DNA Retention after Arrest: Balancing Privacy Interests and Public Protection.

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Abstract

The *S & Marper* judgement of the European Court of Human Rights addresses the question of DNA profile retention in the absence of conviction or admission of guilt. It casts the problem as a question of balancing the principles of individual privacy and public protection. In the Court's view there is a level of public protection conferred by retention of DNA from arrestees against whom no further action is taken which would justify retention, yet relevant data do not exist to determine the level of public protection gained by such retention. A pilot study is reported here showing that a group against whom arrest is followed by no further action exhibits levels of subsequent criminality (measured by frequency, latency and most severe outcome) similar to those of people officially processed by sentence or caution. Survival and count regression analyses suggest statistical approaches to be taken using larger and better samples. A research programme is outlined which would allow evidence-based policy on DNA profile retention.

Introduction

It has become routine in many jurisdictions to take DNA samples from people arrested or acquitted and /or proceeded with in the criminal justice system. For example, in England and Wales the DNA database in the Police National Computer (PNC) has risen by 40% in the last 2 years amounting to 5 million profiles. Just over one million belonged to people younger than 18 year olds at the time of retention (Significance 2009).

The policy varies in different jurisdictions. It has generally been applied to sentenced adult offenders. Controversy has arisen in cases that DNA profiles of people arrested but not processed with (i.e., sentenced or cautioned) are retained, not least because of the prevailing surmise in Western legal systems that people not found or not having admitted guilt remain legally innocent. DNA profiles of suspects arrested for serious violent or sexual offences are retained for up to 5 years in Scotland and 12 years in England and Wales. England and Wales, unlike Scotland, also retains profiles of people arrested (but not admitted guilt or charged) for less serious crimes (up to 6 years) as well as those taken from arrestees under 18. 850,000 profiles in the above mentioned database are taken from those against whom no further action was taken at the time of DNA sampling (Significance 2009). Critics have argued that the DNA profile retention policy has no statutory basis or independent oversight and it is disproportionally used to create pre-suspects among young ethnic minority males (Travis 2009, see also the last paragraph of this section).

In the recent, 2008, and landmark case of *S & Marper*[1], the European Court of Human Rights held that the practice in England and Wales of retaining on the national database the DNA samples and profiles of people arrested, but where guilt was not subsequently established or admitted, should be discontinued. Currently held samples and profiles in such cases should be discarded. The Court's exact statement follows:

[1] European Court of Human Rights, Grand Chamber, S & Marper v United Kingdom. Applications 30562.04 and 30566.04, Judgement of 4th December 2008.

"1. In conclusion, the Court finds that the blanket and indiscriminate nature of the powers of retention of the fingerprints, cellular samples and DNA profiles of persons suspected but not convicted of offences, as applied in the case of the present applicants, fails to strike a fair balance between the competing public and private interests and that the respondent State has overstepped any acceptable margin of appreciation in this regard."

The judgement is couched primarily in terms of achieving a *balance* between two principles, setting the right of privacy of those arrested against public protection to be gained by retention. Defining and comparing the two competing principles has given rise to heated public debate in the UK and elsewhere. It has also initiated academic research, including the present work, and will undoubtedly continue to do so, not least because national policies on DNA retention are required to demonstrate maintaining the above balance, especially since the *S & Marper* judgement. If the European Court of Human Rights had decided that the bio-material privacy of those arrested but not found guilty was of utmost importance without due consideration to public protection, the debate would have ended there and this paper would have remained unwritten.

The trade-off between public and private interests applies to evidence retention of all kinds. That DNA retention seems to be an issue of unparalleled sensitivity perhaps stems from the characterisation of DNA as providing a 'genetic blueprint', evoking recollections of the dark history of 20th century eugenics. It cannot stem from the particular importance of DNA evidence in miscarriages of justice (see Rossmo 2009). Confirmation bias among investigators, i.e., the tendency to find proving evidence of their own preconceptions and oversee evidence which disproves it, (Nickerson 1998) and eyewitness testimony (Marcus 2008) definitely, as well as fingerprint analysis (Dror and Fraser-Mackenzie 2009) potentially, contribute more to such miscarriages. In the USA, The Innocence Project attests to the ability of DNA evidence to exonerate innocent individuals who have nevertheless been convicted of an offence. The Project claims 235 post-conviction DNA exculpations to date. Seventeen of those exculpated had been sentenced to death before DNA established their innocence. The average sentence length served by those exonerated was 12 years.[2] Marcus (2008 p. 29) in what must be a

[2] http://www.innocenceproject.org/know/, accessed April 14th 2009.

reference to the Innocence Project, asserts that over 90% of the overturned convictions had hinged on faulty eyewitness testimony. Nonetheless DNA retention was the central issue of contention on which the Court ruled in *S & Marper*, and hence is the focus of the present paper.

The ways in which DNA sampling may compromise privacy rights have been addressed elsewhere (see for example the edited collection published as Lazer (2004); Nuffield Council on Bioethics 2007; Kimmelman 2000; Murphy 2007; Williams and Johnson 2008 and McCartney 2006a,b) and will not be discussed further here. Less attention has been given to the public protection afforded by DNA retention. In the next section, evidence of such effects when the sampled population comprises adjusdicated offenders will be reviewed *en passant*. If there were no such effects, retention generally would be called into question.

The Impact of DNA Usage

The effect of DNA testing of all prisoners in New South Wales was assessed (Dunsmuir, et al. 2008). From January 2001 onwards, NSW Police tested inmates serving sentences for serious indictable offences in NSW prisons. DNA testing of inmates was associated with a subsequent significant *increase* in the clear-up and charge rate of most offence types, including sexual assault, robbery, and burglary.

In a UK study with less detailed information, Alaster Smith (see also Burrows et al. 2005; Asplen 2004; Bradbury and Feist 2005) reported that:

"Overall, the national (UK) detection rate for the police is 23% of recorded crime. When useable DNA is recovered and loaded onto the DNA database, this detection rate rises to 43%….In domestic burglary….the detection rate rises from 15 to 46%; theft from a vehicle rises from 7 to 61%; and criminal damage increases from 13 to 52%."(Smith 2004, p. 14).

Roman et al. (2008, 2009) conducted a prospective randomised experiment of the cost-effectiveness of DNA in investigating high-volume crimes. Five hundred crime scenes in five communities were studied and cases randomly assigned to treatment and control conditions. DNA processing as well as traditional methods were used to investigate the cases in the treatment group. In the control group, biological evidence was not initially used, and case outcomes were due to traditional investigation. Property crime cases where DNA evidence was processed had more than twice as many suspects identified, twice as many arrested and more than twice as many cases accepted for prosecution compared with traditional investigation.

An inadequately reported study is Chicago's 'Study on Preventable Crimes'. [3] This claims, reporting a sample of only eight individuals, that 63 violent crimes (including 53 murders and rapes) could have been prevented had DNA been sampled upon arrest rather than conviction.[4]

The assessments of the effects of DNA usage are of course specific to a level of skill and effort deployed by crime scene examiners. A necessary piece of research would focus upon the overlooked issue of their skill and preferences, since there is reason to suppose that much forensic evidence is simply not captured. Unpublished material to support this contention is available from the second author on request. Research by Bond (2007) and Adderley and Bond (2008) suggests a means of maximising forensic detections, and notes a reduction in burglary where this was implemented.

Some indirect effects of DNA retention in adjudicated cases should perhaps be mentioned as providing indirect public benefits.

1.Cost. Stelfox (2006) estimated the cost of a murder at £1.46 million at 2003/04 prices. All murders by offenders beyond the point at which they could have been subject to successful DNA-facilitated prosecution thus represent cost and distress savings. By analogy, the argument applies to all other offences. Murder is an offence which is either cleared very quickly or only after a considerable period of time (Stelfox 2006). Savings in investigation costs can be achieved by swift clearance, to say nothing of reductions in putative further offending and attendant public disquiet. The opportunity cost of murder investigations is thus considerable.

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[3] http://www.dnaresource.com/documents/ChicagoPreventableCrimes-Final.pdf, accessed April 16th 2009.

[4] The judgement in *S & Marper* does not prohibit search of the DNA database against swabs taken upon arrest, so any prevention advantage would be retained after adherence to that judgement. What is at stake in the *S & Marper* judgement is the prompt downstream detection of cases.

2.Witness avoidance of court process. Guilty pleas induced by the existence of DNA evidence will avoid the trauma of court appearance and diminish the scope for witness intimidation, although the power of DNA evidence in driving pleas requires further research (see Briody 2002, 2004, 2006).

3.Closure. Convictions afford emotional closure to victims and families.

The Present Research

The research reported here addresses the question of whether the subsequent criminality of arrestees against whom no further action was taken (hereinafter NFA-arrestees) is markedly different to the subsequent criminality of those cautioned or sentenced. If the subsequent criminality of NFA-arrestees is similar to (or greater than) the criminality of those officially processed, then a necessary (but not sufficient) criterion for retention of NFA-arrestee DNA samples on the grounds of public protection has been satisfied.

The prognostic significance of DNA profiles taken from those arrested but against whom no consequent criminal justice action was dealt with in *S & Marper* as follows:

"2. Lord Steyn also referred to statistical evidence from which it appeared that almost 6,000 DNA profiles had been linked with crime-scene stain profiles which would have been destroyed under the former provisions [ie arrestees with no further action]. The offences involved included 53 murders, 33 attempted murders, 94 rapes, 38 sexual offences, 63 aggravated burglaries and 56 cases involving the supply of controlled drugs."

The Steyn figures are not very helpful. They may suggest that fifty-three murders is the total number detectable by retention of samples from NFA-arrestees. The Steyn numbers are time specific. If (for example) they refer to a two year period following arrest wherein fifty-three murders were linkable with NFA-arrestee DNA, is it the case that a four year period would yield 106 murders linkable with NFA-arrestee DNA? Probably not, because some arrestees would die, some would desist from serious criminality, and some would be incarcerated as a result of offences where DNA evidence was irrelevant. Nonetheless, the number of linkable murders would certainly be greater than 53! Put more generally, as time goes by, the number of crimes linked to NFA-arrestees (or any other group) will increase. By expressing statistics as a count rather than a rate, the erroneous impression is given that the Steyn figures represent the sum total of downstream DNA-detectable crime. Recasting the numbers as a rate per sample taken, and cumulatively, would give a better impression of public protection forgone by deletion. Those most concerned with privacy will see this as a partial truth. Linkability of a DNA profile to a crime scene includes many cases where DNA information is irrelevant to subsequent detection. Set in the balance against that argument, there will be cases where imperfect examination of crime scenes leads to traces being overlooked which could have been matched with NFA-arrestee profiles. In brief, fuller analysis of data of the kind used by Steyn would clarify levels of public protection associated with retention of the DNA of NFA-arrestees. The work reported here uses a different methodology and aspires to complement such an extended Steyn analysis.

Data and Analysis

Individuals arrested in Greater London from whom DNA samples were taken on three individual days, i.e., 1st June 2004, 1st June 2005 and 1st June 2006, form the sample of this study. The information provided in the data included offending history, subsequent arrests and criminal justice action taken up to 54 months after DNA was taken. Specifically, the respective risk periods for the 2006, 2005 and 2004 samples were 30, 42 and 54 months. The data had been extracted by police analysts at the Metropolitan Police Service (MPS) which polices Greater London and provided the original data of this study. The data were anonymised when received by the second author. They underwent substantial editing to exclude those with earlier cautions or convictions and ambiguous cases.

Table 1 describes the data and their attenuation as well as the distribution of offence types in respect of which DNA came to be sampled by year. The sub-samples from 2005 and 2006 are more than double than that from 2004 (401 and 394 over 167 cases, respectively). The distribution of offences in the 2004 sample looks also different than that from other years. For instance, most individuals in the sample were arrested for violence and/ or possessing a weapon but this group is the second most frequent in 2004. On the 1st June of this year most arrests were for property crimes. Pairwise statistical comparisons partially confirmed the difference of the 2004 sub-sample. The 2004-2005 contrast did not reach the conventional level of significance (χ^2 = 5.97, at 4 degrees of freedom (hereinafter df), non significant (hereinafter ns)) but the 2004-2006 contrast did (χ^2 = 13.31, 4df, p-value<0.010). No reliable difference was found between 2005 and 2006 (χ^2 = 7.30, 4 df, ns).

<Insert Table 1 about here>

Samples were compared with respect to the age of those sampled. There was a tendency for the samples to differ ($F_{2,585}$ = 2.52, p-value = 0.081). Games-Howell post-hoc comparisons showed the tendency to differ to lie between the 2004 and 2006 samples.

Table 2 shows what happened to arrestees after a DNA sample was taken. It should be borne in mind, when looking at analyses presented here, that the subsequent recorded criminality of the group given custodial sentences will be lower than it would have been had they been free to re-offend throughout the follow-up period. The comparison between NFA-arrestees and those given non-custodial sentences is thus more directly interpretable.

<Insert Table 2 about here>

Tables 1 and 2 and the analysis by age suggest that the sample from 2004 significantly differs from that taken from the other two years. The percentage of NFA-arrestees increased from 28.3% (see first figure of Table 2) in 2004 to eventually 45.1% (see third column and first row of figures in Table 2) in 2006 while the percentage of the other less severe disposals declined. Specifically, on 1st June 2006 warnings and non-custodial sentences were given to 27.7% and 13.6% of arrestees in Greater London, respectively, while on the same day of 2004 to respective 41.7% and 20.8% of arrestees. This may reflect a change in policing practice, whereby more and younger people were arrested, and for less serious offences, so as to exercise more widely the newly-acquired power to have their DNA profiles placed on the national database. This is however a question beyond the scope of the present study and is left for future research.

All ratings of subsequent events were made without the researcher knowing the rating of the offence triggering DNA sampling and the action which immediately followed (this is termed blind ranking). There was thus no possibility that notions of likely patterns might subtly influence interpretation. The post-DNA variables were:

1. Number of subsequent separate dated events (leading to arrest, warning, conviction). Dates were taken as the unit of count to avoid the problems presented by numerous counts dated to the same day;
2. Time (months) to first subsequent dated event;
3. Whether any subsequent dated events involved violence, i.e., assault, or weapon possession;
4. The most severe sanction imposed at the first subsequent dated event.

The time (in months) to the first subsequent PNC appearance was analysed via life tables to estimate cumulative survival function and hazard rate. The cumulative survival function is an estimate of the proportion of the sample not re-arrested at the end of each interval given than they were not re-arrested in any previous interval. The hazard rate is the rate of rearrest within any interval given the number of individuals who have survived until that period (Lancaster 1990; Greene 1997). This paper contains a partial and abridged version of the relevant analyses. More detailed hazard and survival function information is available on the request from the first author.

In short, all groups *including the NFA arrestees* reappeared in the PNC data after roughly the same interval during the follow up period when all years are examined together with appropriate censoring to account for the different follow up periods. The Wilcoxon test statistics of overall and pairwise comparisons were statistically non-significant. Thus, time to re-arrest described a similar time course for NFA-arrestees and others (see Figure 1 below).

<Insert Figure 1 about here>

A statistical comparison of the median survival time and the cumulative survival and hazard functions showed that the NFA group from 2005 had a first subsequent PNC appearance sooner that those who were given a warning /caution (p-value of the Wilcoxon test statistic of pairwise comparison, henceforth W-test, = 0.11) or people in the 'other action' category (W- test p-value = 0.10).[5] Analyses of median survival times by action taken after DNA sampling clustered within offence type (i.e., property, violence/weapon, vehicle-linked, drug or other) which triggered the sample being taken are available from the first author. With respect to vehicle-linked offences the NFA group re-appeared in the PNC significantly sooner than those who received non-custodial sentences (W- test p-value = 0.01). By contrast, with respect to other offences they re-appeared later than those given caution or warning. These analyses however do not modify the central conclusion, that NFA-arrestees are not to be distinguished by their subsequent lower criminality from those whose DNA retention would be unaffected by the *S & Marper* judgement.

The discussion focuses now on the outcome of subsequent contact. The simplest way of presenting the data involves summing across years. This involves conflating different risk periods but gives an overview.

<Insert Table 3 and Figure 2 about here>

Table 3 summarises the proportion of those dealt with who re-appeared as arrestees in the data. Figure 2 shows the most severe subsequent process of NFA arrestees and others. Overall, the subsequent apparent criminality of the NFA group was on a par with those given non-custodial sentences and cautions (χ^2 test of the association presented as Figure 2 equals 2.71, 5 df, ns). We need also to look at the proportion of those with subsequent contacts at which guilt was admitted or established, since repeated arrests with NFA might reflect police harassment. The NFA group proportion with subsequent admitted or established guilt (71%) was slightly higher than the figure for cautions (65%) and slightly lower than the group given non-custodial sentences (84%). Thus the downstream record of the NFA-arrestees seems not to be an artefact of police harassment leading to repeated NFA episodes.

[5] Due to the small number of cases we believe that two – tailed significance test values up to roughly 0.10 are worth mentioning. The reader may decide whether to take this as evidence or reject the respective null hypothesis. The authors are happy to share the details of the statistical analysis if requested.

The proportion of those with subsequent offences involving violence or weapons possession was similar in the three groups (65%, 64% and 60% respectively for NFA, caution and non-custodial sanctions). Eleven of the NFA group had a custodial sentence imposed during the follow-up period. Given that errors of estimation will be magnified by multiplying figures to give a monthly total, the *speculation* is that some 330 of those NFA'd over the course of a month in the Greater London area might have had a custodial sentence imposed during the follow-up period.

Analyses of whether any subsequent incident entailed violence showed that those who commit violence in subsequent events have a first PNC appearance following DNA sampling sooner than others (W-test p-value =0.03) and this is so for members of the NFA group considered on its own. These results -- details which are available from the first author -- are only indicative: they examine the uncensored cases, that is, sample members who were rearrested, and naturally ignore censored observations which play a role in estimating survival times. Future analysis should account for time-dependent covariates.

There seems to be a link between violence and repeat contacts in the follow up period for those re-arrested. Indeed three or more subsequent PNC appearances are significantly associated with at least one violence offence generally (χ^2 = 23.53, 2 df, p-value = 0.000) and, especially, with respect to the NFA group who re-appeared in the PNC data (χ^2 = 15.10, 2 df, p-value = 0.001). NFA-arrestees with two or more subsequent appearances were re-arrested some 17 months sooner than those who appeared only once again during the study period (W-test p-value<0.001).

For the sample as a whole, those rearrested were significantly younger than those not rearrested (t = 6.14, two-tailed p-value < 0.001). The key point for the present paper concerns whether the link between age and rearrest was different for NFA-arrestees. It was not statistically reliable ($F_{1,584}$ = 0.03, ns). The relationship between age and rearrest was similar for NFA-arrestees as for groups where other actions were taken. The importance of this result, if replicated on a larger scale, is that selective deletion of DNA profiles of younger arrestees is a bad idea in terms of public protection.

The other candidate for selective deletion involves offence seriousness, with those arrested for *less serious* offences having their DNA profiles deleted. To address the point, the seriousness of the event leading to inclusion in the sample as an NFA-arrestee was ranked. The seriousness of the first subsequent dated event was also ranked. We thus had a before DNA and an after DNA ranking of seriousness of offences. The two rankings were undertaken without the researcher knowing which was the earlier and which the later set of events.[6] The rankings were not correlated (tau = 0.08, ns). Thus seriousness of offence would be a poor basis for selective deletion of DNA profiles, since it would confer little by way of public protection from more serious offences. This chimes with unhappy Canadian experience (see House et al. 2006).

Subsequent contact and severity of subsequent action are two aspects of a criminal career. Table 4 presents the estimated number of months to subsequent arrest by initial and most serious subsequent action taken. Since more persistent offenders return faster and are liable to more serious subsequent criminality, the results in this Table are not surprising. In particular, the NFA group at initial contact has very different survival times depending on the most severe outcome of subsequent contacts. Subsequent contact comes later (after 13 months) when it leads to a second NFA than if the originally NFA-arrestee is eventually cautioned or sentenced. Indeed, within the NFA arrestee group, the time to subsequent arrest is significantly longer if the most severe subsequent action is again NFA than any other action (respective W-tests p-values < 0.05). The same caveat as for the previous analyses of violence and repeat arrests holds here: the analysis draws from the sample which was re-arrested.

<Insert Table 4 about here>

The effects of more than two covariates on the survival curve were examined via Cox regression models (Lancaster 1990). Results are available from the first author upon

[6] Many thanks are due to Ann Wright for acting as blind ranker.

request, but are excluded here because they do not compromise the simpler account given to this point. For example, the older the arrestee when the DNA sample was taken, the longer the time to his /her subsequent first rearrest, i.e., younger arrestees re-appear in the PNC data sooner than older ones. There was no statistically significant interaction effect of age with either number of, or any violence in, subsequent re-arrests.

The number of subsequent PNC appearances was also modelled via negative binomial regression accounting for the different follow up periods across years in the sample. The results are shown in Table 5. Older arrestees are rearrested less often. There were no significant interactions between age and any subsequent violence for those rearrested. Running similar analyses with a larger sample would confirm whether the lack of interaction effects is real or an artefact of too few cases with each combination of characteristics.

<Insert Table 5 about here>

Discussion

This section is unusual for a discussion section in referring to studies not mentioned in the introduction. The justification is that it was felt inappropriate to discuss some compromise retention policies until a provisional conclusion had been reached about the relative criminality of the NFA-arrestees and the officially processed groups.

The NFA-arrestee group arguably comprises two types of people: the genuinely innocent and offenders who may be particularly skilled in witness and victim intimidation. In the latter case further police action would be fruitless since lack of cooperation would provide insufficient evidence for prosecution. This would make sense of the subsequent re-arrest and conviction history of the NFA-arrestees. In a study of Grievous Bodily Harm events, Belur and Wheal (2009) studied the factors which affect a victim's decision not to substantiate allegations. These included accounts such as:

> *"I did not know the guys who did it, but my friends did. I gave her my friends' names and 'tags' of the guy [who attacked me. The officer] called my friends, but all of them said, I don't know anything. The detective kept coming back but said*

she had no evidence. How can that be, when it was 4pm in the afternoon and there were so many shops? I had given her as much information as I could, but none of my friends gave evidence."

Suggestions of witness intimidation were sparse in the data analysed here, but (subjectively) appeared exclusively among the NFA-arrestee group. If the characterisation of the NFA-arrestee groups set out above is correct, the question is whether the truly innocent in the group can reasonably be expected to carry their presence on the DNA database as a civic burden, borne in the cause of public protection generally.

The present study is intended only as preliminary to a hoped-for research programme. The sample is from one police force area, Greater London, and areas vary widely in rates at which arrests are followed by no further action (between 4% and 36% in 2005).[7] It comes from one calendar date, thus neglecting seasonal variation. That said, the conclusion is that the NFA group subsequently shows itself to be roughly as criminal as the groups with which it was compared. Exceptions do not generally suggest lower subsequent criminality of the NFA arrestees.

Taken at face value, the data suggest that DNA profile retention confers no less per capita public protection than retention of profiles from cautioned and convicted groups. Selective deletion of profiles by age or offence seriousness would seriously compromise the level of public protection afforded by a retention policy, and in this respect the modest data analysed here are in line with the literature generally in its demonstration that early age of onset is a predictor of longer criminal careers (e.g., Piquero et al. 2004; Silver et al. 2000).

The second alternative criterion for selective deletion is seriousness of offence involved at the point of first arrest. This rests upon an incorrect assumption of homogeneity within criminal careers (see Roach 2009). An earlier analysis showed that the offence which led to DNA being taken which led to detection of a subsequent murder case was most often a

[7] Personal communication to second author.

drugs offence (in 29 cases), less often a theft offence (in 10 cases) and least often an offence of violence (Townsley et al. 2005). Selectively deleting DNA taken after drug or theft offences would thus lose the bulk of the evidentiary potential for the solution of murders. To illustrate the point, Stuart Cundy, Senior Investigating Officer in the murder of Sally Anne Bowman, asserted that "had a sample been placed on the national database after a theft offence committed in 2003, [we] could have identified Sally Anne's murderer within 24 hours. Instead it took nearly nine months before Mark Dixie was identified and almost two and a half years for justice to be done." [8]

Finally, there are contextual issues to consider. The very different implications of retention of samples (the biological material itself) and profiles (their digitised representation) are conflated in the *S & Marper* judgement. If samples were discarded and profiles retained, legitimate concerns raised in the judgement about how developments in forensic genetics could compromise privacy would be negated. The judgement in consequence would be much shorter in length and the balance between the interests of individual privacy and public protection reconsidered. The crucial distinction between coding and non-coding DNA sequences and its implications for safeguards does not feature in the judgement.

While properly absent from the judgement, the capacity of the police to work round the restrictions placed upon them by deletion of DNA samples should not be underestimated. Such 'work-arounds' are of two kinds. First, speculative searches of past crime scene samples will still be permitted under *S & Marper*. This would probably lead to less justified arrests for minor offences of those suspected of a serious crime (where a crime scene DNA sample is available) whose profiles have been deleted. There is a threshold of evidence which triggers arrest. That threshold will fall if a police officer believes there to be a chance that an arrest will lead to the clearance of a serious crime committed earlier. Second, forms of words in police intelligence records will develop to reflect the fact that a crime scene and criminal justice profile had previously matched, although the criminal

[8] http://news.bbc.co.uk/1/hi/uk/7259494.stm, accessed April 16th 2009

justice profile had been deleted. This would result in de facto retention of DNA information.

Suggestions for Future Research

More questions have surfaced than have been answered in the present research. This final section outlines some research priorities which may aid answering them. Having provisionally suggested that NFA-arrestees are subsequently as much likely to be sentenced or cautioned as others and that the two obvious forms of selective deletion of DNA profiles would lose much of the public protection potential of retention, the writers think that there is a case for an ambitious research programme. In the writers' view, it should attempt to investigate both the level of public protection conferred by the retention of DNA samples or profiles of NFA-arrestees and the extent of the public's demand for privacy of individual bio-metric information.

To measure the former element a bigger and better replication of the study reported here, across forces across Europe is required. The sample sizes per force and /or country should be large enough to allow analysis by ethnicity in order to test whether the policy is disproportionately used to sample the DNA of ethnic minority young males, which is one of the main concerns voiced by critics. Ambiguities and other inaccuracies in the data should be clarified prior to analysis (perhaps with close collaboration of police analysts and researchers on the non-anonymised version) to avoid risking lack of representativeness. The suggested research programme should sample across time in order to identify trends allowing the separation of opportunistic arrest ('fishing expeditions') to enable placement of profiles on the database. It should also look at patterns across countries and forces sharing the same prosecutors, to disentangle the role of police and prosecutor in the decision not to proceed using a multilevel framework.

The results of the above proposed analysis should stand to replication. For instance, Lord Steyn's evidence on the number of crimes cleared owning to DNA retention of NFA-arrestees which is referred to in the *S & Marper* judgement (see third section) could be used to this effect if it is improved and expanded: The information should be updated and extended to cover all forces and nations. As already mentioned, expressing the results cumulatively over time and/ or as a rate per NFA sample taken rather than counts would offer more insights about the public protection potential of DNA retention of NFA-arrestees.

A separate study to assess the deterrent effects of presence on DNA databases is at least needed to complete measuring the level of public protection conferred by the DNA retention of NFA- arrestees. This would be based on interviews with a representative sample of first time arrestees to assess perceived deterrence, as well as information of their subsequent actual and statistically assessed criminal record in order to compare the results between NFA-arrestees and other groups.

The second principle in the balance entailed in the *S & Marper* judgement is the right to privacy of individual bio-metric information. The public's tolerance to violations of this right under perhaps specific conditions and circumstances should be assessed, not least because in democratic societies policies, especially expensive ones to the tax-payer, should fulfil respective legitimate societies' needs. This can be done via a public opinion survey of retention policy across Europe using appropriate survey methodology to investigate attitudes and perceived 'value' of non-market goods, such as the right to privacy. The survey would be repeated every two years or so to assess possible over time changes in the public sentiment with regards to this issue. Any ad hoc events which may markedly affect people's opinion of the legitimacy of DNA retention policies as well as the media's influence should not be overlooked. The samples would be large enough and representative in each country so as to allow reliable comparisons of the prevailing attitude towards DNA retention of NFA-arrestees across basic population sub-groups (for instance, by age, sex, ethnicity, educational level and employment status) and countries.

Since the *S & Marper* judgement by the European Court of Human Rights states are obliged to demonstrate that their respective DNA retention policies achieve a balance between the right to privacy of those arrested and public protection. A necessary prerequisite which seems so far to have been overlooked is reliable quantification of both principles so that their comparison becomes possible.

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Table 1. Offence type in respect of which sample taken by year.

	Year			
Offence in respect to which DNA was sampled	2004	2005	2006	Total
Property	48	79	62	189
Violence/Weapon	36	99	89	224
Vehicle-linked	22	31	30	83
Drug	8	21	27	56
Other	6	14	27	47
Total analysed cases	120	244	235	599
Excluded cases *	47	157	159	363
Total cases in the Metropolitan Police Service DNA samples of 1st June	167	401	394	962

* Note: Earlier cautions or convictions and ambiguous cases have been excluded from further analysis.

Table 2: Action taken by year sampled.

	Year			
	2004	2005	2006	Total
Action taken after DNA sampled	N (%)	N (%)	N (%)	N (%)
No further action	34 (28.3)	108 (44.3)	106 (45.1)	248 (41.4)
Warning	50 (41.7)	83 (34.0)	65 (27.7)	198 (33.1)
Non-custodial	25 (20.8)	29 (11.9)	32 (13.6)	86 (14.4)
Custodial	5 (4.2)	11 (4.5)	11 (4.7)	27 (4.5)
Other	6 (5.0)	13 (5.3)	21 (8.9)	40 (6.7)
Total	120	244	235	599
χ^2 (degrees of freedom, p-value)				18.69 (8, 0.02)

Table 3: Subsequent Police National Computer (PNC) appearance by action taken after DNA sampled.

	No further PNC Appearance	Further PNC appearance	Total
Action taken after DNA sampled	N (%)	N (%)	N
No further action	140 (57%)	108 (43%)	248
Caution	105 (53%)	93 (47%)	198
Non-custodial sentence	49 (57%)	37 (43%)	86
Custody	16 (59%)	11 (41%)	27
Other	23 (58%)	17 (42%)	40
Total	333	266	599
χ^2 (degrees of freedom, p-value)			0.68 (4, 0.95)

Table 4: Median time to subsequent Police National Computer (PNC) appearance by subsequent and initial actions.

Action taken after DNA sampled	Most serious action at subsequent Police National Computer appearances	Median Survival Time (Months)
No further action [1]	No further action	13.00
	Warning/caution	7.50
	Non-custodial sentence	7.67
	Custodial sentence	11.17
	Other	4.00
Warning/caution [2]	No further action	17.00
	Warning/caution	25.50
	Non-custodial sentence	11.50
	Custodial sentence	2.25
	Other	5.50
Non-custodial sentence	No further action	26.00
	Warning/caution	5.75
	Non-custodial sentence	5.33
	Custodial sentence	15.00
Custodial sentence	No further action	34.50
	Non-custodial sentence	12.00
	Custodial sentence	9.50
	Other	14.50
Other	No further action	29.00
	Warning/caution	4.75
	Non-custodial sentence	28.00
	Custodial sentence	1.75
	Other	5.50

[1] W-test values of overall comparisons of actions at subsequent PNC appearance within action taken after DNA sampled statistically significant at $0.001 < p\text{-value} < 0.05$.
[2] W-test values of overall comparisons of actions at subsequent PNC appearance within action taken after DNA sampled statistically significant at $p\text{-value} < 0.001$.

Table 5: Estimated effects on the number of subsequent Police National Computer appearances.

	Number of Police National Computer re-appearances			
Covariates	Estimate	Standard Error	Estimate	Standard Error
Intercept	-52.911***	.197	-53.626***	.296
Age	-.052***	.006	-.021***	.008
2005	11.946***	.142	12.018***	.179
2006	23.091***	.152	23.710***	.200
No further action (base)	-	-	-	-
Warning /Caution	-.245*	.134	-.090	.173
Non-custodial	.111	.171	.195	.222
Custodial	.582**	.253	.593*	.348
Other	.292	.230	.179	.304
Any subsequent violence	-	-	.671***	.158
Number of Observations		586		258

* Coefficient statistically significant at $0.05 < \text{p-value} \leq 0.10$.
** Coefficient statistically significant at $0.005 < \text{p-value} \leq 0.05$.
*** Coefficient statistically significant at $\text{p-value} \leq 0.005$.

Figure 1: Cumulative percentage rearrested over time for arrestees with no further action (NFA) and those who were cautioned or sentenced (Others) after their DNA was sampled.

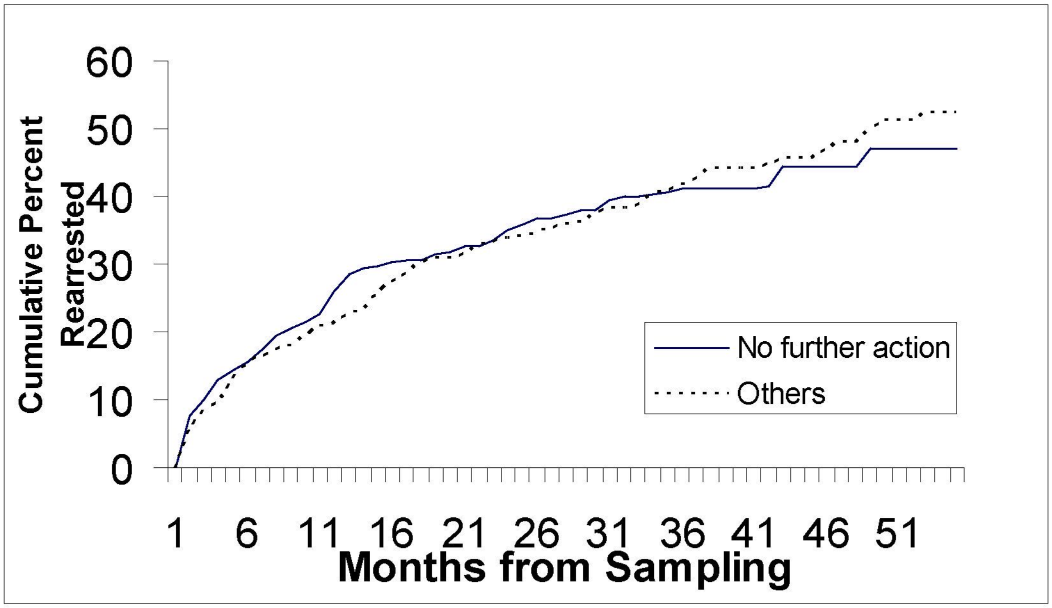

Figure 2: Most severe subsequent process for those with no further action (NFA) and those who were cautioned or sentenced (Others) after their DNA was sampled.