

## **Forensic Science in UK Policing: Strategies, Tactics and Effectiveness**

Nick Tilley, Nottingham Trent University

Michael Townsley, UCL Jill Dando Institute of Crime Science

This chapter will trace growing efforts to rationalise the use of forensic science in British policing, where rationalisation is understood to mean the creation of consistent patterns which also maximise overall efficiency and effectiveness. Factors inhibiting as well as encouraging rationalisation will be discussed. The last section of the chapter will make suggestions for further improvements. A distinction will be made at the start between the intensive use of forensic science techniques, amongst other investigative tools, in relation to major but relatively rare crimes, and their more routine use in relation to volume crimes. This chapter will have little to say about the major crimes and forensic science and will concentrate on volume crimes. Though the use of new forensic tools, notably the National DNA Database (NDNAD), low copy number (LCN) DNA, and the National Automated Fingerprint Identification System (NAFIS), will be discussed, details of their development and debates over their statistical reliability lie outside the scope of this chapter. Rather, the focus here is on rationalisation in the ways in which science is mobilised to help achieve police objectives.

### **The uses of forensic science**

In major crime investigations, especially series, where detection of the individual case is deemed to be of critical importance, forensic science resources are drawn on relatively liberally according to specific needs as they are seen to arise. In particular where other evidence to detect the case is not readily to hand, crime scene examiners (until recently called Scenes of Crime Officers or 'SOCOs') examine scenes thoroughly, and forensic scientists are brought in to play a major part in the investigation. 'Byford Scientists', who are experienced senior forensic practitioners, liaise with Senior Investigating Officers, oversee physical evidence collection and play an active part in ensuring that the various threads of evidence in the case are tied in and the inferences properly drawn. Byford scientists, named after Sir Lawrence Byford, were introduced following the 1982 HMIC inquiry into the failures of the Ripper investigation that eventually led to conviction of Peter Sutcliffe but only after long delays where salient leads had been missed and false ones doggedly followed (Byford 1982). The emergence of Byford scientists describes a development in the interface between specialist advisors and crime investigators, bringing scientific techniques and reasoning to the collection and interpretation of physical evidence. The use of Byford scientists addresses a weakness in the way in which this interface had been working previously in major crime investigation. It represents, thus, one effort to rationalise the use of forensic science.

The main focus of this chapter, however, will be on the application of forensic science in the investigation of volume crimes, which are the bread-and-butter

business of crime investigation and of most of those involved in delivering forensic science services. The sheer number of cases involved means that the case-by-case approach adopted in major crime investigation is not practicable. The speculative and thorough searches for possible physical evidence and analyses of items recovered, which can be undertaken where needed in major crime investigation, are not possible with the resources available. There are nowhere near enough senior forensic practitioners to allocate one to each case or sufficient crime scene examiners for every crime scene to be attended by one of them. Moreover, it is not conceivable that those resources will become available in the foreseeable future. The issue for volume crime investigation is, therefore, that of maximising the benefits from the limited resources available. The last twenty years have witnessed a series of efforts to address just this issue. There has been a succession of diagnoses of weaknesses in forensic processes followed by efforts to remedy them. At the same time there have been some major developments in technique and technology that have fed into the processes of rationalisation.

The assumptions behind processes of rationalisation in the use of forensic science in major and volume crime inquiries are rather different. In major crime inquiries, the emphasis is on making sure that relevant expertise is brought to bear in relation to the particulars of the specific case. Relevant expertise here refers less to the ability to follow standard procedures used in routine forensic work (though it is important still that they are still employed when applicable), than the capacity to look at the case and the inquiry to work through what value might be added and what inferences drawn from the collection and analysis of physical evidence. Rationalisation for major crime inquiry means making sure that forensic expertise is on hand and that conditions are created where proper attention is paid to it. In volume crime inquiries, on the other hand, rationalisation relates to the development of robust systems, rules, habits and standards that can be rolled out and routinely applied across many cases maximising the net benefit at minimum costs.

The classical sociologist, Max Weber, used the adjectives 'substantive' and 'formal' to describe two distinguishable types of rationality. The former refers to specific considerations over the particular merits of any individual case. The latter refers to consistency and predictability across any number of relevantly similar cases. Weber's view was that there was a secular trend towards increases in formal rationality to meet the needs of large scale modern enterprises and government, where co-ordination, efficiency and consistency are *de rigueur*. This is a development that can be found in policing and forensic science over the past twenty years.

### **Key players in forensic processes in volume crime investigation**

Figure 1 shows who, for the most part, does what in the collection, analysis and use of physical evidence in volume crime case investigations. It will be helpful to

have a general understanding of this process in looking at moves towards rationalisation. There have been significant developments throughout.

A volume crime may or may not be reported. Prior to the report or after the report before the first officer attends, the scene may or may not be disturbed. The call handler taking the report may or may not advise the reporter that they should preserve the scene and how they should do so. The call handler may or may not despatch an officer to attend and they will allocate it a higher or lower level of urgency. They may also alert the crime scene examiner that the offence has taken place though this has more normally been left to the police officer attending. The police officer attending may arrive sooner or later. They may or may not collect some physical evidence themselves, but more normally they will determine whether to call a crime scene examiner to examine the scene for physical evidence. The crime scene examiner may or may not be briefed about the offence and what might most fruitfully be looked for in the course of the scene examination. The crime scene examiner will arrive sooner or later and will examine the scene for physical evidence of various sorts. They will collect the selected physical evidence, label it and package it for return to their base unit. A decision will then be taken as to what to do with the physical evidence.

Fingerprints may be sent to the in-force fingerprint bureau for comparison (either manually or through a computer data base) with the collection of 'ten prints', the library of sets of prints taken from past offenders, and with marks collected from previous unsolved offences. Other physical evidence may be sent to a laboratory for further analysis. In most cases this will be external to the police though some processes, including fingerprint enhancement, may take place in-house. The analysis is done more or less quickly and results returned where they will be passed on to the officer-in-the-case -- whoever has assumed responsibility for the investigation, following up what has been done by the first officer attending. In cases where an arrest is made, whether with or without forensic evidence having played a part, unique physical identifiers for that arrestee are taken and forwarded for checks against and incorporation into a local and/or national database. Until quite recently the only unique identifier taken was the set of ten-prints (prints from the top parts of all fingers from both hands). CJ Samples (buccal swabs) are now taken also from arrestees, for DNA profiling and entry on to the national DNA database (NDNAD).

### **Figure 1: Volume crime investigation and physical evidence collection and use**

There is a great deal of scope for error, inconsistency and inefficiency in this process. There are important strategic decisions to be made about the volume and disposition of resources to support these activities, as well as decisions about how the processes are to be managed and operated at a tactical level. The moves to rationalisation have related to just these issues.

## **Rationalisation and the conversion of the Forensic Science Service into an agency**

Early influential studies from the 1980s finding shortcomings in effectiveness and efficiency in the provisions for, activities relating to and use of forensic science in volume crime investigation include Ramsay (1987), Touche Ross (1987) and Audit Commission (1988). Each of these studies was conducted whilst the Forensic Science Service (FSS) remained part of the Home Office, when access was free at the point of use for police services. They found that the laboratories were unable to meet increasing demands deriving from growing crime levels and developments of more powerful forensic techniques. They also found very uneven crime scene attendance by SOCOs and apparently arbitrary levels of forensic service use within police forces.

Consistent with recommendations from Touche Ross (1987) and from a Home Affairs Select Committee Report in February 1989, which had also uncovered low morale, poor management and lack of direction in the FSS, agency status<sup>1</sup> was granted to it in April 1991, when direct charges were introduced for all customers including police services (the police accounting for about 95% of FSS revenue). The Metropolitan Police Forensic Science Laboratory, serving the Metropolitan Police Service and the City of London Police did not join the FSS till later. At the time agency status was granted there were 501 staff in the FSS and 226 in MPFSL. These provided almost all police forensic science needs, except for those met within police services and from a few specialist suppliers in niche areas, for example document examination. The level of provision was widely believed to be inadequate (see Home Affairs Select Committee 1989). By 1993 the number of staff in the Forensic Science Service had grown to 623 (Home Office 1993). And, by late 2005 the FSS were employing more than 2,600 staff (FSS 2005), in a context in which a range of other forensic services providers had also joined the market. Provision has, indeed, grown enormously<sup>2</sup>.

It was expected that the conversion of the FSS into an agency, paid for at the point of service by users of various sorts, principally non-metropolitan police services in the first instance, would introduce market discipline both to the provider and customer (Touche Ross 1987, RCCJ 1993). The customer would learn to make use of services when needed, to wit when the expected return matched the costs. The provider would attune services offered to what was actually needed or demanded by the customer. Alternative providers could compete for services ensuring that costs would be kept down, emerging needs met and innovations made as opportunities arose. The FSS would be free flexibly to pursue opportunities and to develop efficient working practices, less

---

<sup>1</sup> The Forensic Science Service became a Non-Departmental Public Board (NDPB), wholly owned by the Home Office but operating at arms length.

<sup>2</sup> The total number of recorded crimes (excluding violent crimes where counting rules make comparison across time meaningless) fell from 5 million in 1992 to 4.4 million in 2004-5. This means that the ratio of comparable crimes fell by over three quarters from 6,900 to 1,700 per annum per member of the Forensic Science Service.

trammelled by subordination to the Home Office. The transformation into an agency represented a switch from a centrally managed and planned service to one shaped by market forces. The grounds were that the patterns of usage deriving from planned services were not in the event producing effective and efficient use or provision.

### **Rationalisation of forensic provision and processes within police services**

Studies in the 1980s and early 1990s, for example Touche Ross (1987) and Audit Commission (1988, 1993), made suggestions for changes within the police to rationalise their collection of contact trace materials and submission for analysis, as well as for changes in the FSS as the major supplier. The Touche Ross report found the management of scientific support to be poor. It also found that there was insufficient understanding within the police of what forensic science could contribute to its work. It recommended the appointment of a Scientific Support Manager in each police service to oversee scientific support services, which included the work of SOCOs and fingerprint officers, the forensic science budget and the processes involved in the collection and preservation of physical evidence.

Touche Ross also noted wide variations in provision for scientific support by police force. For example there was one SOCO in place for every 1,674 recorded crimes at one extreme and one per 5,226 at the other extreme. In addition the report found that numbers of crime scenes examined per annum by SOCOs also differed greatly going from 331 to 1,476 cases per SOCO at an average of 705. Follow-up work by the Police Requirements Support Unit-Scientific Support Team (PRSU-SST) recommended 600 SOCO visits per annum. The Touche Ross report also noted diminishing resources relative to numbers of offences as crime levels increased. Continuing this theme, the Audit Commission (1993) noted the continuing slower rate at which numbers of SOCOs had grown when compared to numbers of crimes (up 16% and 40% respectively) between 1987 and 1991. It found an average of 800 crime scene visits per SOCO per annum, suggesting there was a growing shortfall in what was needed and a substantial number more than the 600 recommended by PRSU-SST. The Audit Commission again found wide variations between forces - from 450 to 1,350 visits per SOCO per annum.

In relation to the retrieval of contact trace material from crime scenes, both Touche Ross (1987) and the Audit Commission (1993) found substantial variations between police forces: for fingerprints respectively from 120 to 500 and 120 to 400 scenes per annum per SOCO, with no apparent explanation for why this should be the case. Further weaknesses identified included lack of minimum standards, lack of quality assurance, and inadequate communications between SOCOs and detectives.

Touche Ross and the Audit Commission were both trying to steer forces towards greater consistency performance, a closer match of resource to need, improved

quality standards in service delivery, and better liaison with investigating officers, all in the interests of rationalising the provision for scientific support within police services

In the mid 1990s a further detailed study of practices within police services was undertaken, looking at the ways in which forensic materials were collected, analysed and results used. An ambitious and wide-ranging study was co-sponsored by the Forensic Science Service, the Association of Chief Police Officers and the Home Office (ACPO/FSS 1996, Tilley and Ford 1996). It considered the entire forensic process: from scene preservation to presentation of evidence in court, though it concentrated in the main on police use of forensic science.

The main conclusions were that:

- Though structural changes in the management of forensic science suggested by Touche Ross had generally been implemented in police services, little had been done to improve yields from forensic evidence.
- The use of forensic science in the investigation of serious crimes and series of serious crimes was generally informed and thorough, though this was not the case for volume crimes.
- In volume crime cases there was a great deal of discretion in decision-making about the collection and use of forensic material, though staff exercising this discretion knew very little about the nature or potential value of the analyses that might be undertaken.
- The process of investigation, the work of scientific support and the activities of external forensic science suppliers were managed separately and were poorly integrated.
- Though there were quality assurance provisions within the FSS (and other public service laboratories) there were few for forensic science within police services or amongst other external suppliers.
- Forensic science was mostly used reactively, individual case by individual case, with little contribution to intelligence and little orientation to prevention.
- Training in the use of forensic science and communication between those involved in the forensic process (investigator, SOCO, fingerprint officer, investigating officer and external supplier) were both weak.
- There were substantial variations in force practices and investment in scientific support.

Table 1 goes through various stages in the forensic process as it relates to the investigation of individual cases, highlighting in the first column how in theory decisions would be made to maximise the potential investigative benefits from forensic science and in the second what was found to be happening in practice (Tilley and Ford 1996). The study found a consistent mismatch between what would be done if forensic science were to be used effectively and efficiently and what was actually done. This was especially marked in volume crime cases.

Table 1 - The use of forensic science in crime investigation: a summary of findings

The Theory	The Practice
<ol style="list-style-type: none"> <li>1. Scene well preserved by victim/reporter of incident, then FOA*</li> <li>2. FOA/IO* assesses scene accurately for scope for SOCO/forensic scientist collection of case-relevant CTM*</li> <li>3. SOCO/forensic scientist examine scene adequately briefed by FOA/IO to look for CTM confirming/disconfirming and adding to original line of inquiry</li> <li>4. SOCO/forensic scientist communicates useful findings to FOA/IO</li> <li>5. Cases selected for submission where there are prospects of evidence informing direction of inquiry and cost is warranted</li> <li>6. Items selected for submission which throw light on case, plus list of all other items collected which might be analysed</li> <li>7. Items packaged appropriately with continuity assured</li> <li>8. Submissions provide full background information on case, enabling the forensic scientist to make a judgment about answerability and intelligibility of the question asked</li> <li>9. Forensic scientists examines items that are likely to throw light on questions addressed and other issues germane to the inquiry</li> <li>10. IO and forensic scientists communicate verbally about question posed, proposed analysis and results</li> <li>11. Full QA*/QC* procedures for forensic analysis</li> <li>12. Forensic scientists writes clear, objective witness statement</li> <li>13. CPS* grasps meaning and significance of forensic scientist witness statement in context of case and takes appropriate account in prosecution decisions</li> </ol>	<p>Some evidence that evidence frequently disturbed/washed away FOA ignorant about potential discriminative powers of forensic tests.</p> <p>In volume crime, little briefing about case. Generally routine scene examination without focus on details of case. In major crime more information on case, more verbal briefing, more directed examination In volume crime little direct communication: at best available on computer. Much more in major crime. Seriousness of case often more significant than prospects of usefulness. Little use for inceptive purposes. Corroboration rather than elimination orientation. Lists of other items seldom provided. Selection on costs basis.</p> <p>Some evidence of packaging problems.</p> <p>Variable amounts and adequacy of information. Questions often poorly formulated.</p> <p>Some supplier examination of almost all materials sent to them and some failure to assess whether other forensic science examinations might be significant for inquiry. Some verbal communication</p> <p>Not all suppliers have QA/QC. In-force scientific procedures rarely have QA/QC. Generally OK. Some police expectation of less equivocal reports. Infrequent informal contact/consultation of CPS and forensic supplier pre-trial.</p>

14. Court enables expert evidence to be presented clearly with agreed points of difference between prosecution and defense highlighted	Small number of pre-trial conferences involving counsel, prosecution and defense experts.
--	---

\*Note: FOA refers to first officer attending; IO to investigating officer, CTM to contact trace material, QA to quality assurance, QC to quality control, and CPS to Crown Prosecution Service.

A large number of recommendations, published by ACPO and the Forensic Science Service as *Using Forensic Science Effectively*, emerged from the study. These aimed to rationalise the way forensic science was used in practice, and included specific suggestions for:

- An integrated team approach to investigation, where police officers, SOCOs, and forensic providers work together and communicate with one another, all focused on achieving outcomes
- An intelligence-led proactive orientation to the investigation of volume crime, with an eye to strategic preventive use of forensic science rather than a focus only on detecting individual cases
- Performance indicators that emphasise outcomes, rather than processes
- Improvements in awareness of forensic science capabilities, so that informed decisions can be made about the collection, submission and analyses requested from forensic providers.
- The introduction of quality control techniques across the entire forensic process.

### **Rationalisation following the ACPO, Forensic Science Service and Home Office review**

Her Majesty's Inspectorate of Constabulary (HMIC) undertook an inspection to find out what progress had been made in implementing the recommendations from *Using Forensic Science Effectively*, and also to look at progress in making good use of the DNA database and NAFIS, neither of which had been fully implemented at the time that the research for *Using Forensic Science Effectively* was conducted. The advent of the DNA database has had profound implications for the rational use of forensic science. It offered, as with fingerprints, a technique for establishing linkages with very high levels of confidence. A full DNA profile as with a full fingerprint could provide close-to-conclusive evidence linking a person to a scene or a scene to a scene in a way that is not matched by other forensic techniques, using for example, glass, fibres, shoe marks, or tool marks. Collection of DNA stains at crime scenes in conjunction with a DNA database of known offenders promised the potential for mass forensic science use both in relation to volume and major crime. Fingerprinting had not been included at all in the ACPO/FSS/Home Office study. There were already automated fingerprint recognition (AFR) systems in many police services prior to NAFIS, though no national system. However, much fingerprint work had been of a craft nature. Fingerprint officers compared scene marks with those of known active offenders whose ten-prints were kept to hand in 'bundles'. They also made comparisons with marks of suspects nominated by investigating officers. Some had remarkable memories for fingermarks and were quick to identify offenders.

NAFIS, as a national system using common methods for all forces, offered new search possibilities expanding the potential for wider-ranging linkages than those that were available in the craft work conducted within traditional police fingerprint departments, or with earlier AFR systems.

The HMIC inspection was published in summer 2000 as *Under the Microscope*, with a follow-up eighteen months later published as *Under the Microscope Refocused*. Both reports aimed at stimulating rationalisation in the use of forensic science in police services. The first expressed disappointment at the progress in attending to the recommendations of the ACPO/Home Office/FSS study. It noted patchy implementation and very limited attention from ACPO level officers.

The section of the report dealing with policing and the DNA database was quite damning. The following shortcomings were identified:

- There was wide variation in the availability and use of IT.
- Most staff lacked formal training.
- There was little evidence of written guidance or policies to which staff could refer.
- There was poor monitoring of error rates.
- Little performance management information was collected.
- Administrative errors were not rectified.
- There was inadequate dispatch or delivery service security arrangements.
- Storage arrangements for samples were inadequate.
- There were inadequate processes for the retaking of failed samples.

*Under the Microscope's* conclusions on fingerprinting uncovered problems of communication with members of the fingerprint bureau, lack of integration into the investigative process, delays in process leading to identifications, and failures in performance management regimes to concentrate on outcomes rather than activities. It advocated the development of well-formulated service level agreements delineating 'the reciprocal responsibilities and expectations between providers and customers (ensuring that)...the parties know where they stand, what they can expect from each other, and have a joint foundation for improvement.' (paragraph 3.25)

*Under the Microscope Refocused* found only modest progress since the original report. Ten forces were included in the follow-up. The Executive Summary states that '[o]nly three of the ten forces enjoyed the active participation of an ACPO ranking officer in "championing" the scientific support function'. In terms of DNA it reported that, '[i]t is clear from the responses that crime scene attendance and screening policies continue to present difficulty'; and for fingerprints '[o]nly one of the forces assessed had developed their use of Service Level Agreements.' Under *Managing the Intelligence and the Identifications*, it reported that, '[m]any forces still have a great deal of difficulty in managing the process of turning identifications into detections and this is rooted in the paucity of quality performance management information.'

## **Rationalisation since *Under the Microscope***

The Police Standards Unit (PSU) was set up within the Home Office in July 2001, as part of the Government's police reform agenda for improving police performance and achieving reductions in crime (Police Standards Unit 2003). A Forensic Support Programme comprised one thread of PSU's work. PSU aimed to reduce disparities in performance and spread good practice by 'standardizing use of science and technology'. PSU focused in particular on DNA and NAFIS. Special projects included 'Operation Cesare' in Lincolnshire, which attempted to improve SOCO performance, DNA and fingerprint processes and rates of capitalization on DNA matches and fingerprint identis; and 'Safer Homes' in the West Midlands, which speeded up analysis of DNA stains recovered from burglary crime scenes. In the West Midlands case, of which more will be said later in this chapter, early claims for preventive success in relation to volume crime (Police Standards Unit 2003) were not supported in the subsequent systematic evaluation of achievements (Webb et al 2005). Among other problems, weaknesses in feedback, variation in SOCO performance, and absence of arrests following matches were found even in this demonstration project. No independent evaluation could be found for the Lincolnshire project.

A 'Pathfinder project' assessing the effect of increased and improved forensic activity in relation to volume crime (burglary and vehicle crime) in two English police forces operated from May 2000 to April 2001, with results published in 2005 (Burrows et al 2005). The Pathfinder project was concerned to look at the use of new and improved forensic techniques, in particular low copy number (LCN) DNA, improved use of footwear and toolmark evidence, and improved linkages amongst and between offenders and scenes through a Force Led INTelligence System (FLINTS)<sup>3</sup>. Special FSS employed Forensic Examiners were appointed to each of the seven divisions included in the Pathfinder project to help find (and train SOCOs to find) material for LCN DNA swabbing that might otherwise be missed from relevant crime scenes. The project was followed neither by improvements in detection nor falls in crime in the divisions where it operated in comparison to those where it did not operate. Notwithstanding this disappointing finding, overall use of LCN DNA techniques did result in a number of detections, notably of vehicle crimes, that would otherwise not have been achieved.

A seven force study of the routine application of forensic science in volume crime cases published in 2004 found what should be by now familiar weaknesses in the management and use of forensic science within police services (Williams 2004).

---

<sup>3</sup> FLINTS uses forensic links provided by DNA, tools, footwear marks and fingerprints to draw out connections between scenes and people, for example people found at the same crime scene, and crime scenes linked to one another. The original acronym was Forensic Led INTelligence System.

Across the seven forces included in the study findings included considerable variation:

- in Scientific Support Unit (SSU) staff levels,
- in crime scene attendance rates (59% to 89% of domestic burglaries and 11% to 33% of vehicle crimes),
- in SOCO average numbers of scenes examined across the seven forces studied (348 to 575),
- in DNA hit and fingerprint ident rates (domestic burglary fingerprint 4% to 19%, domestic burglary DNA hits 2% to 5%, vehicle crime fingerprint ident 7% to 23% and vehicle crime DNA hits 4% to 8%), and
- in the level and type of integration of scientific support into wider investigative work.

Notwithstanding moves to increase provision of SOCOs/CSEs which are consistent with recommendations of earlier studies, huge differences in provision, workload and performance seem to have remained.

The most up-to-date substantial study (dealing with crimes committed in 2003-4) covering forensic processes, amongst other aspects of volume crime investigation, found continuing wide variations in practice and outcome in by Basic Command Unit across eight paired high and low detection rate BCUs (Burrows et al 2005). For example SOCO scene attendance varied from 63 per cent to 100 per cent for domestic burglary; from 27 per cent to 74 per cent for non-domestic burglary; from six per cent to 65 per cent for theft of motor vehicles; and from three per cent to 33 per cent for theft from motor vehicles). Combined fingerprint ident and DNA hits varied from 4.6 per cent to 8.1 per cent for domestic burglary; from 2.7 per cent to 8.7 per cent for non domestic burglary; from nought per cent to 1.9 per cent for theft from motor vehicles; and from 1.9 per cent to 17.9 per cent for theft of motor vehicles. There was, unsurprisingly, a positive association between rates of attendance and DNA hits and fingerprint ident for non-domestic burglary, theft from motor vehicles and theft of motor vehicles, where attendance rates varied very widely. There was none, however, for domestic burglary where attendance rates were in all cases relatively high and where diminishing returns seemed to have set in.

It can be seen that for almost 20 years many similar problems in delivering on the promise of forensic science have persisted despite a series of efforts to address them, to improve outcomes and achieve consistently high levels of performance. Forensic science continues to appear technically impressive but making the most effective use of it in routine volume crime cases has proven remarkably tricky. Variation in levels of provision and inconsistency in achievement continue to be found suggesting that benefits are not being optimized. Putting in place means of best exploiting the potential of the science continues to be a substantial challenge. The chapter turns now from efforts to rationalize the use of forensic science predominantly in its conventional role as an aide to detecting individual cases to examine its potential to inform crime preventive strategies.

## **New directions in rationalizing forensic science use**

In the final section of this chapter we set out some ideas of how the use of forensic data could and should be developed in the future<sup>4</sup>. It almost seems banal to declare that the predominant motive for the collection of forensic data is to resolve a single criminal matter. Apart from the obvious example where identical forensic data are found at multiple scenes, it is surprising that few people have contemplated the ways in which the voluminous amounts of forensic data collected routinely could contribute to efforts beyond this, eg crime reduction. This is the focus of this section.

Two observations can be drawn about the current use of national forensic databases. First, they do not assist in situations in which the offender is not yet known to the criminal justice system (is not present in the database). Some argue that there are very few perpetrators who have not come to the attention of police at some previous point, and they will certainly not be prolific offenders<sup>5</sup>. We will return to the issue of unknown offenders shortly. The second observation is that most forensic activity is reactive in nature and the unit of analysis is the individual crime<sup>6</sup>. By reactive we mean the task is to identify a culprit, though along the way suspects may also be eliminated. The ultimate goal is apprehension and utilising the criminal justice system.

With these two observations in mind, the chief innovation in the use of national forensic databases recently has been the development of familial searching (Bieber, 2006). The technique exploits the fact that parents pass on genes to their offspring, which means that intra-family DNA will be more similar than inter-family DNA. The promise is that the NDNAD will become more useful as familial searching increases the proportion of the population who might be matched. In fact, the provision of familial searching underpins the Forensic Science Service's Forensic Intelligence Bureau.

Unfortunately, populating national forensic databases may not be enough. As noted earlier, the results of an evaluation by Webb et al (2005) showed that 'fast-tracking' the recovery, matching and reporting of DNA material from burglary scenes and speeding up the apprehension of those individuals identified was not associated with a reduction in the amount of burglary reported to the police. So, in the context of a much larger national DNA database and despite bringing burglars to book an average two months earlier, no impact on burglary was observed. Webb et al conclude that a host of reasons exist why an initiative that

---

<sup>4</sup> The authors acknowledge their indebtedness to Ken Pease for insightful comments about the ideas contained in this section.

<sup>5</sup> From countless discussions with police officers there seems to be a consensus that the size of the unknown offender population is very small.

<sup>6</sup> Occasionally a series of scenes are linked but these are comparatively rare. Regardless, the endeavour focuses on an individual offender.

enjoys popular operational support might not yield the anticipated benefits; these include low collection rates of DNA, the offending patterns of those subject to swifter apprehension, the long term decline in burglary in the area and the retention of decision making over remand and sentencing beyond the remit of the pilot scheme. It is these wider, non-forensic issues which frustrate the application of forensic data to inform the intelligence function. Again, it is not the forensic science itself but its management and use that thwarts its effective exploitation.

What familial searching and fast tracking have in common is that they are primarily focussed on finding offenders. There is very limited crime reduction potential to forensic science as currently envisaged, apart from catching committed offenders and incapacitating them through incarceration, or deterring them by perceived increases in chances of punishment via the criminal justice system.

Consider for a moment the types of non-forensic data collected at a single crime scene. These include victim characteristics, location information, time and date ranges of commission, generic modus operandi, property taken or damaged, suspect descriptions, witness statements and type of offence. While ostensibly collected for the purposes of investigation, in the case of volume crime little is done from an investigative perspective with this information. However, they can be combined with information from other similar crimes to identify and analyse crime patterns. These observed patterns then(ideally) inform prevention efforts. For example, if the majority of domestic burglary incidents share similar entry points then crime prevention advice on security measures might be disseminated throughout an estate. Goldstein (1990) explores this concept of problem orientation in greater depth.

Under the National Intelligence Model (NIM) in the United Kingdom it is relatively common that police recorded crime data are subjected to analyses to understand features of crime in order to try to prevent further incidents. In fact, one of the four key intelligence product under the NIM exists for this very purpose (the problem profile). Unfortunately, forensic data are not employed routinely for this purpose.

Part of the problem appears to lie with the perception of different types of information within police agencies and the purpose to which they might be put. We discriminate between two broad functions: *intelligence* and *analysis*. The former can be described as focussing mainly on individuals, is largely retrospective in scope, and the ultimate goal is usually conviction<sup>7</sup>; thus data used for an intelligence purpose could be described as yet to be verified evidence (in the legal meaning of the term). On the other hand, the analytic

---

<sup>7</sup> Obviously some variation exists, some intelligence can be used to prevent – but this is not its normal, routine application. Regardless individuals are the predominant focus of intelligence.

function is consistent with how Goldstein (1990) describes problem analysis. It should be focussed on groups of events which are similar in some way, the goal is often preventative, and in this sense the purpose of the analysis is proactive<sup>8</sup>. To summarise, the analysis function is about testing explanations (hypotheses) about a problem using data.

Even at the individual case level, the information yielded by the comparison of crime scene samples with other scene samples is relatively neglected. For the purposes of understanding offending patterns, scene-to-scene matches are at least as important as scene-to-person matches, since they could encompass the criminal careers of people who never come to official attention. This would offer insights into the active offender population that have previously gone unobserved. Importantly, forensic data are substantially free of the types of bias that plague conventional sources of data about offenders and offending, although they are inevitably subject to their own set of biases and operational filters. We limit our discussion to DNA in the main but there is no reason why other forensic material could not be used in the same manner outlined here. Looking at fingerprints and DNA together would be especially instructive, though difficult (since, for example, people have many fingers, so the prints of different digits of as yet unknown offenders would not be linked).

FLINTS (described briefly earlier) is probably the closest information system to what we have in mind. Data located in disparate datasets are linked by virtue of (for example) common spatial location, temporal range, associates, descriptions and bio-metric indicators so that patterns can be located efficiently. FLINTS provides the means by which separate elements can be linked, but it has the potential to provide forensic intelligence and forensic analysis.

From an analysis perspective, the strengths of forensic data are: (i) *complete environmental information*: each forensic sample could be matched with spatial, geographic and criminal data of the offence; (ii) *perfect linking*: forensic data are (virtually) unique to individuals, enabling the generation of scene-to-scene matches which would indicate how many offenders are leaving traces and their respective levels of offending; (iii) and *undetected crimes*: forensic data would be linked to all scene samples, not just those for which an offender has been found, leading to the identification of prolific unknowns – those offenders who are unknown to the criminal justice system but leave traces in many places. There are, however, two main weaknesses in using forensic data for in the way set out below. First, offences are represented unequally - burglary, vehicle crime and sexual offences are represented in greater numbers than disorder, fraud or harassment. Second, none but the most reckless offender leaves traces at all their crime scenes.

---

<sup>8</sup> Like the intelligence definition, there will be some deviations in practice from our analysis definition, however the vast bulk of analysis that are routinely conducted in police agencies fit this pattern.

So far, no one has systematically used forensic data to describe the active offending population. Wiles and Costello (2000) look at what DNA traces tell about offenders' travel to crime distances. Leary and Pease (2003) seek to establish 'proof of concept' by exploratory analysis of West Midlands data. By using forensic data in an *analytical* manner it should be possible to better understand the size, nature, structure and dynamics of the offender population. These patterns could then be used to enable more effective reduction and detection strategies to be developed. Further, this approach re-orientes forensic science within the policing environment from servicing reactive investigations to informing organisational strategy.

Within the academic literature, criminal career research focuses on the active offender population. It explores a range of dimensions of offending patterns: *prevalence*, the proportion of individuals who participate in crime; *frequency*, the rate of activity of participating individuals; *duration*, the length of the criminal career; and *seriousness*, including both crimes committed and switching patterns. Its findings are central for policy and decision makers within and beyond the criminal justice system<sup>9</sup> For example, knowing how many prolific offenders are active at any one time, how they switch between crime types, how many are unknown to the criminal justice system and how long average careers persist would all provide better strategic guidance for crime detection. The research is pretty consistent in concluding that:

1. demographic variables are closely associated with prevalence, but not frequency of offending;
2. the onset of criminal careers peaks in the late teenage years; desistance from criminality is common in early adulthood;
3. individual offending rates assume a highly skewed distribution - those with an early onset of criminality will have higher offending rates;
4. offenders are generally versatile, not exclusively specialising in one type of offence; and
5. because of the age-crime relationship, the duration of most criminal careers is very short.

Until recently, official records and self-report offending surveys were considered the only sources of data for criminal career research with researchers content to acknowledge the inherent data limitations<sup>10</sup>. Forensic data differ from both. Undoubtedly they do suffer from some form of bias. Compared to official data, they are collected earlier in the criminal justice process and therefore suffer less attrition (studies of prisoners will only include those arrested and convicted, a distinct sub set of the offending population).

---

<sup>9</sup> The literature on criminal careers is extensive. Interested readers are referred to Blumstein et al. (1986); Tarling (1993); Farrington et al. (1998); and Piquero and Mazerolle (2001).

<sup>10</sup> Longitudinal data suffer from bias in offending patterns, but not the sample. Official data suffer from bias in the sample and probably in offending patterns.

Forensic data are also exposed to different types of organisational filters than official crime data. For one, they are collected by a group with a different skill set and operational objective. Police collect details of volume crime incidents mainly for administrative purposes. Despite rhetoric to the contrary, most police officers do not actively engage in detecting criminal incidents. The incomplete and inconsistent recording practices of front line police officers has been the bane of crime analysts who attempt to infer patterns from a fragmented data source.

Crime scene examiners perform a very different function from police officers at crime scenes. They scrutinise locations for clues as to how the incident occurred and the identities of individuals involved. This outlook generates data with biases of a different nature to officer-collected data. The bias introduced by the crime scene examiner process may be less severe than that associated with police officer recorded crime data simply, given that the former has scientific training emphasising consistent and accurate data collection.

Nonetheless, it is a fact that forensic data are collected at a minority of crime scenes, as shown in Williams (2004). To what extent could an accurate description of a population be based on such a small sample? Of themselves, small samples are not much of a problem if the sample is representative (consider the size [small] and accuracy [very] of pre election polls). Moreover, potentially useful methods do exist for the analysis of information where large sample sizes are difficult to obtain.

*Capture-recapture* techniques are used in wildlife ecology to estimate population parameters when it is difficult, dangerous or costly to count every single organism (e.g. fish in the ocean). The simplest model involves capturing a cohort of a population of interest on two occasions. With three quantities – the number captured in the first sweep, the number captured in the second sweep and the number captured in both sweeps – it is possible to estimate the size of the population (Pollock et al., 1990). So, even if the sample size is proportionately small, it is still possible to generate an estimate of the population size.

Applying the technique to forensic data would mean that we would treat crime scene data as samples of 'captured' observations and by aggregating months of data into sweeps the capture-recapture technique could be employed to estimate the number of offenders active at a particular point in time. By taking observations at a number of points in time more complex (and realistic) models could be developed (Pollock, 1982). For instance, closed population models assume no change in population size (e.g. no births, deaths, immigration, emigration), so are most suitable for sampling periods covering a relatively short period of time. Open population models allow births, deaths and migration to occur (i.e. there may be gains or losses between sampling periods). Recent work has introduced a number of models which include temporary emigration (i.e. where subjects are unable to be captured during a sampling period) (Kendall et al., 1997). These models are likely to be relevant when considering members

of the burglar population who become incarcerated or are transient and are therefore not present in the population being sampled but may return at some time in the future.

In this section, we have argued that forensic data could be used in broader ways than currently to generate an understanding of the criminal careers of offenders. This information would be of considerable operational relevance and should influence crime control strategies. It should be possible to investigate two of the four major dimensions of criminal careers (prevalence and offending rates) as well as estimate the size of the offender population.

### **Conclusion**

The major forms of rationalisation that have emerged to deal with major crime are very different in form, function and assumption from those that have developed in relation to volume crime. Both try to address the failure adequately to draw forensic science into the investigation of crime. The former mainly risks efficiency, by trying to minimise the chance that potential effectiveness is overlooked. The latter mainly risks effectiveness, by trying to minimise the chances that efforts are wasted where there is little scope of benefit. This may amount to horses for courses rationalisation, but leaves unresolved methods of minimising the costs of either rationalising strategy.

If we look a little more closely at the efforts at rationalisation in relation to volume crime, we find two models at work, whose workings have been identified by Williams (2004). These are shown in Table 2. They reflect more general variations between 'procedural' and 'discretionary' approaches to the investigation of volume crime using whatever means are available (Burrows et al 2005).

The technical assistance/procedural approach treats SOCOs (and other forensic science services, and by extension others involved in different aspects of the investigative process) as specialists with defined roles to be performed in relation to specified sets of cases in specified ways to specified standards with specified functions. Rationality and integration are achieved with clear division of labour and well-defined decision-rules aiming to produce consistency in the ways in which cases are processed. Net benefits are maximised to the degree to which the specified processes optimise trade offs between missing opportunities and undertaking work which produces no benefits.

The expert collaboration/discretionary approach treats SOCOs (and other forensic providers and others in the investigative process) as professionals exercising informed and collaborative case-by-case judgement to attempt to maximise overall outcome effectiveness in relation to the purposes of crime investigation and crime detection. Rationality is achieved through informed decision making in relation to a particular offence or a specific crime problem. Net benefits are maximised to the degree to which those involved have the

understanding, intelligence and commitment collectively to achieve targeted outcomes.

The ACPO/FSS/Home Office project tended to favour the expert collaboration/discretionary model (which comes closer to the Byford approach to major crime). *Under the Microscope* (albeit a follow-on to the ACPO/FSS/Home Office project), alongside the work of PSU has tended to favour the technical assistance/procedural approach. It is not clear yet which will prove the more useful.

Table 2 - Two approaches to the routine integration of scientific support to crime investigation

<b>Technical assistance integrated into organisational structures</b>	<b>Expert collaboration integrated into the investigative process</b>
<b>Control</b>	
External hierarchical supervision	Internal professional supervision
Attempt exhaustive attendance	Ensure informed attendance
Locally accountable	Locally co-accountable
CSEs as supervised specialists	CSEs as reflective practitioners
<b>Reach</b>	
BCU boundary governed	BCU and cross-border oriented
Reactive	Proactive
Contribute to intelligence	Define, contribute to, and use intelligence
Suspect identification orientation	Suspect targeting, identification and detection focus

Source: Williams 2004: 24.

This chapter shows that if forensic science is to contribute optimally to policing and criminal justice objectives -- the reduction of volume crime, the quick elimination of the innocent and the conviction of the guilty -- understanding and managing effectively the human, social side of the forensic process is absolutely critical. The series of findings showing recurrent weaknesses in the process indicates just how difficult it is to rationalise the process. The difficulties are compounded by changes in the science, the legal framework within which forensic processes take place, the evolution of criminal practices, political priorities, and the understanding of criminal behaviour.

Scientific and technological developments, most obviously those that are increasing the potential of DNA profiling and improving the algorithms for and other functional capacities of AFR systems (MHB 2004), are creating new potential contributions of forensic science with likely implications for what should be done and delivered through the forensic process. The science and what it might offer does not sit still. Likewise, the legal framework alters. PACE, for example, increased the importance of forensic science as other routes to detection became more difficult to follow because of the risks they posed for

justice. Alterations in the range of those for whom CJ DNA samples could be taken and kept have altered the size and potential from the DNA database. Criminal behaviour is thought to some degree to evolve with the tools available to the police for detection. Offenders adapt in their MOs. For example they may torch cars stolen for joyriding rather than risk the recovery and analysis of fingermarks or material open to DNA profiling. Political priorities partly affect the funding streams available to support DNA. They also shape policing priorities and through this the nature and extent that forensic processes might contribute. Improved criminological understanding may suggest strategies more effectively to disrupt criminal behaviour by focusing on identifying associations, patterns of offender recruitment, or prolific offenders. The preceding section has provided some pointers to what might be done in this regard.

In a context in which criminal behaviour, law, science, priorities and criminology are all in some flux it may be that rigid rules maximising consistency in patterns of outcome (which have never in practice yet been found) are less promising than an informed, professional model where informed reflective practitioners work together to forge evolving collaborative strategies.

## References

ACPO/FSS (1996) *Using Forensic Science Effectively*. London: ACPO/FSS.

Audit Commission (1988) *Improving the Performance of the Fingerprint Service*. London: HMSO.

Audit Commission (1993) *Helping with Inquiries*. London: HMSO.

Bieber, F.R. Brenner, C.H and Lazer, D. (2006) 'Finding Criminals Through DNA of Their Relatives', *Science*, (published online May 11)

Burrows, J., Hopkins, M. Robinson, A. Speed, M. And Tilley, N. (2005) *Understanding the attrition process in volume crime investigation*. Home Office Research Study 295. London: Home Office

Burrows, J. Tarling, R., Mackie, A., Poole, H. and Hodgson, B. (2005) *Forensic Science Pathfinder Project: Evaluating Increased Forensic Activity in Two English Police Services*. Home Office Online Report 46/05. London: Home Office.

Byford, L. (1982) [Report by Sir Lawrence Byford into the police handling of the Yorkshire Ripper case](#). London: Home Office (Released in June 2006, under the Freedom of Information Act

Goldstein, H. (1990) *Problem-Oriented Policing*, New York: McGraw-Hill

- Farrington, D.P., Lambert, S. and West, D.J. (1998) 'Criminal careers of two generations of family members in the Cambridge Study of Delinquent Development', *Studies on Crime and Crime Prevention*, Vol 7, 85-106.
- Her Majesty's Inspector of Constabulary (HMIC) (2000) *Under the Microscope*. London: Home Office
- Her Majesty's Inspector of Constabulary (HMIC) (2002) *Under the Microscope Refocused*. London: Home Office
- Home Affairs Select Committee (1989) *Report on the Forensic Science Service*, 2 vols. London: Home Office.
- Jeffreys, A.J., Wilson, V. and Thien, S.L. (1985) 'Hypervariable 'minisatellite' regions in human DNA', *Nature*, 314: 67-73.
- Leary, D. and Pease, K. (2003) 'DNA and the Active Criminal Population', *Crime Prevention and Community Safety: An International Journal*, 5:7-12.
- MHB (2004) *The Processing of Fingerprint Evidence after the Introduction of the National Automated Fingerprint Identification System (NAFIS)*. Home Office On-Line Report 23/04. London: Home Office.
- Piquero, A.R. and Mazerolle, P. (2001) *Life-course Criminology: Classic and Contemporary Readings*. Belmont CA: Wadsworth.
- Police Standards Unit (2003) *Memorandum*, Minutes of Evidence submitted by the Police Standards Unit to Home Affairs Committee, July 8<sup>th</sup> 2003.
- Pollock, K.H. (1982) 'A capture-recapture design robust to unequal probability of capture', *Journal of Wildlife Management*, Vol 46, pp 757-760
- Pollock, K.H., Nichols, J.D., Brownie, C. and Hines, J.E. (1990) *Statistical Inference for Capture-Recapture Experiments*, Wildlife Monographs, No. 107
- Ramsay, M. (1987) *The Effectiveness of the Forensic Science Service*. Home Office Research Study 92. London: Home Office.
- Tarling, R. (1993) *Analysing Offending*. London: Home Office.
- Tilley, N. and Ford, A. (1996) *Forensic Science and Crime Investigation*. Crime Detection and Prevention Series Paper 73. London: Home Office.
- Touche Ross (1987) *Review of Scientific Support for the Police*, 3 vols. London: Home Office.

Webb, B, Smith, C, Brock, A and Townsley, M (2005) 'DNA fast tracking', *Crime science: New approaches to preventing and detecting crime*, Smith, M and Tilley, N (eds.) Crime Science Series, Cullompton: Willan

Wiles, P and Costello, A (2000), 'The 'road to nowhere': the evidence for travelling criminals', *Home Office Research Study 207*. Research, Development and Statistics Directorate. London: Home Office.

Williams, R (2004), *The management of crime scene examination in relation to the investigation of burglary and vehicle crime*, Home Office Online Report 24/04