and even more unlikely to apply accurately. The court held that in cases such as this, in the absence of special features, expert evidence should not be admitted to induce juries to attach mathematical values to non-scientific evidence.

With regard to the second submission the court did accept that a Bayesian approach is a sound and reliable methodological approach but had great reservations about its use in jury trials.

With regard to the final submission the court did not accept the criticisms of the defence with regard to the judge's summing up. It was unnecessary in this case for the judge to summarize fully the evidence of the defence expert and the court was not persuaded that as a result of the summing up the conviction was unsafe.

The appeal was dismissed.

Conclusions

This DNA evidence in this case appeared to be very cogent evidence and, as confirmed by the Court of Appeal, the appropriate way to present this evidence is in statistical terms. The defence were able to challenge the weight to be given to this evidence through cross-examination as would be expected in a case involving DNA evidence. The problem faced by the defence was to ensure that the jury were not simply overawed by this evidence and that they did fully consider the non-DNA evidence and attribute appropriate weight to it. The result of this problem was a rather ambitious attempt by the defence to instruct the jury not simply in the logic behind Bayes' theorem, particularly the importance of the prior odds, but to propose that the jury might actually use a Bayesian approach to systematically evaluate the non-DNA evidence and adjust their estimate of the likelihood of guilt in the light of each new piece of evidence. As agreed by the Court of Appeal, Bayes' theorem is a logical method of reasoning but it is complex and it is difficult to disagree with the court's conclusion that reliance on evidence of this kind in such cases is a recipe for confusion, misunderstanding and misjudgement, possibly even among counsel, but very probably among judges and, almost certainly, among jurors.

It is very interesting to note that in the final paragraph of the judgement the court states that it is of the opinion that "in cases such as this, *lacking special features absent here*, expert evidence should not be admitted to induce juries to attach mathematical values to probabilities arising from non-scientific evidence adduced at the trial." This clearly suggests that the court feels that there may be circumstances in which it may be appropriate to allow such evidence to be adduced. There is however no indication as to what might constitute such special features and so justify the admissibility of such evidence. The circumstances of this case could be considered to be quite extreme in that it was the defence adducing such evidence when faced by prosecution evidence presented solely in statistical terms. It is difficult to imagine quite what, if any, special features the court envisaged when making this statement but it does suggest the court did not wish to close the door completely on Bayes' theorem.

The majority of Bayesians would accept that it is inappropriate to instruct a jury in Bayes' theorem, however, one would hope that the judgement in *Adams* would not prevent either the prosecution or the defence, as appropriate, being free to explain to the jury the theory behind a Bayesian approach to the evidence. This is no more than an explanation of a logical approach to the interpretation and evaluation of evidence.

FURTHER READING

Redmayne M "Presenting probabilities in court: the DNA experience". The International Journal of Evidence and Proof (1997) vol 1 no 4 pp 187-214

Steventon B "Statistical Evidence and the Courts - Recent Developments". Journal of Criminal Law (forthcoming)

The International Journal of Evidence and Proof, Special Edition, 1997.

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