
Ethical, Social and Policy Aspects of Forensic Genetics: A Systematic Review

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Newcastle upon Tyne, UK, 15 May 2014

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CHAPTER 1: INTRODUCTION AND BACKGROUND

The EUROFORGEN Network of Excellence has brought together some of the leading individuals and groups in European forensic genetic research in order to ‘develop a network of excellence for the creation of a European Virtual Centre of Forensic Genetic Research.’ The Network aims to further existing collaborations in this field of research and operation as well as improve knowledge of innovations in forensic genetics amongst potential users, policy makers and the general public. Like all European Union Commission Framework Programme 7 activities, the Network pays particular attention to the social contributions that may be delivered through scientific and technological developments. In the case of EUROFORGEN, these contributions are aimed at ensuring the security of citizens through the application of forensic genetics in support of criminal investigations and prosecutions.

This review contributes to one of the Network’s goals – to map the landscape of recent and contemporary social, legal and ethical debates about forensic genetics in Europe and beyond. In this publication we consider recent social and ethical commentaries on the criminal justice uses of innovations in forensic genetics, giving attention to the variety of standpoints that can be found in such commentaries. Further publications of Workpackage 4 will provide an account of current European legislation in this area as well as offer ethical guidelines for those researching and using forensic genetics in European criminal justice contexts.

One perspective in contemporary security debates has celebrated each of the many new developments in forensic DNA profiling and databasing that have occurred over almost three decades of scientific and investigative work as contributing positively to the exoneration and the conviction of criminal suspects (Townley and Ede 2004; Bramley 2009). This perspective is supported by the argument that scientific advances are able to more effectively support investigations wherever legislation permits criminal investigators to take, use and retain biological samples from a large number of crime scenes and from many categories of individual subjects. The acceptance of this argument has led to a strong – global – expansionary tendency in which relevant authorities in more jurisdictions collect and retain samples and profiles from an increasing number of people in searchable forensic DNA databases. In some cases, analysis of this process has led to claims that the establishment of ‘universal’ DNA databases would be a desirable innovation. For example, Kaye and Smith (2003) have carefully considered the cases for universal forensic DNA databases. A.M. Cutter

(2006), writing about the development of forensic genetics in general, has described the common view that “[i]f it can be shown that (a) the innocent have nothing to fear; and (b) that society has much to gain, then the application of the technology in question is acceptable”, and Barry Scheck has referred to the usefulness of large databases as facilitating the ‘prospective exoneration’ of some criminal suspects.

However, various academic, legal, and civil society groups, especially those that have applied to the forensic field older bioethical anxieties concerning the collection and use of human genetic material, have reacted more critically to the increasing uses of forensic genetic technologies. Central to these more critical standpoints has been a concern with the potential effects of the increased surveillance of citizens made possible by the expansion of forensic DNA profiling and databasing, as well as questions about what agencies will have research and operational access to a variety of sources of DNA samples and profiles, and for what purposes. Concerns have also been raised about the governance of this new domain, especially in light of the typically restricted participation of non-police actors in key policy and decision-making fora.

This review does not seek to take sides in the commonly encountered binary divide in arguments about forensic genetics, a binary between benefit and risk, or between promise and threat. However, it does present some of the recurrent arguments and concerns about innovations in forensic genetics and their operational applications. Colleagues who read this report may feel that we spend too much time considering critical voices in recent and contemporary social, ethical and policy considerations of innovations in forensic genetics. Our view is that those who wish to foster the innovation process in this sensitive area can only benefit from a fuller knowledge of the kinds of reception – both critical and supportive – that actual and potential innovations have already received. A simple re-iteration of an intention to support justice needs to be supplemented by a willingness to engage with critics who may agree with the intention but differ on what are appropriate ways to deliver this support, or who focus on the unintended consequences of scientific and technological innovation.

There is a need for criminal justice actors, policy makers and publics to be better informed about the developing uses of forensic DNA, and there is also a need for those involved in the development of science and technology in this domain to engage more fully with civil society organisations, policy makers and publics across the European Union. This report seeks to contribute to the furtherance of this engagement.

Innovation in Forensic Genetics

One of the difficulties for criminal justice users, policy makers and publics is that forensic genetics is a rapidly developing field of applied science. Since its first appearance in the work of Alec Jeffreys, who with colleagues observed the existence of hypervariable polymorphic 'minisatellite' regions in the human genome (Jeffreys, Wilson, and Thein 1985), it has taken a number of different but complementary directions, and its deployment in investigations and prosecutions has increased markedly. DNA 'fingerprinting' using Restriction Fragment Length Polymorphisms (RFLP) was first used in the criminal justice system to support the investigation of the murders of Dawn Ashworth and Linda Mann in Leicester, UK, leading to the exoneration of the suspect Richard Buckland and the subsequent conviction of Colin Pitchfork in 1987.

RFLP requires a relatively substantial DNA sample for the production of reliable results (Goodwin, Linacre, and Hadi 2007), but the development of the Polymerase Chain Reaction (PCR) technique in the second half of the 1980s (from Mullis et al. 1986, onwards), meant that small DNA fragments could be copied many times in order to increase the material available for analysis from the original sample. As PCR techniques were further improved, more degraded and smaller amounts of DNA became amenable to analysis, and automation improved the overall efficiency of DNA profiling. These innovations have facilitated the increasing use of DNA profiling for criminal and other forensic investigations, including work on compromised or heavily degraded samples (e.g. Gill et al. 1994).

In England and Wales, the analysis of short tandem repeat (STR) polymorphisms was first utilised in a murder investigation in 1990, identifying 8-year old skeletal remains of missing Karen Price by matching DNA extracted from bone to that of her parents (Hagelberg, Gray, and Jeffreys 1991). Other early cases relying on STRs also focused on the identification of remains, including the efforts to identify bodies following the events at Waco, Texas (Clayton, Whitaker, and Maguire 1995). Since then, STR techniques have become the technology of choice for forensic DNA profiling around the world, being used both to exonerate and convict suspects, and also to overturn previous convictions. The development of STR multiplexes for the collection and comparison of DNA samples has subsequently facilitated the establishment of national forensic DNA databases, the first of these (the National DNA Database of England and Wales, NDNAD) being created in 1995. The use of such databases, enabling the ordered collection and retention of suspect DNA samples and making these easily accessible for comparison with DNA traces found at crime scenes, have subsequently become essential features of modern policing. The adoption of another type of STR analysis in forensic work using the Y-chromosome (Y-STRs) has further expanded the capacity of DNA profiling. The first

criminal justice case of its use contributed to the exoneration of an already sentenced rape suspect in Germany in the early 1990s (Roewer and Epplen 1992; as cited in: Jobling and Gill 2004, 740).

Mitochondrial DNA (mtDNA), an alternative 'lineage marker' adopted by forensic genetics, can complement autosomal STR multiplex analysis. Forensic mtDNA analysis is applied in order to scope familial relationships between mother and child (Goodwin, Linacre, and Hadi 2007, 125-130) and is particularly helpful in identifying victims in cold/historical cases, or in cases where certain types of DNA material are not discovered at the crime scene. This type of marker was first used as part of hair analysis in a murder case in 1992 in the UK (Jobling and Gill 2004, 740-747). The first forensic mtDNA use in a court featured in the US murder case of Paul Ware in 1996 (Houck 2009, 125).

More recent advances in understanding single-nucleotide polymorphisms (SNPs) also have utility in forensic analysis. These are mutations of base pairs, some of which may be associated with genes influencing the physical development of humans (Amorim 2011; Amorim and Pereira 2005; Budowle and Van Daal 2008). Research and development in this domain are on-going; for example, a private-public collaborative SNP Consortium (TSC) has been working on providing a public resource of mapped SNPs since 1999, and has turned towards studying the utility of SNPs in detail (Thorisson and Stein 2003).

Forensic genetics in society

This increasing mobilisation of DNA profiling in many criminal justice systems has produced a wide range of novel social institutions – not least the DNA database used for criminal investigations and its governing bodies and legislation – and stakeholders involved in crime detection and prosecution. Stakeholders range from policy makers to police, lawyers, judges and juries, from forensic scientists in academia and police laboratories to ethics and advisory groups that are part of the governance of forensic science, and from public to commercial providers of forensic services. Over the last few years, commercial actors have contributed to the further development of DNA analysis by exploring more numerous STR loci and developing more reliable multiplexes. In some jurisdictions, where commercial actors have also become more closely involved in case work (as in England and Wales) their role has given rise to particular concerns over how to preserve public confidence in a supply framework that might otherwise be seen to be unacceptably market-driven, a problem which was anticipated some years ago by Paul Roberts (1996).

In the United Kingdom, two major agencies – the Nuffield Council on Bioethics, and the Human Genetics Commission – have both published substantial reports on the legislative and operational developments in DNA databasing that occurred in England and Wales between the establishment of

the National DNA Database in 1995 and the decision of the Council of Europe's European Court of Human Rights (ECtHR) in the case of *S and Marper v UK Government* (Council of Europe 2008). In addition, the monitoring group Genewatch UK has also been actively interrogating official statements and statistics on the National DNA Database for a number of years as well as appearing before the several parliamentary House of Commons Committees that have inquired into aspects of forensic DNA profiling and databasing in England and Wales. In the United States of America (USA), the American Civil Liberties Union has frequently commented on the state and federal expansion of DNA collection and retention (cf. Krinsky and Simoncelli 2011).

Elsewhere in Europe criticisms of expansionary DNA profiling regimes have been voiced sporadically and in an insular manner, for example by the activist German 'Campaign against DNA collection frenzy' (Gen-ethisches Netzwerk e.V. 2011). The Hungarian Civil Liberties Union has to some degree contributed to the Hungarian parliamentary debate into surveillance and data protection of human genetic data (Hungarian Civil Liberties Union 2008). Other examples include the Greek National Commission for Human Rights who in 2009 responded to Government proposals on DNA analysis and profile retention for Greece, and the Irish Human Rights Commission which responded to the DNA Database Bill for Ireland in 2010.

When biological materials or the information derived from them, are used to support criminal prosecutions in common law traditions, the adversarial character of judicial hearings are inevitably used to raise questions of the confidence to be credited to the authority of the underlying science or the standards of its technological application by particular practitioners. Forensic science policymakers and practitioners are especially sensitive to this last issue and, for this reason alone, may be forced to adopt highly risk-averse approaches to some of what might otherwise seem highly promising forensic bioscience innovations. Whilst inquisitorial systems may not be subject to this particular contingency, there is no evidence that innovations in forensic genetics have been applied more widely in such contexts.

These judicial and policy features remind us that, whilst the theories and practices of forensic science and its practitioners in the laboratory matter greatly, the 'matters' of science are not confined to the laboratory tools, techniques, coats and walls (e.g. Latour 1983, 1987). Sheila Jasanoff has recently reminded us that when we consider the history of scientific endeavour we should ask 'not only who wins and who loses in particular struggles over representation, but who benefits, to what ends, by what means, and at how great a cost. Studies in this vein allow the researcher to examine the interplay of structure and agency, to investigate how issues get reframed and new identities or solidarities emerge, and to acknowledge that matters of fact are not the only matters of

concern to people' (Jasanoff 2012, 439-440). Scientific and technological developments emerge and are tested in what Barry (2001) has termed the 'technological society', and in another use of the term, Sheila Jasanoff has suggested that it would be useful to approach 'social controversies as laboratories for studying how science and technology work in society' (Jasanoff 2012, 439). This report considers some of the controversies about innovations in forensic genetics by reference to Jasanoff's suggestion.

EUROFORGEN in the European Science Context

The societal dimension of forensic genetics includes also the regimes of its research and funding. The EUROFORGEN Network of Excellence is a European Framework Programme (FP) project. European research efforts, via the European Research Council (ERC) and the European Commission, including the Framework Programmes (particularly since their sixth instalment), aspire to foster the development of a European identity via pan-European research – the European Research Area (ERA) – whilst building the knowledge and skills basis for commercially competitive knowledge-based European markets. Research supported under the Framework Programme has contributed to the European Union's Lisbon Agenda (since 2000) and its Europe 2020 strategy (since 2010). Part of this European identity-building is the understanding that contemporary society operates as a laboratory for developing, testing and applying science and technology, including our attempts at forecasting, utilising, and governing these (cf. Krohn and Weyer 1994; Nordmann 2009).

Arguably, the almost ubiquitous neoliberal discourse, emerging in the 'West' in the 1980s and leading towards a stronger contemporary alignment of regulatory, political and industrial interests (e.g. Abraham and Ballinger 2012; Lave, Mirowski, and Randalls 2010), provides the backdrop to the commercial aspect of European public funding towards competitiveness and is embedded in the perception of the 'technological society'. Whilst the generous European support for research is a positive development, the alignment of a European identity with neoliberal discourse and its implied commercial prerogative may need to be tempered in the context of sensitive research, specifically in its applications to security and justice issues, to which EUROFORGEN is aiming to contribute.

Framework Programme projects are expected to work towards a specific societally relevant goal (not just 'technological convergence' per se), for example around fishing, ageing, energy, or security. This approach has been framed elsewhere in terms of 'grand challenges': basic and applicable – upstream and downstream – research that addresses recognised societal needs. Accordingly, FP projects are tasked to incorporate social and humanities research as well as some form of public

engagement and deliberation as an element of addressing research legitimacy through increased transparency and inclusivity, and as part of the European shift towards ‘Responsible Research and Innovation’ (RRI) (cf. Owen et al. 2009; Owen and Goldberg 2010; von Schomberg 2011). RRI aims to overcome the perceived ‘lag’ between innovation – research and introduction to the marketplace – and its governance. A vital element of this approach is the development of socially responsive research that follows good practice of effective and ethical conduct, a task policy makers of the European Union have emphasised for research supported by the EU (e.g. Geoghegan-Quinn as cited in: Owen, Macnaghten, and Stilgoe 2012, 753; von Schomberg 2011). Furthermore, the European research agenda aims to avoid narrow (scientist/positivist) definitions of technologies and their use – as exemplified, for example, in the view of cognitive science as engineering for the mind, not of the mind (Nordmann 2009, 294). Similarly, the scientific and technological developments around DNA profiling need to help authenticate, yet not prescribe identities to individuals or population groups (more on this later). Technology development needs to be considered in the context of service to society – its ideas framed by societal concerns, thus expanding and adapting boundaries of human agency.

Research undertaken in EUROFORGEN pertains largely to the European shared competency Area of Freedom, Security and Justice (AFSJ) – this area loosely represents what used to be the third of the three pillars constituting the European Union as a supranational body – ‘Police and Judicial Co-operation in Criminal Matters’ (until dissolution of this competence structure in the Treaty of Lisbon 2009). Specifically for forensic science, the Council of Europe – at their Justice and Home Affairs meeting in December 2011 – has developed a ‘vision for European Forensic Science 2020’, primarily discussing the creation of a ‘European Forensic Science Area’ and developing a ‘forensic science infrastructure’ for Europe. Part of this vision is the harmonisation of producing, sharing and using forensic data, and training for stakeholders involved in the forensic space – towards creating ‘forensic awareness’ – across the member states. Forensic science is here embedded in discourses of anti-terrorism activities, of fighting organised crime, and prosecuting criminal activities in the narrower sense. Contributing to this agenda, specifically as part of a European forensic infrastructure, is the European Network of Forensic Science Institutes (ENFSI) and its development of a European Standard Set (ESS) of markers (Welch et al. 2012), in which a number of colleagues of EUROFORGEN are involved. The development of such a set may enhance cross-border collaboration and cross-national recognition of laboratory tests, a significant aim of the vision for European Forensic Science 2020 and its accreditation policy for forensic service providers in member states. The exemplary efforts around ESS are influenced by the development of a Law Enforcement Information Management Strategy, which is being considered in order to improve the management

and sharing of digital data (González Fuster, Gutwirth, and de Hert 2009; Informal High Level Advisory Group on the Future of European Home Affairs Policy ('The Future Group') 2008) in the European Union. Such a strategy has implications for forensic genetic data processing, retention, and sharing.

It has become commonplace to talk about a complex world of which uncertainty is a fundamental aspect. Experiences of catastrophic moments including terrorist attacks, the breakdown of the rule of law through civil unrest, and the effects of organised crime – provide catalysts for increased security efforts, and the development and deployment of surveillance technologies that can increase 'visibility' both pre- and reconstructively (cf. Valier 2001). A range of projects responding to such uncertainties have formed part of the European research agenda on Policing and Justice over the years. In Appendices 1 and 2 we provide a brief list of some of those projects that include social, ethical, and policy studies relevant to our interests in the uses of science and technology in support of justice and security. Whilst none of them cover the same ground as EUROFORGEN, many of them re-visit the relationship between privacy and security, and also pursue an interest in the role of public trust and the protection of fundamental rights in and through the maintenance of personal safety and collective security. In other words, they advance beyond the relatively sterile debate between what seem to be opposing values, and instead consider some of the more nuanced aspects of the relationship between individual and social goods. In addition, they raise the more general issue of the relationship between social ambition and technological innovation across a number of domains as well as that of technology governance. The following chapters will consider some of these issues as they arise and are dealt with in the context of forensic genetics.

CHAPTER 2: THE INNOVATION TRAJECTORY OF FORENSIC GENETICS

Forensic genetics is a field with particular sensitivities and public-private interests as it can interact significantly with the ways in which we understand ourselves as biological beings as well as how we perceive and construct societal relationships. Cho and Sankar (2004) point to previous experiences with medical genetic research and its implications in their argument for integrating the analysis and review of ethical, legal and social aspects (ELSA) of scientific research and development of novel techniques and technologies around genomic information. Equally, the British experience with genetically modified (GM) crops in the 1990s – that is its public rejection of application and subsequent consumer products – is an example of innovative and sound science and technology developed without considering widely held cultural perceptions and notions about food, eating and nutrition as well as the notion of ‘nature’ and what is ‘natural’ in food. These aspects all concern the human body and the embodiment of certain human assumptions, expectations, and practices. The development and application of GM research had also become part of a complex network of discourses around the politics of food including crop seed use and fighting hunger, in which commercial aims of organisations funding GM research, and conflicting rationales about ending world hunger, had become detrimental to the perception of the research as beneficial, or even as benign.

Fundamental social and cultural concerns about nutrition, eating habits, food safety, and the contribution of science to these, are comparable to those of providing societal safety and security through the implementation of forensic genetics technologies and its interrelations with social and cultural practices around the human body and its integrity. It is widely acknowledged that the collection, retention and use of various kinds of biological materials, usually without the consent of those from whom they were taken or retrieved, along with the information routinely derived from them, raises significant governance questions. These policy and practice questions have traditionally focussed on the establishment, exercise and monitoring of powers necessary for the effective and ethical collection and use of such materials, and the balance between Governmental use of these powers and the rights – to autonomy, liberty, privacy and justice – of individual subjects.

Innovations in forensic genetics mobilise, are shaped by, and are evaluated with reference to, a series of promises and expectations about their capacity to provide social benefit and/or to supplement existing knowledge and its practical application. The literature that describes and

promotes these innovations unavoidably co-mingles scientific claims about the power of new and emergent DNA profiling and matching technologies with assertions about the nature of social order and the operation of social institutions. In this sense there is a complex and recursive relationship between matters of scientific fact and matters of social value – particularly so in the case of applied practices like those of forensic genetics. Jasanoff (2004) and others have focussed attention on this integrated process by reference to the notion of ‘co-production’, in order to emphasise the way in which epistemic and normative expectations and outcomes are embedded in scientific and technological accomplishments, as well as the ways in which legal and political concerns help shape such developments. Scientific innovations are simultaneously social innovations, and cannot be properly understood without reference to that fact. Scientific advances may provide a foundation for new social arrangements, but these advances themselves are made possible only by the mobilisation of extra-scientific material, social and cultural resources and imperatives.

In his analysis of ‘personalized medicine’, Richard Tutton (2012) employs the approach of the ‘sociology of expectations’ to describe why and how various stakeholders have considerably invested – both discursively and materially – in an emergent field such as pharmacogenomics. Tutton argues that the temporality of expectations, firmly embedded in social and scientific contexts, plays a central role in this investment:

[Scholars of the sociology of expectations] recognize that disappointments and failures are inescapable features of innovative science and technology: but expectations are often rearticulated in relation to changing material conditions in ways that can be generative of new research agendas and renewed cycles of investment (Arribas-Ayllon, Bartlett, & Featherstone, 2010). Brown and Michael (2003) in particular examine how scientific actors recollect ‘past futures’ that characterized their science. They explore what these scientists then did in the present with these recollections through their incorporation into constructions of present futures. (Tutton 2012, 1722)

On the example of medicine and healthcare, Tutton argues that the privileged place for research laboratories in these fields has emerged through the material and symbolic investment into promises that laboratory sciences can transform and improve medical practices, both scientifically and socially (*ibid.*, 1723). Spaces of controlled experimentation and testing have from the 19th century onwards promised a shift away from a medical practice that, for one, had relied on untested tools and techniques, and for another, had emphasised the uniqueness of the patient’s body and mind and as such side-lined the possibilities of universal medical research and general healthcare. Expectations as to the nature of the patient – and the best treatment medically and socially – have

found reiteration in recent medical narratives, yet in different forms. Whilst early laboratory-informed clinical practice promised to provide treatment for large population groups, the 'patient-as-a-person' movement re-mobilised the individual nature of health care and emphasised the special doctor-patient relationship proponents saw obscured through formal impersonal lab technologies in the early 20th century. More recently, 'past futures' of this binary of 'individual' and 'population' have been 'recycled' in promises that understanding the individual nature of the human metabolism – and even more recently, a person's genome – would result in very specific and effective medical treatments. Tutton's study shows how scientific and social developments co-produce an applied field through the reimagining of persistent categories around the individual and the population. This repertoire of material and discursive imaginaries is adaptable and evolves around the improvement of the application of research for, and in, healthcare. What we can directly draw from this analysis for DNA profiling and databasing is recognising the similarity of shared imaginaries that play out in the process of identifying a trace (an individual) by drawing on shared population characteristics.

Tutton's and other diverse studies in the sociology of expectations (Borup et al. 2006; Brown and Michael 2003; Brown et al. 2000; Hedgecoe and Martin 2003; Hedgecoe and Martin 2008; Lente 1993; van Lente and Bakker 2010; Martin et al. 2008; Selin 2007) are relevant to appreciating how advances in science and technology are produced. For EUROFORGEN and forensic genetics this relates to how advances are established in, and transported across, jurisdictions within narratives about improvements in the delivery of robust 'facts' and evidential 'truths' about crimes and the individuals involved in them. In such promissory contexts earlier procedures are often characterised as limited, deficient or problematic whereas the emergent present or future is narrated in beneficial terms of improving these problematic pasts, a performance constituted by the 'dramatization of the new' and its 'corresponding normalization' (Tutton 2012, 1722), similar to what Kevin Burchell has described as 'argumentative switching' between the novel and the established aspects of a technology in the boundary work of applied science (2007).

The dynamic processes of socio-scientific interaction in general, and the role of promise in these processes in particular, are easily visible in the historical trajectory of forensic genetics. In the course of this trajectory, the longstanding desire of a range of criminal justice and other agencies for credible methods for validating the identity claims of present persons and inferring the identity of absent persons has both responded to and shaped the scientific work carried out in relevant laboratories and other research sites. Whilst some scholars argue that the focus on progress (and social and commercial competitiveness), and the accompanying overly promissory nature of

narratives of technology development, may diminish an attentiveness to ethical issues (e.g. Beck 1986; Jonas 1979), there has been no shortage of such attentiveness in the wider social responses to developments in forensic genetics and their use in investigations and prosecutions. The promissory narratives of some – policy and commercial – advocates of the expanding uses of forensic genetics have often been contested by social actors outside the scientific, policy and commercial networks that are directly involved in promoting relevant innovations. Whilst utopian narratives may have dominated some accounts of this history, civil society and academic groups have often offered dystopian counter narratives in which the uses of forensic genetics and their consequences are imagined quite differently.

It is useful to think of the history of this process as consisting of three separable but related waves of innovation, waves that have carried forward distinctive scientific and technological promises and achievements. At some times and in some places these waves have been given additional energy by particular legal, social and ethical impulses, whilst at other times and places, legal, social and ethical responses have reduced their potential for use within different criminal justice contexts.

First Wave: from Inauguration to the end of the DNA Wars.

The first wave of forensic genetic innovation had a very precise beginning. Alec Jeffreys has described the ‘Eureka Moment’ at which he viewed his first ‘DNA fingerprints’ of several individuals, noting the detailed similarities and differences between each ‘fingerprint’ as having occurred at 09:05 on 10 September 1984. Whilst Jeffrey’s initial discoveries were made without relevance to their forensic utility, the potential applications of the technology to criminal justice were almost immediately envisaged by him and his close collaborators. Particular individuals in the UK Forensic Science Service, as well as members of key international commercial organisations quickly saw the potential in Jeffrey’s work, and his original RFLP (restriction fragment length polymorphism) reliant approach was utilised to support investigations in a number of criminal cases. Following these primary events, a series of additional socio-legal considerations and a range of institutional interests became central to the way in which this field of technoscience developed. Lynch and McNally (2009) have captured this dynamism in their coinage of the term ‘biolegality’ in an account of the development of DNA profiling and databasing. There, the authors describe the interdependence and convergence of biotechnological and legal aspects in the criminal justice system by exploring how biotechnological innovations have enabled the setting up of DNA criminal databases, whilst in turn legislative change has enabled the police use of such databases:

Biolegality refers to how developments in biological knowledge and technique are attuned to requirements and constraints in the criminal justice system, while legal institutions anticipate, enable, and react to those developments. This ongoing process redefines the rights and status of the suspect body and the identity and credibility of criminal evidence.

Biolegality has been used to describe novel and emergent identity categories at the interfaces of biotechnology and legal regimes (Atkinson, Glasner, and Lock 2009; Machado, Santos, and Silva 2011) whilst Chris Lawless (2012) reminds us – on the case of Low Template DNA usage in the courtroom – that ongoing controversies in science and law around DNA profiling and databasing remain a significant aspect of biolegal processes.

Controversies were at the heart of the first wave, generally described as a period of ‘DNA Wars’ (Cole 2004; Lempert 1996, 1997; Lynch 2003), a term which alludes to the similarly named ‘gene wars’ around the Human Genome Project (e.g. Cook-Deegan 1994). There were significant Defence challenges in some of the early court cases involving the statistical basis for determining DNA profile matches, the most conspicuous of these being the trial of Joseph Castro for the murder of Vilma Ponce and her two-year old daughter in 1989 (cf. Jasanoff 1995; Lander 1992). It was also claimed by some critics at the time that poor knowledge of DNA profiling and matching procedures amongst advocates resulted in fewer challenges to this emergent technology than might otherwise have been expected. Details of a variety of courtroom disputes in the United States and in the United Kingdom (where many of these issues were first raised) can be found in two authoritative accounts of this period in biolegal history, the first by a legal scholar especially concerned with developments in the United States (Kaye 2010), the second by a group of Science and Technology Studies scholars which examines the history in both jurisdictions (Lynch et al. 2008). Both accounts show how a number of changes in extraction, analysis and visualisation methods all contributed to the willingness of judicial and scientific authorities to support the general acceptance of subsequent STR (short tandem repeat) profile construction and matching as the workhorse technology of forensic genetics across the globe.

In addition to questions concerning the construction and matching of DNA profiles, arguments quickly developed over estimates of the random match probabilities relevant to assessing the significance of the matches found between DNA profiles in the course of investigations and prosecutions. Disputes on this matter – based on knowledge of population genetics – continued for some time, The resolution of the theoretical disputes surrounding estimates of random match probability proved more difficult, especially but not exclusively in the United States, and was eventually achieved only by the use of a standard technique for settling scientific controversies, the

establishment of an expert committee of the US National Academies of Science and the publication of their agreed report and policy recommendations. In this case, a first report published in 1992 (National Research Council 1992) was subject to further academic criticism, leading to further review and negotiation with a subsequent publication of a second report (National Research Council 1996). This report signalled an end to significant controversy over this aspect of forensic genetics (Koehler 1997; Lander and Budowle 1994; Lempert 1997; Roeder 1994; Weir 1996).

The interplay of scientific, technological, legal and social issues within the first wave centred largely on the establishment of the credibility of DNA profiling and its case-based uses. The strength of its scientific foundations has never seriously been disputed, although questions of the quality of laboratory processes and other issues relating to sample collection, preservation, contamination and so forth, recur whenever the wave reaches new shores. There also remain some controversies concerning the interpretation of some profiles (especially mixed and incomplete profiles) and over the use of 'low template' technologies. Accordingly, prosecutors in different jurisdictions vary in their willingness to utilise these to support court cases.

Second Wave: The Establishment and Expansion of DNA Databases

The last 20 years have witnessed an increasing number of criminal jurisdictions in which forensic DNA databases have been established – usually, but not always, on a national basis¹. These hybrid scientific-legal innovations have usually required legislative changes and the provision of additional funds to create and populate such databases with profiles obtained from known subjects and those obtained from biological material recovered from crime scenes. Particular commercial actors – largely but not exclusively biotech companies – have also been prominent advocates and supporters of these state criminal justice ambitions, and their interests have matched the enthusiasm of many prominent policing agencies. Proponents assert that forensic DNA databases enhance the public good because they: have the potential to make speedy and robust suspected offender identifications through automated profile comparisons in centralised criminal justice databases; provide the ability to confidently eliminate innocent suspects from investigations; increase the likelihood of generating reliable and persuasive evidence for use in court; reduce the cost of many investigations; provide a

¹ For an overview of European DNA databases see: F. Santos, H. Machado, S. Silva (2013) Forensic DNA databases in European countries: is size linked to performance?, *Life Sciences, Society and Policy* 9 (12) doi:10.1186/2195-7819-9-12.; and the ENFSI website at <http://www.enfsi.eu>, for example the ENFSI DNA Working Group DNA Database overview from December 2013 at: http://www.enfsi.eu/sites/default/files/documents/enfsi_survey_on_dna_databases_in_europe_december_2013_1.pdf

likely deterrent effect for potential criminal offenders; and increase public confidence in policing and in the wider judicial process (Fereday 2004; Home Office 2009).

On the other hand, civil society actors and academic commentators from a variety of nation states have argued that there exist significant threats to the privacy of those whose DNA profiles are obtained and used for particular investigations, and in some cases retained on forensic DNA databases for varying periods of time (e.g. Genewatch UK 2005). Privacy concerns are magnified when considering the retention of profiles, and samples taken, without consent from those who were not subsequently brought before the courts, or when prosecution cases against them have failed to establish their guilt. In such circumstances, it may be difficult to justify the breach of their privacy represented by the retention of their biological samples and the profile data obtained from them, let alone the continuous speculative searching of these data against all newly loaded DNA crime scene samples.

Insofar as DNA profiling in particular represents a new 'borderless body technology' (Gibson 2001) in which conventional understandings of the body are increasingly challenged 'in the name of control, regulation and predictability' (Ball 2005), then it is argued that the efficiency of its investigative and prosecutorial uses has to be balanced against more general considerations of the ethical issues that surround this new form of body knowledge. Finally, at a community level and from a sociological perspective, Troy Duster (2003, 2004, 2005, 2006b) and others have noted the ways in which criminal justice DNA databases re-inscribe prior differences in the treatment of minority groups by the police and, in doing so, pose new threats to the already excluded.

For these, and other related reasons, legislators and regulators in many jurisdictions have carefully deliberated which categories of persons should have their profiles taken, against what existing profiles these 'subject' profiles should be speculatively searched and, whether and for how long, which subject profiles should be retained on DNA databases (for early accounts of these issues, see for example Nelkin and Andrews (1999) and Lazer (2004). There is ongoing debate in many societies about what inclusiveness and retention regimes should be applied to forensic DNA databases.

A further development in this wave of innovation has been less concerned with the expansion (or restriction) of the categories of individuals whose DNA profiles are retained on such databases but more concerned with ensuring the availability of legally held information across criminal jurisdictions. Increased police responsiveness to the existence of cross-border crime as well as a focus on issues of national security have been the engine for new arrangements for the exchange of DNA intelligence between investigators across the European Union and beyond (McCartney,

Williams, and Wilson 2010; Johnson and Williams 2007; Prainsack and Toom 2010). These international regimes are in constant development and have raised additional concerns for some national and international actors, especially those with a focus on data protection issues.

Third Wave: Inferring Personal Characteristics from Crime Scene Samples

A third wave of forensic genetic innovations has been building for some time; like some aspects of the other two waves, it is ongoing, and its current energies are being felt differently across the globe. It is difficult to assign to it any simple starting point in the form of a scientific discovery or the creation of a new social apparatus. In place of these origins, the various efforts that together constitute this third wave have a single pragmatic source: the fact that all existing criminal justice forensic DNA bases are less than universal. This fact means that when genetic information has been derived from biological material left at crime scenes, and there are no matches between profiles obtained and profiles already held on such databases, there remains scientific interest in the creation of potential investigative value through the expert interrogation of that material. This value is created by making reliable and contextually relevant inferences about the person who deposited it. These inferences may be used, for example, to inform the direction of an investigation, to adjudicate between competing accounts of the same event, to choose between alternative witness statements, or assist in the production of information released to the public. All of the methods deployed in support of the effort to create such value provide supplements or alternatives to the preferred rigid designator of STR multiplexes since in these cases the rigid designators have not matched any already held on databases or otherwise derived from individual samples. Instead, they promise to specify common but differentiated personal properties – of relatedness to others, or of features of visual appearance. A promise which itself reminds us that forensic genetics has always sought to distinguish itself from the assertions of some other forensic fields to search for ‘discernible uniqueness’ but instead always to operate in terms of ‘genotypes’, ‘haplotypes’ and ‘phenotypes’ (Amorim 2012).

One preferred approach to this endeavour has been to utilise the workhorse profiling methods of forensic genetics with their focus on polymorphisms in intra-genic regions of the genome in order to search for a suspect by their possible family relatedness, or their membership of larger social collectives – especially ‘ethnic groups’. Whilst the first has proved investigatively successful, the second has proved less so. Forensic STR profiles show low inter-population variance and so are not ideal for predicting population of origin. They may also suffer from the fact that available information about population of origin may be defined in oversimplified or unstable ways – as in the case of entries on the Police National Computer (PNC), a shared intelligence database in the UK that

'holds details of people, vehicles, crimes and property that can be electronically accessed by the police and other criminal justice agencies' (see the website of the former National Policing Improvement Agency).

However, markers with greater power have emerged from studies of admixed populations for epidemiological purposes, or for mapping disease genes. Such Ancestry Informative Markers (AIMs) have been used for some time, and there is widespread interest in developing their deployment in forensic contexts. A variety of existing marker sets based on SNP arrays offer varying degrees of geographic resolution, and online data are available to those who want further to develop these sets and apply them to the forensic context.

A third related development in this wave puts to forensic uses technologies that claim to capture exonic information – data about functional genes – which can be used to predict, with varying degrees of specificity, visible characteristics of the persons whose crime scene samples have been analysed. Many human phenotypes – stature, facial features, and pigmentation – are understood to have a strong genetic component. Commercial and academic groups have been developing SNP tests for these features for some time in order to provide reliable predictors of common physical characteristics, in particular those characteristics that might be relevant to supplement or disambiguate eyewitness evidence available to criminal investigators in particular cases.

Commentary and observations on the scientific foundations for, and criminal justice uses of, these third wave developments have, so far, tended to parallel those offered on the earlier two waves. On the one hand there have been arguments that derive from 'investigative pragmatics' – a response to technical innovations which gives equal stress to their utility and to the fact that they should be understood as variants on more traditional ways of generating potentially useful information to support criminal investigations. These arguments stress the intelligence – rather than evidential – uses of such innovations, the necessity for careful explanations of their potential to investigators and a degree of sensitivity about their operational deployment.

On the other hand, a variety of dystopian arguments have suggested that there are potential social and cultural risks arising directly from currently known versions of these developments and/or from their possible extension, in particular the risk to vulnerable social groups that they become the subject of investigative attention in cases of serious and high profile crimes – and that that investigative attention feeds and exacerbates existing social and criminal justice disadvantages experienced by members of such groups. These arguments are still to be played out in a number of contemporary jurisdictions, but as might be expected there are different ways in which jurisdictional

authorities are seeking to govern the introduction of any or all of these innovations into criminal justice systems. Some may choose to do it by Command Regulation through National Legislation whilst yet others rely on organisational regulations devised by internal policing authorities – national or local – or other relevant agencies like the Forensic Regulator in the UK.

However, one important difference in the policy and legal responses to them derives from the very fact that they will not be used as evidence in criminal trials since any individual who is arrested, or charged as a result of their investigative use will be required to provide a biological sample from which a DNA profile can be generated and which can then be directly compared to the crime scene profile already held by relevant authorities. Always ‘intelligence’ but never ‘evidence’, third wave innovations create bio-legal (or bio-investigatory) resources that have different epistemic and criminal justice standings than those generated in the first and second waves.

Conclusion

At the beginning of this chapter we suggested that it is useful to think of three separable but related waves of innovation in forensic genetics, waves that have carried forward distinctive scientific and technological promises and achievements. Since the mid-1980s, scientific and legal developments have co-produced the field of forensic genetics as we know it today, and wider commentary has influenced the debate over DNA technologies’ societal utility, and the social and ethical values that its uses engage. It should be clear that, at some times and in some places, these waves have been given additional energy by particular legal, social and ethical impulses, whilst at other times and places, legal, social and ethical responses have reduced their potential for use within different criminal justice contexts. It is important to emphasize that the scientific foundation of forensic genetics has not been significantly challenged in the course of these commentaries. Instead, it has been the practices of applying such knowledge that have been at the heart of the debate.

In the next chapter we consider the two prevalent criminal justice models that mobilise, utilise and influence the application of the forensic genetics innovations that we have described above. We also discuss the standardisation processes that are intricately interwoven with these prevalent criminal justice models, and which feature in EUROFORGEN’s rationale and work plan.

CHAPTER 3: FORENSIC GENETICS, CRIMINAL JUSTICE MODELS, AND STANDARDISATION

In this chapter we consider the ways in which existing understandings of differing criminal justice imperatives have been reflected in, and supplemented by, the establishment of forensic genetics as a resource for both investigations and trials. We also reflect on the significance of the social and organisational process of standardisation in relation to these imperatives.

Forensic Genetics and Crime Control

A strong theme in the shaping of forensic genetic technologies and in discussions of their social and ethical acceptability is the – seemingly simple – notion that their existing and emerging applications improve the capacity of their State users to control crime. This theme instantiates a longstanding preoccupation with police uses of novel technological interventions of various kinds, including information and communications technology, surveillance equipment, weaponry and vehicles, as well as the expanding repertoire of forensic science. The use of these interventions, it is often asserted, will lend scientific and technological support to efforts to improve the effectiveness of crime detection, and may also contribute (although this may be more difficult to establish) to the deterrence or desistance of offenders, and to the safety of police officers and apprehended suspects (as argued for the use of Tasers and pepper spray). The historical context for this ‘scientification’ (Ericson and Shearing 1986) of policing, along with the extension of police powers required for its uses to control crime through effective detection, was the political necessity to confront rising crime rates in many jurisdictions during the second half of the 20th century, along with increasing awareness of, and attention to, the economic, social and emotional effects of crime (see Cohen (1985) and Garland (1996) for developments of the ‘crime control’ model in the UK and the US). Whilst crime control imperatives take into account certain social costs such as the limitation of individuals’ liberties, it is also seen as a way of securing the liberty of honest citizens through the protection of individual safety and state security. Recently, there has been an internationalisation of crime control considerations in efforts to counter cross-border criminality and terrorist threats. The European Union has witnessed the introduction of a number of distinct measures, some of which have direct relevance to the use of DNA profiling to assist investigations and prosecutions. One of these is the Prüm Treaty, a development which reflects the earlier Hague Principle of Availability by establishing infrastructure and procedures which make it possible for European States to share

particular forms of intelligence (Prainsack and Toom 2010). Amongst these cross-border exchanges is the exchange of DNA information, albeit under strict conditions. Another is the creation of the European Investigation Order (EIO) (The Council of the European Union 2010), suggested in 2010 and negotiated between the Council of the European Union and the European Parliament since 2011. Taken together, these measures expand existing police powers to include mutual cross-border investigative support that may require the use of genetic and other technologies for criminal investigation by authorities in one state in order to fulfil the investigative requirements of authorities in another state. The EIO itself goes beyond the data sharing agreements of the Prüm Treaty, leading to unease about a dominance of criminal justice functionality and forensic utility over civil liberties within and between different national jurisdictions (cf. Whitehead and Porter 2010).

The notion of 'investigative value' is a central good within crime control discourse, and much of the enthusiasm for advances in DNA profiling and databasing for support of crime control objectives, is informed by the assumed capacity of these technologies to add to such value. This assumption entails that new or enhanced investigative affordances are made possible through scientific and operational developments in the collection, analysis and uses of genetic material, producing intelligence in investigations and evidence to support prosecution. The development of DNA analysis techniques and national DNA databases, and the expansion of Police powers to collect, retain and use DNA samples in many European member states, reflect the crime control model's utilitarian approach to increasing the effectiveness and professionalization of crime investigation services through the exploitation of technological opportunities and operational improvements. It is regularly asserted that increased access to ever growing DNA databases, as well as investment in new DNA profiling technologies, will further enhance the capacity of Police to detect suspects quickly and unequivocally, and in this way contribute to the detection and reduction of crime and an improvement in public safety.

In an increasingly 'geneticized' and technological society such promissory narratives about technology have become commonplace. It is almost universally accepted that DNA intelligence and evidence can be technically superior to that provided by other forensic disciplines. Its basic assumptions are much better supported by peer research carried out in a range of contexts, and its routine practices have been subject to extensive external scrutiny (cf. National Research Council 2009). This technical superiority means – for the wider criminal justice community as well as for the general public – that DNA analysis can be expected to be able to deliver fast, clear and precise answers for the typical questions asked in the course of criminal investigations – what has been described as the 'CSI effect' of public perceptions of DNA analysis. This – imagined – capacity in turn

strengthens the perceived 'exceptionalism' of DNA, and its actual and promised role in criminal investigations (cf. Williams and Johnson 2004).

However, these expectations about effective crime control through DNA technologies have been contested by some critical observers (e.g. Barbour 2011; Cutter 2006; Genewatch UK 2005; McCartney 2006a; Murphy 2009). These and other critics have argued that the results of existing research have shown that it is much more difficult than is normally understood to establish the utility of various DNA profiling and databasing techniques and their impact on crime detection. Whilst crime control imperatives stress notions of efficiency (Duff 1998), relevant data have provided difficult to capture and hard to interpret (cf. Williams and Weetman 2012). This applies even to well-established technologies, let alone the more recent innovations such as familial searching, the use of ancestry-informative markers and those for inferring externally visible characteristics. Whilst several Annual Reports of the UK National DNA Database contained information concerning the increasing number of DNA matches following rises in the size of the database, and the UK Home Office reported enthusiastically on the increase in detections facilitated by the DNA Expansion Programme, the aggregate data used in these accounts is incapable of showing how particular investigative trajectories were supported (or not supported) by the availability of DNA intelligence. There have been no systematic case-based studies of the use of DNA in support of crime detection and prosecution in the UK since the Pathfinder study carried out between June 2000 and May 2001 and published in 2005. This is one of the reasons behind the recent Human Genetics Commission call for the development of a much more systematic approach to the measurement of 'forensic utility' to be applied to the evaluation of DNA profiling in the UK.

Researchers in Australia (Briody 2004, 2006; Briody and Prenzler 2005; Raymond, van Oorschot, Walsh et al. 2009; Raymond, van Oorschot, Gunn et al. 2009; Raymond 2010) and US-based studies have begun to provide much better data on the contribution of DNA to detections and prosecutions. One US study is based on a randomised control trial of the use of DNA profiling in support of property crime (Roman et al. 2008), and a second series of studies (Peterson et al. 2003a, 2003b; Peterson et al. 2010) is based on the analysis of a large number of case trajectories.

Due Process, Forensic DNA Profiling and Databasing

Law makers and law enforcers in contemporary liberal democratic societies recognise that criminal justice systems cannot be driven by crime control imperatives alone. Another set of imperatives are regularly brought into play alongside them, and – to an extent – also modify their application in

practice. These alternative 'due process' considerations require that the proper operation of a criminal justice system provides fair treatment and trialling of suspects and defendants, and strong measures to protect their rights in the judicial process of criminal investigations. Central to a due process focus is the ideal that the criminal justice system acts not to convict offenders – although that may be one of its outcomes – but to discern and adjudicate truthfulness and fairness in the administration of justice. From this perspective it is the Courts rather than the Police who hold definitive authority for the disposition of those suspected of or charged with criminal offences. Whilst the Police should be afforded relevant and legitimate powers to investigate possible offences and detect suspects, those powers, including the authority to draw on scientific expertise, must be 'balanced' with the rights of individuals guaranteed by civil society. Furthermore, where scientific intelligence and evidence play a significant role in contemporary criminal justice investigations, it is essential that courts are understood as the source of final authority in determining whether these forms of intelligence and evidence are based on valid foundations and reliable methods. Whilst forensic scientists have sometimes found the ways in which courts exercise this authority unresponsive to what they regard as principled scientific practice, and courts have sometimes struggled to cope with new science, the legitimate authority of the courts in these matters is an essential feature of the rule of law in modern democratic societies.

The forensic science community in general continuously faces both internal and external anxieties about the reliability and strength of its research base as well as some of its routine practices (e.g. Edmond 2012; The Law Commission 2011; M'charek 2000; National Research Council 1992, 1996). Inspired by such concerns, the recent review of forensic science by the US National Academy of Sciences (National Research Council 2009), and a FBI retrospective enquiry into all criminal investigations that have relied on forensic hair and fibre data and expertise (Hsu 2012; Liss-Schultz 2012), continue to threaten judicial and public confidence in some, although not all, forensic technologies. We have already referred to early challenges to the uses of forensic genetics in courtroom deliberations including the controversy of the US 1989 Castro case (Jasanoff 1995; Lander 1992) throughout which the presented DNA 'evidence' was challenged on the basis of non-standardised local DNA profiling practices that diverged considerably between US laboratories. An equally significant challenge to practices, but this time primarily pertaining to police management of forensic evidence, was made throughout the O.J. Simpson double-murder trial in 1995. Simpson's legal counsel Barry Scheck successfully challenged crime investigation processes and the 'chain of custody' for crime scene samples along with assertions about the inadequate standard of anti-contamination measure in the laboratory responsible for extracting and profiling relevant DNA samples. It is an inherent matter of fact and of concern that forensic work is 'messy'. Samples are

taken in inclement environments and can be partial, degraded, or contaminated. Physical laboratory-based sciences may consider the work with such materials – for example due to the nature of a crime, conditions at a crime scene, or owed to collection and storage practices of samples – as ‘impure’ technical rather than scientific work. Contamination, in practical rather than epistemic terms, is a concern in forensic work and has been raised by practitioners, users and courts (M'charek 2000; National Research Council 1996).

The significant message from Scheck's critique of DNA evidence in the O.J. Simpson case was that forensic genetic investigative and adjudicatory value are as dependent on the correct and transparent management of evidence as they are on the underlying science and its technological application. In fact, critics of the use of DNA evidence in particular cases tend to confuse the two concerns, often claiming ‘flaws in the science’, where errors could in fact be more accurately describe as ‘flaws in the handling of evidence’. Evidence handling is important for all kinds of forensic science, but the super-abundance and persistence of DNA means that particular care needs to be exercised within this domain. As tests have become increasingly sensitive, and knowledge of DNA persistence and transfer has grown, concerns have surfaced about the possibility of contamination in earlier cases; and some more recent cases have also been problematized. The advent of DNA technologies which are capable of generating profiles from vanishing small amounts of biological material has made the issue of potential contamination increasingly urgent.

In addition, judges and advocates have sometimes struggled with the reasoning practices of forensic DNA scientists, and – at least in the UK – the judiciary have not supported attempts by some advocates to educate fact-finders in Bayesian versions of these practices. The difficulty of engaging with the probability basis of forensic genetics is something that has been problematized constantly since the emergence of this field (Balding and Donnelly 1994; Koehler 2001; Koehler and Kaye 1991; Leung 2002; Thompson and Ford 1989), and was the basis of many of the first wave controversies resulting in the two US National Research Council reports. Due process considerations require expert scientists to be balanced in their findings in order to avoid prosecution or defence bias. Several US and UK groups have sought to provide clear accounts of the kinds of statistical reasoning preferred by forensic genetic scientists and expert witnesses in order to support efforts at proper balance (UK examples include: Aitken et al. 2010; Puch-Solis et al. 2012; The Forensic Science Service 2005; US examples include: Holder Jr. et al. 2012; Kaye and Sensebaugh 2011; Michaelis et al. 2008; Thompson and Krane 2003). Expert interpretations can be misleading, as argued in a recent piece in the UK Law Society Gazette:

‘The DNA profile from the handgun matches that of the suspect; the chance that some unknown person unrelated to the suspect would have the same profile is one in a billion.’ ... If the DNA had come from a close relative of the suspect then the chance of a match would be much greater than one in a billion – perhaps one in 10,000. Why not give that alternative? The reality is that the choice of an unrelated person for the alternative maximises the weight of evidence against the suspect. A balanced approach would not do this: indeed a balanced approach would not offer any evaluative opinion, or statistic unless the circumstances of the case implied a clear defence alternative (Evetts et al. 2012).

Yet despite such historic and ongoing procedural and methodological difficulties, it is obvious that the contribution of DNA profiling to the criminal law due process commitments of liberal democratic societies has been overwhelming positive. In addition to the uses of this technology to support the detection and prosecution of a significant number of serious crime cases (including a number of hard-to-solve ‘cold’ cases), its use in exonerating innocent individuals and righting wrongful convictions has also been a spectacular success. This has been especially so in the United States, where the US Innocence Project, founded by Scheck and Neufeld in the wake of the Simpson trial, has provided a model subsequently followed by individuals and groups in other jurisdictions. Whilst Scheck’s skills of advocacy were used successfully to question the credibility of DNA evidence presented during the Simpson trial, he and other participants in the Innocence Project subsequently have obtained judgements requiring the analysis, or re-analysis, of biological evidence retained from a number of previously contested convictions (Neufeld 2000; Scheck et al. 2000). In a significant number of these cases, DNA profiling has helped to establish that miscarriages of justice have taken place and that innocent people have been incarcerated, in some cases for long periods of time. Scheck in particular has become a supporter, not only of DNA profiling, but also of DNA databasing which he argues is capable of providing ‘prospective exoneration’ of individuals who otherwise might well become the subject of police suspicion and worse.

The increasing use of and reliance on forensic genetic technologies to detect criminal suspects and prosecute criminal offenders can both complicate and enhance due process issues. Courts require valid and reliable expert testimony that will assist finders of fact in making robust judgements of innocence or guilt; expert forensic genetics testimony is able to meet those requirements. Some aspects of these due process demands conflict with crime management imperatives, especially those that push police forces to pursue low cost and fast turnaround services. In turn, these desires can impact strongly on what should be science-based considerations of methodological requirements, and on the diligence of forensic practice. However, despite the tension between these differing

demands, there are some desiderata that are shared by both due process and crime control priorities. The next section turns to discuss one of these – the need for harmonisation and standardisation in techno-scientific processes in forensic genetics.

Setting Standards in Forensic Genetics

One of the key objectives of the EUROFORGEN Network of Excellence is the harmonisation of forensic genetic practices in Europe through the development of agreed work practices, common training, analytical tools and processes, and improved communication between a variety of stakeholders. The rationale for such harmonisation, and the development of ‘guidelines’ and ‘standards’ in forensic science, as in all similar enterprises, derives from social, politico-legal and professional considerations as well as scientific ones. It is for this reason that we include a discussion of standard setting in this report. Genetic data relating to criminal investigations are complex and can be ‘misread’ even by those working directly with them, for example if they are unaware of certain limitations to analysis outputs, or if sample handling and labelling are not executed meticulously (e.g. de Keijser and Elffers 2011; Schneider 2007). The ambitions of the community of forensic geneticists to ensure the quality of its work, reinforces its position as the most credible forensic science disciplinary group, and advances its relevance as an exemplar of how to which other forms of forensic science practice need to emulate.

This internal drive for standards and standardisation may often coincide with the demands of external stakeholders – policy makers and regulators, criminal justice actors, and the wider public – for the normalisation of forensic practice. The most obvious reason for a move towards standardisation is the understanding that poor scientific practices in a forensic lab can eventually contribute to miscarriages of justice (Thompson 1997, 2006, 2008). Considered in this way, the social process of standardisation is the engine which delivers promises of compatibility and comparability, and releases the collaborative potential of knowledge and skills across a specific domain. The labour-intensive process of developing and agreeing on a set of ‘good practice’, and the means to both ensure and govern it, is also a process of community building, of building internal social order. As part of this community, a shared material infrastructure of tools, techniques and processes is developed, as well as an economy of scale for a peer group that can engage with each other, and holds shared values of research, knowledge and skills, and their application. Good practice is also a measure of accountability, and proscribes processes in order to, for example, balance the potential of human error and ensure wider trust in the capacities of the community, and the specific

methodologies applied. Standards may be imported from other established authorities. In the case of forensic laboratories, the relevant laboratory standard is ISO17025, and laboratories that are not accredited to this standard will struggle to have their work accepted by most courts and many police forces. Even academic publications on innovatory genetic techniques regularly emphasise that findings originate from an ISO17025 accredited laboratory (for kinship analysis see, e.g., Børsting et al. 2012; Bugert and Klüter 2012; Dario et al. 2011; Schwark et al. 2012). Exceptions to accreditation requirements may exist, as can be seen in the recent UK experience in which police laboratories that have been formed (or reformed) since the closure of the UK Forensic Science Service in March 2012 have been given time (by the Forensic Regulator) to reach this standard whilst still being able to do conduct analyses in advance of its award.

However, such general standards are not able to deal properly with domain-specific divergences in practices, and where controversies arise within expert domains, key individuals or agencies within a field of practice often seek to impose locally relevant practices (e.g. the recommendations of the Paternity Testing Commission of the International Society of Forensic Genetics as described in Morling (2003). When there are no such agencies, or competing ones, then external authorities may seek to impose their own order. The National Research Council resolution of some early controversies in the United States led to a degree of standardisation which enabled forensic DNA experts to speak with a more confident authority in the court room, at least as far as the calculation of random match probabilities is concerned (Cheng and Yoon 2005; Fradella et al. 2003), and of DNA profiling in particular (Deftos 1994; Jasanoff 1995; Lander 1992). As new variants on existing technology emerge, the requirement for standardisation is continually revived.

One recent instance of ongoing debates about standardisation has been that concerned with efforts designed to increase the sensitivity of DNA profiling tests. In this instance, UK judicial questioning of Low Template DNA analysis (*R v Sean Hoey* [2007] NICC 49, 20/12/2007) led to a review commissioned by the Forensic Regulator. This review (Caddy et al. 2008) concluded that LT-DNA is 'fit for purpose', although it is generally agreed that confusion continues over how best to interpret its results. Subsequent efforts have been made to promote consensus on interpretation and reporting standards for such methods within a more general approach to the interpretation of DNA evidence in the UK (cf. Gill et al. 2012).

The operation of the standardisation process in forensic genetics is conditioned by the fact that it is a comparatively young field, existing in the context of increasing yet overwhelming and under-structured knowledge about the human genome. Some knowledge is appropriated from other fields of genetic inquiry and adapted for forensic practices. For example, at the moment short tandem

repeat (STR) loci remain the backbone of forensic genetics, but other marker types increasingly enter the field, such as single nucleotide polymorphisms (SNP) for work with contaminated DNA material, and for phenotypic predictors such as biogeographic ancestry and externally visible characteristics (e.g. Amorim 2011, 2012; Amorim and Pereira 2005; Budowle and Van Daal 2008; Kidd et al. 2011; Kidd et al. 2012; Pereira et al. 2012), and alu-insertion elements (e.g. Asari et al. 2012) or microbial markers. The question of which markers to use in forensic genetics, and in what circumstances, is influenced by existing requirements, for example by the fact that existing national and local DNA databases are based on specific STR markers, but also by the nature of the marker itself.

Existing standards of DNA profiling are more robust than those found in many other forensic science domains such as ear print comparison, voice and facial recognition, or some types of fibre analysis. In all settings, standards and standardisation processes mobilise expectations about the future of more reliable and authoritative forensic practices, and in this sense the theme of standards is permanently promissory. Standardisation efforts – both articulated and executed – draw on positive experiences of previous harmonisation of practice and validation. They are also mechanisms to build trust in desired outcomes. The dedication to such an undertaking as exemplified by EUROFORGEN reflects on forensic genetics as a field that aims to realise its potential and accept its responsibility beyond the scientific domain. Importantly, the standardisation of forensic practices cannot be achieved in academic isolation but only by understanding the requirements and expectations of forensic users, the wider criminal justice system, and the public.

Conclusion

Forensic genetics offers technologies that can contribute to policing and governance efforts on most places along the continuum of criminal justice models ranging between ideal types of crime control and due process. Recurring core themes connecting criminal justice approaches with forensic genetics technologies are effectiveness and efficiency, fairness of application, and transparency in use. The process of standardisation promises – and is expected to deliver – a positive impact on all of these themes by strengthening both the scientific value of the underlying science and technology and also its value for application in investigatory and judicial contexts. Whilst we have provided an introduction to understanding the interactions and co-production of bioscience and criminal justice here, the following chapters focus more closely on ethical and social dimensions of DNA profiling and databasing. In the first of these we consider the significance of several cornerstone reports which have shaped subsequent discussion of these matters.

CHAPTER 4: ETHICAL, SOCIAL AND POLICY AGENDAS: KEY DELIBERATIONS ON FORENSIC GENETICS

Comprehensive understanding of the role of forensic genetics in a criminal justice system, and how this role is shaped by the actions and expectations of scientists, users, regulators, and publics, is impossible without a grasp of the technological capacities of DNA profiling and databasing. Additionally, such understanding also needs to take into account the wider factors that determine the history and current availability of a variety of types of expert knowledge, how these types of knowledge are integrated in police inquiries, and how they are permitted to inform courtroom deliberations. These wider factors, conditioned by a range of ethical, social, legal, and policy considerations and expectations, have been briefly mentioned earlier, and we have already suggested that there is a dynamic and recursive relationship between laboratory and field applications of forensic genetics, ethical considerations of risks, and social expectations of benefit.

This relationship reflects the fact that the social and the ethical are never entirely separated from science but are implicated within it, and vice versa. Normative deliberations are not confined to specialist agencies or experts; they recur throughout the routine and exceptional processes of scientific discovery and forensic practice. Sheila Jasanoff's (2004, 2) explication of this relationship is especially helpful when she writes that '[w]e gain explanatory power by thinking of natural and social orders as being produced together ... co-production is shorthand for the proposition that the ways in which we know and represent the world (both nature and society) are inseparable from the ways in which we choose to live in it ... society cannot function without knowledge any more than knowledge can exist without appropriate social supports.' The same theme is taken up by Martyn Pickersgill (2012, 2) who has coined the term 'regimes of normativity' to refer to the 'assemblage of morally inflected global and local discourse and practices' that affect all kinds of scientific work. Pickersgill's formulation also encourages us to give attention to the role of 'official and informal institutions, agents and discourses that prescribe what scientists ought to do.'

In this chapter we commence that work – which we continue in the subsequent chapters – by reflecting on several 'cornerstone' reports that have engaged with forensic genetics and had impact beyond their national boundaries. In providing this review, we hope to contribute to an improved appreciation of the quality of the claims, counter-claims and discursive strategies that recur in discussions of ethical, social and policy aspects of forensic genetics. Furthermore, we will use this

work to inform further discussions amongst colleagues within the Network of Excellence. Following those discussions, and the collection of additional information, we hope this revised material will be useful to inform future public debates on societal aspects of forensic genetics.

Deliberations on Forensic Genetics

Four independent expert reports have provided signposts for much of the current social, ethical and policy discussions of forensic genetics. In date order, these are: the US National Commission on the Future of DNA Evidence (which met between 1998 and 2000, disseminating its deliberations on the internet, and published several reports, including 'The Future of DNA Testing: Predictions of the Research and Development Working Group' in November 2000); the American Society of Law, Medicine & Ethics (ASLME) Project on DNA Fingerprinting and Civil Liberties (which held meetings at the Kennedy School of Government, Harvard University, between 2003 and 2005, and whose work is represented in a series of papers in a special issue of the Journal of Law, Medicine & Ethics published in Summer 2006); the Nuffield Council on Bioethics Working Party on the Forensic Uses of Bioinformation: Ethical Issues (which took evidence from a variety of experts between 2006 and 2007 and published its report in late 2007); and the UK Human Genetics Commission Working Party on the National DNA Database (whose work was informed by a 'Citizen's Inquiry' into the UK National DNA Database in 2008, and who published 'Nothing to Hide, Nothing to Fear?' in 2009).

The work of these four groups took place between 1998 and 2009, at different moments in the waves of innovation to which we referred in the previous chapter, and drew on a variety of disciplinary perspectives. The US National Commission was especially concerned with legal and technical features of the development of DNA profiling. Whilst it recognised that 'a number of issues raised in this report have social, ethical, and legal implications beyond the assignment of the working group' and identified some of these issues, it called on other groups to pursue them in more detail. At the same time, it considered a number of policy questions, including questions concerning the appropriate scope of DNA sampling and retention as well as the reduction of sample backlogs. It also recommended the establishment of systematic research efforts to determine the effectiveness of police uses of DNA profiling and databasing and 'how the technology affects the investigative process.'

The ASLME project (funded by the US National Institutes of Health) took up many of the topics which the US National Commission had declared itself unable to pursue: a range of social, ethical and legal issues, especially those that surrounded questions of privacy and civil liberty. There was no effort to

produce a consensus report by those involved in the workshops, and (perhaps unsurprisingly) more attention was given to US preoccupations and practices than to those from elsewhere. Instead of attempting to generate agreement, participants were encouraged to provide normative and factual resources which would 'direct the public discourse so essential for shaping how DNA forensics and technology is applied and used' (Moulton 2006, 148). Recurrent questions explored included database inclusiveness, sample retention, 'racial identification', informed consent, the scope of profile uses, and the effects of DNA identification on family relationships.

In addition to these US efforts, two UK projects (by the Nuffield Council on Bioethics and the Human Genetics Commission) also sought to provide resources for future public deliberations, but also undertook formal public consultation amongst their working methods. The two projects used very different methods to structure these consultations. The Nuffield Council on Bioethics Working Party disseminated, to individuals and organisations known to be active in the field of forensic bioinformation (and also more generally on its public website), a 'consultation paper' containing information and a series of questions. 135 responses to the consultation were received, and an analysis of these responses was presented in the Working Party's Report. The report itself focused on the ethical, social and legal issues that the authors argued were current at the time, alongside what they could discern as 'potential future' uses of forensic bioinformation.

The group supplemented a focus on forensic genetics with consideration of fingerprint collection and comparison. They argued in general terms that whilst 'well-functioning forensic databases have the potential to promote the public interest to a significant degree' (Nuffield Council on Bioethics 2007, xiii), it was equally important that their existence and uses did not significantly challenge the inventory of ethical values generally upheld in liberal democracies, identified as those of 'liberty, autonomy, privacy, informed consent and equality.' The report contained a large number of recommendations for changes in the governance of research and operational uses of forensic genetics informed by a rights-based approach which sought to balance the demands of public protection against the protection of these core ethical values, or between the common good of security and the individual good of personal liberty.

The UK Human Genetics Commission had a longstanding interest in forensic DNA profiling and databasing dating back to the early years of this century, even though on some occasions they had struggled to sustain this interest in the face of Government reservations about including this domain within their work programme. Before undertaking the study that led to 'Nothing to Fear, Nothing to Hide?', the Commission had included consideration of the UK NDNAD in several of the previous studies, and they had successfully lobbied Government for representation on the NDNAD Strategy

Board. In preparation for what has been their most detailed work on forensic genetics, the group had (along with the Economic and Social Research Council Genomics Policy and Research Forum in Edinburgh, and the Policy, Ethics and Life Sciences (PEALS) Research Centre in Newcastle) commissioned a 'Citizens Inquiry' into the NDNAD. This inquiry established two public panels who heard evidence from 'interest groups, the police, database governance bodies, forensic scientists and journalists' (Human Genetics Commission 2009, 11). The panels also visited Scottish Parliament and a community centre in the London Borough of Hackney in order to hear from a variety of people with political interests in, and personal experience of, the police uses of forensic genetics. Following completion of the Citizens Inquiry, the HGC also undertook a wider public consultation, with some of the results included in the published report. The report itself made a number of significant observations, many of which supplemented and extended those made earlier by the Nuffield Council on Bioethics Working Party. Emphasising the – often unappreciated – novelty of forensic DNA databases, they noted policy confusion in how the UK NDNAD was characterised and governed as well as the inadequacy of current ways of determining its utility. One chapter of the report was devoted to an analysis of the 'consequences, both experienced and implied, of the NDNAD for individuals and society' (*ibid.*, 12), and another to understanding the implications of newly emerging forensic genetic technologies, and the relationship between forensic and medical genetics. Finally, the report's authors offered a series of recommendations aimed at redressing the shortcomings in policy and governance they had identified. Amongst these were: the commissioning of privacy and equality impact assessments of NDNAD regimes; the development of agreed measures of 'forensic utility' and the public dissemination of data on uses; the harmonisation of markers across the EU (and possibly elsewhere), along with the development of measures to control and monitor international datasharing; and improved NDNAD governance, including the establishment of an independent oversight body and a strengthening of the powers and standing of the NDNAD Ethics Group.

When read together, these four sets of deliberations provide a good general sense of the range of social, ethical and policy issues raised by developments in, and operational applications of, forensic genetics to criminal justice. Whilst participants in them did not all come to the same conclusions, there was some overlap in what they chose to examine in detail, and they are useful in reminding us of the necessity for supplementing the prevailing repertoire of concepts and concerns that distinguish bioethics and its focus on medical contexts by additional resources and questions in order to do justice to the particularities of criminal justice contexts. By 'prevailing repertoire' we mean at least the following values: dignity and respect for persons; individual and collective beneficence; justice (fairness in distribution of benefits and risks); informed consent; personal

privacy; and democratic deliberation. The introduction of additional concepts and arguments are made necessary by the fact that the read-over from previous health and health-research oriented deliberations of genetics is not straightforward. Whilst the core set of values may be similar, their articulation is different, and the investigative and prosecutorial demands of criminal justice systems raise new issues, actors, and imaginaries that also need to be taken into account. For these reasons, and especially in the light of the fact that many criminal justice applications necessarily involve actions that do not require the consent of the persons at whom such actions are directed, ethical, social, and policy interrogations of forensic genetic research and practice frequently supplement that basic repertoire with additional normative and factual considerations – especially but not exclusively those of liberty, security, crime control, due process, good governance, normalisation, stigma, and proportionality.

Outlook

In the two chapters that follow we outline this wider set of concepts and discuss how they have recurred in ethical, social and policy debates over the nature of forensic genetic technologies and their uses in support of criminal justice objectives over the last twenty years. We also acknowledge some current shortcomings in our treatment of them. The first is that a report of this length cannot be exhaustive in its descriptions and interrogations of so many considerations and issues; we have been deliberately selective. The second is that our coverage of these concepts and their appearance in specific debates is limited by the Anglo-centric character of much of the work that we have reviewed for this report. It is a regrettable fact that all four of the deliberations that we have described so far have taken place in English-speaking jurisdictions based on common law adversarial legal systems, and that much of the previous work on which they draw is similarly lacking in comparative reach. At least one of the reports has been especially influential beyond the boundaries of the Nation State in which it was produced, but there are also significant limitations that result from their restricted origins. Previous work carried out by one of us has already noted that there are differences in national responses to potential and actual forensic genetic innovations across the European Union (Williams and Johnson 2005), and others have asserted that these differing reactions are the result of a number of diverse social and cultural factors at work which condition any efforts to regulate the introduction of these kinds of innovations. In addition to the difference between common law and civil law traditions, there are diverse models of policing that operate in different EU States, and there are variations amongst those States in their adoption of policies aimed at ‘controlling crime’ on the one hand, and on the prioritisation of ‘due legal process’

in the management of criminal suspects on the other hand. States also differ in how consensus is established on the balance between 'public security' and 'individual liberty' in the use of a range of investigatory techniques. Finally, and despite on-going efforts to harmonise legislation governing the storage and handling of personal information, the role of (both national and international) data protection in criminal matters remains contested. All of these factors are relevant to understanding the different ways in which global innovations in forensic genetics have been approached in different jurisdictions, and the resulting patterns of inclusion into or exclusion from investigative and judicial processes.

CHAPTER 5: FORENSIC GENETICS AND BIOETHICAL VALUES

In this chapter we undertake a more detailed examination of ethical and social considerations especially relevant to forensic genetics, and point to some of the controversies – both historical and contemporary – that surround them. We also note the variety of actors and agencies that have promoted, reviewed, or contested the significance of technoscientific innovations and operational developments, along with the claims to knowledge (and diverse interests) made by these actors and agencies. We do each of these things by reference to a series of underlying values and principles that are central to the current repertoire of bioethical concepts. These concepts have been used to inform the themes and narratives that have emerged in the course of the main academic and policy debates and exchanges over the benefits and risks of innovations in forensic genetics over the last few decades. We give particular attention to what we earlier called ‘third wave’ developments, especially those which are represented by work carried out in the current repertoire of EUROFORGEN exemplary projects.

Dignity, Bodily Integrity and the Collection of Genetic Samples

Much contemporary discussion of bioinformation tends to treat the bodies on which such technologies are focused as ‘informational objects’, and then focuses on social, ethical and policy issues that arise in the course of the further analysis and/or uses of that information. This tendency forecloses consideration of important issues of human dignity and bodily integrity that arise in DNA profiling and databasing from the initial sampling of bodies as anatomical subjects. Whilst some observers are content to label these issues as ‘bodily privacy’, we prefer the terms chosen in this heading since we see invasive procedures which cross the boundary of the body (for example through the collection of blood or tissue using a variety of instruments to penetrate the skin, or via the mouth), as potentially challenging a person’s innate right to bodily integrity. As Gerlach (2009, 149) points out ‘Privacy is about protecting information, while bodily integrity is about protecting the thing itself.’ There is a long history of legislation which recognises this right in a large number of liberal-democratic jurisdictions, and its meaning and significance have been explored in deliberations about medical treatments and in penal practices.

Regimes governing the collection of samples of genetic material for analysis in the course of criminal investigations differ sharply from regimes which govern the collection of such samples for medical purposes. In almost all liberal-democratic jurisdictions, there is a stage in the investigatory or prosecutorial process at which legitimate authorities are permitted to take samples for DNA profiling from those suspected or convicted of a crime. It is in considerations about what is permissible at these moments that issues of human dignity and bodily integrity are most powerfully highlighted.

Häyry (2003, 2004, 2006) has written extensively about dignity as one of a series of fundamental European ethical values. Whilst the significance of the term can vary according to the various traditions in which its use is located, there remains for Häyry and Takala a core meaning, that '...our physical, moral and genetic integrity must be defended both against violations stemming from other people's interests, and from violations arising from our own whims and desires.' (Häyry and Takala 2007, 29-30)

Other writers have also commented on the value of human dignity and the related matter of bodily integrity as issues which deserve further discussion in the context of forensic science in general and forensic genetics in particular. van der Ploeg (2005) reminds us that issues of bodily integrity come into focus whenever medical or criminal justice procedures involve crossing 'internal' and 'external' bodily boundaries; and while penetrating the skin (for example to take a blood sample) is a clear instance of such boundary crossing, naturally occurring openings and orifices are also zones of particular contention. Along with others, she argues that the breach of bodily integrity – and thus dignity – that results from the taking of buccal swabs is a serious one, and one whose significance is acknowledged by the extensiveness of legal debates about the practice of such 'bodily searches' in a number of criminal jurisdictions. The long history of efforts to secure the body of citizens from interference by state authorities is noted in Gerlach's (2009) account of deliberations on the establishment of forensic DNA sampling and databanking regimes in Canada. In Canada, and elsewhere, according to Gerlach, there has been a tendency to exclude issues of bodily integrity from consideration, instead displacing it with an attentiveness to privacy: '...it normalizes a shift in how we conceive of the body in criminal law, a shift that was enshrined in legislation through the exclusion of bodily integrity and the inclusion of privacy safeguards' (*ibid.*, 149), and in this way privileges state interest and power over citizens' sovereignty over their bodies.

Distinctions are made by commentators as to how and when this reduction of bodily sovereignty is permissible. It is often argued that buccal swabs are easier to acquire, and are less intrusive, than blood sampling whilst providing similarly informative DNA profiles. Whilst the mouth is in many cultures considered to be an intimate area of the body, it may be perceived as a means for less

intrusive sampling than taking blood from a vein; technological developments have enabled respective legislative changes to be proposed and implemented (e.g. *Criminal Justice and Public Order Act 1994*, in the UK). It seems broadly agreed that at some point in the investigation of an individual's suspected involvement in a crime (for example on arrest or at the point of being charged), then the taking of swabs from the inside of their mouth is a legitimate intrusion. However, this argument is complicated when such sampling is used in intelligence led-mass screening where a refusal to participate can lead to further suspicion of an individual. Whilst not arguing against such sampling, Steventon (1995) has cautioned against increasing the range and number of criminal cases that require sampling from formerly intimate body areas such as the mouth, whilst Mooki traces 'a direct link between greater interference by the state with the bodily integrity of individuals' (1997, 574) in the extension of police powers to sample from formerly intimate body areas. The general concern here seems to be with the possibility of a creeping redefining of further areas of the body as being non-intimate in nature, although it is difficult to imagine the criminal justice necessity for any such extension.

Finally, of course, in the forensic context biological material is gathered for DNA extraction and profiling from a variety of sources in addition to the consensual or non-consensual sampling of known donors. Regimes for the collection, analysis and retention of biological material recovered from scenes of crime have not especially troubled those who have expressed worries about the expansion of forensic DNA profiling. The only exception to this concerns the practice in some jurisdictions of the surreptitious sampling of objects known to have been in contact with criminal suspects where investigators either do not have the power to request samples or do not wish their interest in a subject to become known.

Genetic Informativity and Personal Privacy

Many different kinds of genetic information are mobilised in a number of diverse environments, including medical research, health-care, paternity testing, advertising, popular culture, and forensic science. In each of these domains, claims for genetic informativity – that analysis of the human genome can provide domain relevant information – are subject to differing criteria of evaluation and accountability. The kind of genomic information sought and produced by those using DNA profiling in support of criminal investigations and prosecutions varies according to the specific technologies used and on the context in which such data are required, produced and negotiated. This context has administrative, legal and social dimensions that influence the production and interpretation of

forensic genetic data, and as such its informative value and normative authority. Despite these differences, the legitimate privacy expectations of individuals whose genomic information has been collected and used have always been foregrounded as requiring consideration by publics, policy makers and practitioners. Whilst the concept of privacy is an essentially contested one (Gallie 1956) with a variety of connotations, included in its meanings – when applied to criminal justice contexts – are some or all those features identified by the authors of the recently published US Presidential Commission for the Study of Bioethical Issues: ‘... confidentiality, secrecy, anonymity, data protection, data security, fair information practices, decisional autonomy, and freedom from unwanted intrusion’ (2012, 25).

Perhaps because of this wide repertoire of meanings, there exists a large body of commentary concerned with assessing the seriousness of the potential infringement on privacy rights occasioned by the profiling, retention and subsequent sharing of DNA profile information derived from individuals sampled in the course of criminal investigations. Many relevant international investigative instruments recognise privacy as a fundamental human right, but the most important judicial ruling on such privacy of significance to forensic genetics was delivered in December 2008 by the European Court of Human Rights (ECtHR) in the case of *S and Marper v the UK Government*. In this case, an eleven year old boy, ‘S’, and an adult, Marper, had each been arrested and sampled during the course of investigations that did not result in their conviction of any offence. Their subsequent efforts to have these samples destroyed and profiles removed from the UK NDNAD met with failure at each level of relevant UK judicial deliberation. The final decision in this case, that of the House of Lords in 2004, was that the retention of their DNA did not breach either their privacy right or their right against discrimination in relevant articles of the European Convention on Human Rights to the extent that the State should be denied this contribution to the prevention and detection of crime.

However, members of the ECtHR disagreed with the lower court’s judgement and unanimously ruled 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 ... 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. Accordingly, the retention at issue constitutes a disproportionate interference with the applicants’ right to respect for private life and cannot be regarded as necessary in a democratic society.’ (Council of Europe 2008)

The strength and clarity of this judgement is such that all subsequent European legislation and practice relating to the retention of DNA samples and profiles taken from individual subjects (and hence any uses that can be made of these samples and profiles) should be prudent in taking it into account (e.g., the UK Protection of Freedoms Act 2012 has done so). The reasoning used by the ECtHR judges on this issue invites us to balance the contribution of forensic genetics to the general good of crime detection and crime prevention against the individual good of privacy. We will later discuss the use of the judicial concept of 'proportionality' in this context, but note now simply that the notion of a balance between public and private interests (of which privacy is simply one of the latter) is a common trope in discussions of such measures.

For some – academic and legal – authorities a person has no reasonable expectation of privacy in their DNA profile if the sample from which the profile was developed was taken lawfully during the course of a criminal investigation. Proponents of this argument usually cite its value to crime control imperatives, but also restrict the uses of such profiles to 'law enforcement' or to the 'investigation of crime and the prosecution of offenders', 'criminal justice' or 'police' uses. A recent decision by the Supreme Court of Ohio, USA, instantiates this position in its judgment that, following the lawful procedure of DNA collection and profiling, defendants/donors have no standing to object to the retention of the sample and profile in the national US DNA database CODIS (The Supreme Court of Ohio 2012).

This judgement, and similar ones made by legal and other scholars about DNA profile and sample retention are informed by what one of us has already called a 'genomic minimalist' rendering of the informational significance of forensic DNA profiling. This characterisation emphasises that the genomic data used for the construction of profiles are derived from non-coding regions of DNA and therefore cannot be used to infer any personal – or private attributes of the subject from who the sample was taken. Whilst the ECtHR judges were not impressed by this argument, arguing that the mere possession of genetic data was already a breach of privacy rights, others have been more willing to cite it as grounds for limiting the significance of privacy critiques.

In many criminal jurisdictions, the tenor of forensic genetic privacy deliberations has been shifted by the arrival of the third wave of innovations that we identified in Chapter 2. Efforts to enhance the informativity of genetic analysis of crime scene stains is the essential distinguishing factor of these innovations, and a variety of approaches have been used to produce such enhancements. Some have been based on enriched uses of the conventional STR multiplexes utilised for forensic DNA databasing. The techniques of 'Familial Searching' (or 'genetic proximity testing' to use the term preferred by Prainsack (2010a, 29) to distinguish between biological and social relatedness) provide

a conspicuous instance of this trend, and for some commentators, the use of these techniques contradict the minimalist claim even as it relates to non-coding genomic information. The ECtHR judgement referred to above certainly took this view, arguing that the use of DNA profiles to identify genetic relationships as well as genetic distinctiveness was an interference with the right to private life of those people potentially caught up in this process.

The other main development has been the efforts to develop Single Nucleotide Polymorphism (SNP) arrays capable of proving information about attributes of the source of the biological sample in question. SNP makers refer to biallelic differences (alternatives, insertions or deletions) at single points on the genome. Taken singly, they will not necessarily discriminate well between two sources, but when a large number of SNPs are combined in 'SNP Panels' of 'SNP arrays', then their discriminative power is enhanced. It seems generally agreed that SNPs provide exceptionally useful supplements to standard STR methods since they provide a very large number of potential markers; the analysis of SNP arrays can be highly automated; and they do not require the longer genomic sequences necessary for STR analysis (e.g. Amorim 2011, 2012; Amorim and Pereira 2005; Budowle and Van Daal 2008; Kidd et al. 2011; Kidd et al. 2012; Pereira et al. 2012).

These and other efforts to increase the informativity of crime scene samples have sometimes caused concern in the jurisdictions in which their uses are increasing, but it is important here to note the difference between the acceptability of analyses carried out on samples from scenes of crime, and analysis carried out on samples taken from known individuals in the course of criminal investigations. Privacy and confidentiality considerations are – according to most views – lessened in their significance when applied to analyses carried out on the former sample sources. Furthermore, in criminal justice terms, these kinds of genetic inferences are characterised as 'investigative intelligence' only, and will not produce evidence to be presented in courtrooms. The development of such technologies is reminiscent of Richard Tutton's above mentioned history of pharmacogenomics and its varying discourses ranging between uniqueness of the individual and a focus on populations.

However, insofar as this kind of analysis shifts the focus of the genetic informativity of a sample from the uniqueness of the individual to comparable elements within a large population, it raises other concerns, concerns which have also surfaced in the application of ideas about genetic 'populations of origin' in the medical domain. Whilst some commentators have positioned these concerns within a privacy framework, we see them rather differently – as related to issues of stigma and equality – and so discuss them in the next section of this report.

Equality, Stigma and Criminal Justice

One of the main concerns of the Home Office Report 'Keeping the Right People on the Database' (2009) was to provide evidence for the seemingly common belief that persons arrested but not convicted have a higher chance of offending in the future, and that therefore it is legitimate to retain indefinitely for future speculative searching, DNA samples and profiles taken from arrestees (cf. Levitt and Tomasini 2006, for a discussion of this general assumption). Whilst forensic genetics is silent on the substantive issue of database retention, there is a sense in which support for all DNA profiling regimes – and therefore our understanding of the utility of forensic genetics in general – is affected by such arguments, and thus necessarily has to confront issues of the equal treatment of all individuals by the criminal justice system along the potential stigmatisation of particular individuals or groups that may result from their treatment within this system.

It seems generally agreed that those who are proven to have committed criminal acts are less deserving of claims to some human rights than those who – to all appearances – have been law abiding citizens. But this is only the case for those rights that are not absolute, and there are differences in the extent to which jurisdictions define legitimate breaches to such conditional rights. Perhaps the usual policy rationale is that it is the provision of equal treatment within distinctive categories of persons, rather than between all categories of persons that is most important to achieve. Thus all convicted prisoners may be deserving of equal treatment, but that their treatment can legitimately differ from that accorded to law abiding citizens, and that cutting across these, and other, categories are other relevant natural and social parameters like age, citizenship, et cetera. Of course there is continuous controversy about which categories are legitimate or not as well as how individuals are placed in one or another category.

Second wave discussions of these matters focused largely on the question of the categories of persons whose DNA was – and should be – retained on forensic DNA databases. There have been many commentaries on the US and UK databasing regimes which have focussed on the collection and retention of DNA samples and profiles from particular social groups that might be thought to be especially vulnerable to the stigmatising effects of such practices – albeit conditioned by policing processes in general rather than forensic DNA databasing in particular. Studies that have focussed on ethnicity and 'race' include those of Duster (2004, 2006a), Ossorio and Duster (2005) and Skinner (2012). Another set of studies has been more concerned with the legitimacy of the retention of samples and profiles from children and young people (e.g. Mansel and Davies 2012; Tozzo et al. 2010; Tozzo et al. 2012) as well as the unconvicted (Hepple 2009; McCartney 2006b, 2012).

Discussions of third wave innovations have raised questions of equality and stigma in a different way. Here, emerging innovations based on SNPs, such as AIMs and the genotyping of phenotypical information (EVCs) have raised expectations that in the near future forensic techniques can, with a convincing degree of certainty, determine the population group origins of a human DNA sample as well as provide information on some of the physical attributes – such as skin pigmentation – of the person whose sample has been analysed. Already, some studies have reported a degree of progress that gives cause for optimism about the capacity of such emergent technologies (e.g. Kayser and Schneider 2009; Ruiz et al. 2012; Spichenok et al. 2011; Walsh et al. 2011). The use of these technologies represents a clear departure from earlier assurances to critics that forensic genetics only uses so-called ‘non-coding’ parts of the genome that do not hold any significant information about the individual and its relatives. Some (e.g. M’charek et al. 2012; Toom 2012) have described this as a significant extension of jurisdictional intrusion into bodies and the information derived from them in support of criminal justice ambitions.

EUROFORGEN has specific ambitions both to identify ancestry informative markers at ‘the continental and subcontinental level’, and also to find genetic ‘markers for common physical characteristics to identify the genetic basis of patterns of visual appearance typically used to construct an eyewitness account. These characteristics will include: pigmentation, age and simple facial structural variation’ (EUROFORGEN DoW p. 18).

In the case of ancestry informative markers and the enquiry into biogeographic ancestry in the context of criminal investigations, approaches to the interpretation of genetic data are unavoidably linked to prior social assumptions and categories. This means that forensic geneticists are by default steeped in a controversial history of classifying human individuals and groups through their genetic properties. Concerns about the use of ‘racial’ categories in forensic genetics, and their possible relationship to race issues in criminal justice generally have been reiterated recently (Chow-White and Duster 2011; Genewatch UK 2005; Ossorio and Duster 2005), with some even warning of a creeping scientified politics of ‘eugenics’ (Duster 2003) or, more specifically, a ‘racialisation’ of forensic genetics (Skinner 2012) through the production of genetic ‘facts’ based on culturally conceived and unreflective assumptions. In addition, M’charek (2000, 2008) has asserted that the results obtained from the application of these technologies are more likely to be utilised when they do seem to identify minority ethnic groups, which will also reinforce the notion that they reflect existing social prejudices against such minorities.

This socio-political history and the discourse around ‘race’ and ‘ethnicity’ used in forensic contexts reflect concerns that traditionally conceived views may be infused with emergent technologies, and

in turn impact on wider public and policy perceptions of legitimate efforts to identify the larger population groups to which any individual may belong. Whilst contemporary societal, but also individual, governance mobilises recent and emergent biological insights, data and technologies – what has been described as ‘biopolitics’ (Rose 2006; Stenson 2005) – these need to be challenged as to their underlying social and cultural assumptions. Forensic genetic techniques such as the use of ancestry informative markers aim to enable probabilistic statements about the individual through the classification of human populations based on racial and ethnic distinctions for governance purposes such as criminal justice. These techniques continue to face opposition in legal terms, following the *European Council Resolution 2001/C 187/01*, of 25 June 2001 (Amorim 2012).

Challenges to the informative value of ancestry informative markers and their relation to ethnic identity have been raised for both social and practice-related aspects. A recurrent argument attends to the differences between genetic ethnic identification and self-identification of a donor, or even the attributed ethnicity of a donor through the person collecting samples. Cho and Sankar (2004) argue that in policing practice it is often assumed that a pre-conceived reference population and the suspect correspond, yet methods of assigning race or ethnicity have not yet undergone a process of standardisation, and are more often than not dependent on the individual conducting the assignment, and her interpretation of local reference populations. There is also considerable concern wherever concepts of ‘race’ and ethnicity’ are used interchangeably in ways that neglect their differing social and scientific connotations (Bostanci 2011). Populations (groups and sub-groups) are the basis for ‘knowing’ genetically, yet categories such as ethnic identity are socially constructed, indeed are a vital part of active identification of individuals and communities (Chow-White and Duster 2011; M'charek 2000; Skinner 2012). Even biological categories – and reference populations – are products of human classification and a necessary reduction of a complex world for efficacious and efficient engagement with it. Using these to make factual statements, critics anticipate, could lead DNA profiling to enforce, or at least support, existing unreflective social assumptions about race and ethnicity.

The boundary between the development and uses of ancestry informative SNPs and the development and uses of phenotype-informative SNPs can be difficult to discern. AIMs are short sequences of DNA known to vary in frequency between geographically dispersed populations with no concern given to phenotype (some markers may be associated with it, some may not); markers used to predict EVCs are associated with phenotype, with no immediate reference to ancestry/ethnicity; although they may be associated with it. Some studies are concerned to provide descriptors that are neutral with respect to ancestral features, while also being concerned to focus

on SNPs 'located in and nearby genes known for their important role in pigmentation' in order to predict skin and eye colour (Spichenok et al. 2011). Other studies involving coloration – in this case eye colour – point to the difficulty caused by the existence of a 'complex and continuous range of intermediate phenotypes distinct from blue and brown eye colours' (Ruiz et al. 2012).

These points of tension are inherent to themes of the convincing – but sometimes contested – capacity of DNA to tell us something about the identity of individuals and populations, and the ability of science and technology to realise that capacity (e.g. Skinner 2012). IMPRINTS, a project funded by the UK Engineering and Physical Sciences Research Council, has re-emphasised social aspects of identity – various relationships between individuals, between individuals and organisations, and of individuals with artefacts (van Zoonen et al. 2012). In popular culture (Nelkin and Lindee 1995) as well as in the governance of social structures the 'genetic imaginary' has provided

a set of social concepts for thinking and speaking about the civilization of the gene and its future direction ... a sort of 'hyperreality' wherein future possibilities are treated as present realities and as such are shaping our current actions.' (Gerlach 2004, 5)

A final set of commentaries on these developments positions them by reference to the turn towards a biological culture in criminology, embedded in the increasing 'biologization' and 'geneticization' of society, specifically of popular culture and research cultures (Nelkin and Lindee 1995; Goodman et al. 2003; van Dijck 1998). Since the late 1990s the crime control discourse has expanded efforts into understanding the causes of criminal behaviour to include the genetic dimension. What Nikolas Rose has called the 'biology of culpability' (Rose 2000) has aimed to explore 'genetic risk' – the genetic predisposition towards violent or anti-social behaviour – which has not only become a consideration in sentencing but also for crime prevention. Specifically behavioural genetics aims to further understanding of tendencies towards violence and/or criminal behaviour by exploring the genetic causes of crime, and social scientists have taken an interest in exploring its impact (e.g. Farahany and Bernet 2006; Onay 2006; Levitt and Manson 2007) as well as the potential determinism inherent in much of behavioural genetics (Allen 2004; Duster 2004).

Despite the critical commentaries referred to above, there is obvious value in being able to provide investigators with information about the visual appearance of criminal suspects by the analysis of genetic material that has been recovered from crime scenes. What Kayser has called 'Forensic DNA Phenotyping' is a growing field of research, albeit one which has had a relatively small number of case applications (at least compared with other forensic genetic techniques). Careful explanations of

its underlying assumptions, and sensitive applications to particular cases, may help overcome some of the existing reservations about the meaning of key terms within this field. It is also an area in which there is need for an improved dialogue between research scientists, criminal justice stakeholders, civil society groups and publics.

Forensic Genetics and Social Solidarity

The previous two sections revolved around the question of the varying and developing nature of the useful information that DNA profiling may be capable of providing to investigators as well as the question of 'What should society be allowed to learn about its citizens in the course of attempting to identify them?' (Eric Juengst cited in: Etzioni 2004, 210). Whilst this question was framed as an issue of privacy, other normative considerations are also relevant to its answer especially if we consider the differing circumstances in which efforts at identifying citizens may take place. When the circumstances relate to communal goods like those of collective security or public health, then an appeal might be made to the value of solidarity. From the perspective of those who emphasise this value, according to which the contribution of an individual to the common good of crime detection and prevention is itself a moral imperative, we have an obligation to assist the police and the courts in efforts to detect and reduce crime. This participation will, if effectively exploited by legitimate authorities, result in the production of individual security and collective security from which other social goods may also be derived or facilitated. The use of this broadly communitarian approach to issues in forensic genetics parallels its uses in relation to other forms of scientific research, and indeed scientific research in general. For both Chadwick and Berg (2001) and Harris (2005), for example, there exists a 'moral imperative' in line with which participation in scientific research is seen as a moral duty since its results will (when achieved) eventually benefit all members of society (see for the complex governance in a technological society: Barry (2001). More recently, Prainsack and Buyx (2011) have reviewed the increasing use of the concept in bioethical deliberations on illness and health treatment, but did not extend their consideration to its uses in the forensic context.

Described by Cutter (2006) as an alternative to the 'Naïve Position' which balances social gains against individual harms, the relevance of social solidarity desiderata have been especially well articulated by Etzioni in a series of books and papers which apply his communitarian perspective to a range of topics, including privacy concerns in general, ID cards and biometric identifiers, and the ethical, legal, and policy aspects of forensic DNA profiling and databasing (Etzioni 1999, 2004, 2006).

Relying on both empirical ('benefits to public safety are very substantial' [2004: 127]) and normative arguments (privacy is a 'social licence' to carry out a limited number of acts free from 'communal, public and governmental scrutiny' [1999: 196]), Etzioni concedes that forensic DNA tests and databases are intrusive interventions into the lives of citizens (even though minimal ones), but is also keen to distinguish how these technologies should legitimately be applied to different categories of persons – especially 'criminals, suspects and innocents' (the first of these possessing only diminished rights which can be weighed against the high public interest in being able to identify them genetically, and the third possessing full rights with only low public interest in collecting and retaining their biological samples). Whilst Etzioni's preference is always for 'moral persuasion' for achieving a balance between individual and community interests, rather than coercion as a source of social order, his view of the liberal democratic state is a predominantly benign one. This means for him that, as long as both scientific and operational aspects of forensic genetics are predominantly state provided (or very closely state regulated) these activities are deserving of civic trust.

Conclusion

Actors within the field of forensic genetics continually seek to improve and expand the technical capacities for collection, retention and use of DNA for criminal investigative purposes. At the same time, many commentators on these developments have focused their attention to questions of proven utility and on the social and ethical values and principles which are engaged by their actual and potential applications. In this chapter we have been concerned with the latter set of issues. The following chapter realigns an interest in the effective uses of forensic genetics with an interest in how these uses should be governed. Finally we consider the issue of public trust in the capacity of forensic genetics to contribute to a transparent and fair criminal justice system before proposing a way forward for further work in support of EUROFORGEN WP4.

CHAPTER 6: GOVERNANCE, PROPORTIONALITY AND TRUST

Our discussion in Chapter 2 – of the three waves of technological innovations in forensic genetics – has already introduced ideas about the mutual co-production of technological and legal devices and innovations. Our review suggests that the availability of technologies has inspired legislative changes, which in turn have legitimised certain uses of such innovations. In Chapter 4 we offered an overview of the management of forensic genetics applications according to certain criminal justice models which, together with Chapter 5, already anticipated the problematisation of governance and debates over the proportionality of uses of forensic genetics in the criminal justice system. This problematisation and these debates are both discussed further in this chapter. Our discussion concludes by offering an agenda for our further work in EUROFORGEN by exploring the notion of trust, particularly public trust, and suggesting potential engagement and research trajectories for WP4.

Governing Forensic Genetics

There is no global consensus on how forensic genetic profiling and databasing should be governed, let alone how the research and operational uses of local forensic sample collections should be regulated. Whilst a variety of agencies are involved in such governance in different jurisdictions (with some agencies being much more inclusive of a wider constituency base than others), there is no common set of agreed principles by which these agencies work, and there is no evidence of efforts to consider the development of international standards for particular issues such as consent or the scope of permitted research, or general ones, such as transparency or accountability (cf. Capron et al. 2009; Kaye 2008; McCartney et al. 2010; Van Camp and Dierickx 2007). Liberals and communitarians agree that strong and effective governance of such collections and their uses is essential for public accountability – and hence the maintenance of public trust. Writing about bioinformation more generally, McCartney, Williams and Wilson (2010, 73) asserted that ‘The requirements for “good” (effective and ethical) governance remain poorly understood in the context of forensic bioinformation, yet it is essential that consistent management, cohesive policies and robust processes can be established and evidenced. This includes the future “steering” of forensic bioinformation policies as well as the mechanisms and consequences of their current delivery’. These remarks echo those made earlier by the Nuffield Council on Bioethics Working party when

they sought to understand the changing governance structure of the UK National DNA Database Board in general, and the governance of forensic genetic research conducted by the agencies that contributed DNA profiles to the database.

They are also reminiscent of the 2009 report by the Human Genetics Commission (HGC) 'Nothing to hide, nothing to fear', in which the HGC pointed out that the UK National DNA database had emerged step by step and was lacking a comprehensive legislative foundation and an independent governance body for its operation. Until then, several Acts of Parliament pertaining to national security issues and policing practices informed the management of the database and its respective techniques and technologies. The report's aims were not to challenge the usefulness of the database but rather to enhance its effectiveness (by suggesting to define, operationalize, and measure 'forensic utility'), reliability (through the introduction of an elimination database for police officers), social acceptability (by integrating considerations of privacy and proportionality), and its safety (for example by suggesting strict international sharing guidelines).

The establishment of the UK NDNAD Ethics Group in 2007 was a significant step forward for the governance of this database, and consequently for the governance of forensic genetic innovations used to provide intelligence to the police forces of England and Wales. It provided to the NDNAD Strategy Board, and to wider stakeholders, an independent view on many of the social and ethical issues that had previously troubled critics of the UK regime, as well as concrete suggestions concerning specific investigate procedures. Over the five years that it has existed, and since its first publication in 2008, the Ethics Group has raised questions about the definition, collection and use of so-called 'voluntary samples' and the retention policy of samples from specific groups such as children, acquitted, or convicted persons; the group has also contributed to efforts to improve transparency and accountability of the database and police practices pertaining to it.

Other European jurisdictions differ widely in their governance arrangements for forensic genetics in their respective criminal justice systems. Amongst the most interesting of these are the (currently embryonic) arrangements for the governance of the forensic DNA database in the Republic of Ireland where legislation has established a specific oversight body accountable directly to the parliament. The situation elsewhere in Europe is more mixed, and a recent book edited by Hindmarsh and Prainsack (2010) includes descriptions of the varied arrangements for the governance of forensic DNA profiling and databasing in a number of European (and other) jurisdictions.

Values, Criminal Justice and Public Policy: the Concept of Proportionality

One of the key discursive devices in efforts to resolve the differences that frequently recur in social, ethical and legal discussions of forensic genetic applications – at least in Europe – is the reference to the notion of ‘proportionality’. Proportionality may be seen as a simple balancing of considerations, but a more careful look at how the concept has been elaborated within European jurisprudence suggests that a decision on the proportionality of any particular measure involves two assessments: a factual assessment and a value judgement. It has also involved answers to three questions: whether the measure in question is sufficiently important to justify an infringement on a fundamental right; whether the measure is sufficiently well linked to a legitimate objective; and whether the measure is no more than is necessary for the attainment of the objective (cf. Jacobs 1999, 1). As such, the balancing work of proportionality is complemented by a level of ‘trumping’, and the consideration of competing and complementary interests and rights around the rules of ‘legitimate ends, suitability, necessity, and proportionality in its narrower sense’ (Klatt and Meister 2012, 8). Taken together, all of these considerations are used to determine whether or not a particular state power strikes a ‘fair balance between the demands of the community and the requirements of the protection of an individual’s fundamental rights.’ (Judicial Review brought by Fergus Gaughran against the PSNI [2012]: NIQB 88)

Judgements that involve reference to proportionality when issued by the European Court of Human Rights (ECtHR), are tempered by reference to the doctrine of ‘the margin of appreciation’ according to which the ECtHR recognises the right of democratic societies to determine for themselves, how particular human rights principles should be applied in the evaluation of individual measures in order to safeguard their national interests (cf. Greer 2000). The doctrine of the margin of appreciation is intended to provide the opportunity for States to recognise the presence of local economic, political, social and cultural factors which are relevant to determining the legitimacy of particular legislative measures. In the case of *S* and *Marper* cited earlier, the ECtHR determined not only that the UK DNA retention regime that had been challenged in that case was not only a disproportionate breach of the privacy rights of the appellants, but also that the regime exceeded the margin of appreciation in this matter as determined by the Court.

Trust in forensic science applications and their governance

In this concluding section of our report we focus on the significance of dialogue – between experts and publics, and its contribution to the development of levels of public trust necessary for the

successful integration of forensic science innovations into the existing network of uses and users of already accepted forensic genetic practices. We also consider how to take forward the work for which this report is a preparation.

In a useful discussion of forensic DNA profiling and databasing oversight and accountability mechanisms, Etzioni (2006, 220) remarks that 'the ultimate source of oversight is the citizenry, informed and alerted by a free press and civil liberties advocates, and briefed by public authorities about their needs.' This may be an argument for the recruitment of citizens to the kind of oversight boards and bodies that are either in place or under discussion in various jurisdictions. However, there is a wider issue that underlies recruitment to such boards, even where they already exist. The wider issue is that of general public awareness and views of forensic genetics research and its applications. A recent report by the Metropolitan Police Authority's Civil Liberties Panel (2011) notes this issue when it refers to the 'disproportionate numbers of some ethnic groups on the [UK] DNA Database who have not been convicted of a crime.' (p. 41) The panel responsible for the report express their concern over a possible deterioration of the relationship between the police and different ethnic communities related to 'perceived differences in treatment of particular ethnic groups' (*ibid.*). Public confidence in the fair use of DNA technology by police and government may be compromised due to such perceptions, and what are thought to be the police practices that lead to unacceptable outcomes.

We cannot overemphasise the importance of the social issue of trust in the criminal justice uses of forensic genetics, even though what is known about levels of trust – especially 'public trust' – is not always clear. Duster's (2006) account of cases of unlawful police practices across the USA pays attention to public perception of potential unfairness – or even arbitrariness – in police work. Experiences of wilful or accidental mishandling of evidence can lead to distrust in the police use of genetic technologies, Duster argues, especially because DNA evidence is considered to be highly definitive by publics. Duster's work also suggests that public trust about DNA and genetic technologies in criminal investigations can vary immensely – with some appreciating the potential of added security whilst others consider realistic opportunities for misuse. Subsequent studies by Prainsack, Machado and others (Machado and Silva 2010; Machado et al. 2011; Machado and Silva 2012; Prainsack 2010b; Prainsack and Kitzberger 2009) have also explored aspects of trust amongst individuals whose views have not been extensively examined – those convicted of crimes. Perhaps it is not surprising that these studies (based in Austria and Portugal) consistently found a sceptical view of the quality of DNA evidence amongst these individuals, although the scepticism was focused more on the honesty of police investigations than on the robustness of the underlying science and

technology. Whilst it is easy to doubt the motivation underlying such assertions, they can still provide a useful reminder of the extent to which the reliable use of any such developments depends on the extra-scientific activities of a large number of individuals who are typically involved in gathering, transporting, analysing and reporting all forensic science evidence (see Lynch references throughout this report).

These studies also remind us of the more general relationship between experts (in science and/or the law) and all citizens. The forensic science community seems divided on how properly to think about and communicate with this wider group. On the one hand there is an acknowledgement of the necessity to communicate clearly the strengths and weaknesses of specific practices, and not to exaggerate the capacity of different kinds of DNA profiling methods to deliver simple truths within the complex and ambiguous investigative and judicial processes that make up criminal justice systems. On the other hand there is a lingering suspicion that the public availability of too much detailed knowledge of how forensic technologies work can be turned to the advantage of the intended wrongdoer.

But for some social critics, the latter concern works only to re-inscribe existing social division between those with and those without power, and from this perspective, a more open dialogue with a variety of publics is an essential feature of the good governance of techno-scientific innovation. There are many empirical studies seeking to measure levels of 'public' trust in the commercial and state sponsorship of emerging uses of biotechnology (Gaskell et al. 2003; Human Genetics Commission 2001) along with critiques of their methodology and assumptions. In addition, lessons can be learned from Jasanoff's more ambitious historical and comparative studies of the relationship between the production of scientific knowledge and the production of democratic order as expressed in what she calls 'civic epistemology' or the 'tacit knowledge-ways through which [modern technoscientific cultures] assess the rationality and robustness of claims that seek to order their lives' (Jasanoff 2005, 255). Throughout her work Jasanoff constantly raises issues about how 'publics' are constructed, how issues of scientific credibility and trust are managed, and how these issues bear on larger questions of state legitimacy in democratic societies.

A recent discussion of collaborations between natural and social scientists in another field (synthetic biology) reminds us how important it is to avoid reiteration of the sterile exchange between utopian and dystopian images of any kind of technoscientific development (Marris and Rose 2012). The authors argue instead for interdisciplinary partnerships which encourage discussion of 'the inherent complexities, uncertainties and about desirable futures' within a wide continuum of stakeholders so

that both ‘promises and challenges’ can be better understood and faced. It is these kinds of conversations that we seek to inform and promote on behalf of EUROFORGEN.

Improving Consultation and Deliberation

It is regularly asserted in discussions of new technologies that there should be widespread expert and lay involvement in deliberations over their applications. In the course of preparing this review, we solicited information from EUROFORGEN National Contact Points about any expert and/or public deliberations on forensic genetics that had taken place in their jurisdictions. The results of this solicitation suggest that in most of the European countries involved in this data search, public debate seems to be very limited, often confined to legal and legalistic debate, insular and moderate media attention, and some online activities of bloggers and fora.

Civil society activities

To a degree, human rights and civil liberties organisations have participated in debates about emergent or already established DNA databases, as in the case of Human Rights Commissions in Ireland (on the DNA database in 2010) and Greece (on establishing legal limitations to the use of DNA profiling and databasing in 2009), and Civil Liberties organisations in Ireland and Hungary (on the protection of genetic data). These are rare cases of civil society actors showing strong participation in public debates about forensic DNA technologies in criminal justice regimes outside of the UK.

National and governmental activities

However, a wider range of governmental and government-commissioned activities have been reported. Whilst apparently only in Portugal the Conselho Nacional de Ética para as Ciências da Vida (national ethics council for the life sciences) has contributed to relevant debates, other advisory bodies, such as the Swedish Data Inspection Board (who focus for now only on an ‘elimination’ database) and the Spanish DNA Commission (which is constituted by a technical and a legal sub-committee hosting various stakeholder groups, and currently focuses on sampling from juveniles and familial searching) provide input for governmental decision-making on criminal investigative and other forensic uses of DNA technologies, including ethical and legal as well as technical and investigative perspectives.

Participants in governmental deliberations are special parliamentary commissions, for example the Slovenian commission set up in deliberations about a revision of Criminal law regarding the

collection of buccal swabs. Other stakeholders and contributors have supervisory roles, such as the Polish Ombudsperson (in 2001 encouraging the development of legislation about the use of DNA analysis in civil trials) or the Information Commissioner in Slovenia (who submitted recommendations on legislative and software related issues of the Slovenian DNA database). Organisations with similar civil rights responsibilities such as the Hungarian Data Protection and Freedom of Information Authority, the Belgian Privacy Commission, or the Dutch Data Protection Authority have also been involved in informing national deliberations about the use of DNA in national criminal justice regimes.

Higher education research activities

There have been some instances of academic research into the ethical, legal and social aspects of DNA profiling and databasing apart from the pan-European projects listed in Chapter 2, and UK-based research. Strongly engaged in this field are two groups in the Netherlands (the groups of Armade M'charek in Amsterdam and Bert-Jaap Koops in Tilburg). In Portugal, the Centre of Social Sciences, and the Centre for Biomedical Law have also conducted ELSA studies, the former included a public deliberation component. In Estonia insular academic publications have been received, whilst the Greek Laboratory of Forensic Medicine and Toxicology at the University of Thessaloniki contributed a paper in 2011 criticising the 2009 national legislation on DNA databases as lacking in terms of proportionality; the potential of stigmatising immigrant groups; the lack of public dialogue and of harmonisation across Europe.

Public debate and deliberations

As mentioned above, a focused public inquiry had been conducted in Portugal, as part of an academic research project into social and ethical aspects of DNA databasing. In a Romanian academic research project, a number of medical and legal students participated in a survey on the establishment of a DNA database which tended to be in favour of such a step.

There was some public debate over the extension of a medical population database in Sweden. There, the 'PKU-sample bank' (a metabolic disease-oriented blood-spot research biobank with samples from all newborns in Sweden since 1975) was made available first for disaster victim identification (DVI) in the South East Asian tsunami of 2004, but later also used in the investigation of the murder of Foreign Minister Anna Lindh (cf. Ansell and Rasmusson 2008; Hansson and Björkman 2006). These exceptional uses have opened up opportunities for the debate around a criminal DNA database and its constituency in Sweden, and for the use of medical databases in DVI and criminal investigations (e.g. Capps 2012).

More recently, Irish public media has apparently discussed and welcomed the introduction of a DNA database in 2012, a debate that has been ongoing for some time in the only European country so far to deliberate in depth on social, ethical and legal aspects of DNA databasing before any such device has been instituted.

In the case of Belgium, the recent apparent success of using familial searching in a manhunt taking samples from 8,000 males in the Netherlands in November 2012 – subsequently leading to the arrest and charge of a man for the rape and murder of 17 year girl 13 years ago – has re-opened and influenced public and media debate about a national general DNA database. The Belgian example also illustrates divergent opinions of criminal DNA databases in different regions, with the Flemish region being more welcoming and the Southern Wallonian region more sceptical about potential secondary uses of a DNA database, primarily the concern about garnering medical information for commercial and other purposes.

Whilst the cited examples give a brief overview of activities, these remain limited in scope, and many took place some years ago without the benefit of subsequent supplementation. One of the ambitions of EUROFORGEN in general, and this WP in particular, is to improve the quality of existing debates about ethical, social and policy issues surrounding developments in forensic genetics. The original bid for the Network funding asserted that it was essential to identify the social, legal and ethical risks associated with the application of forensic genetics in support of criminal investigations and national security. Public concerns about criminal DNA databases and the protection of individual privacy rights need to be understood and addressed in the context of maintaining the safety of citizens and the security of European societies. Research, industry, stakeholders and end-users need a common framework of reference to facilitate the exchange of ideas and opinions, and to improve and moderate both the practical applications and the social acceptance of these new technologies.

At the same time, public discussion will be improved if people beyond the narrow community of research forensic geneticists have a clearer grasp of what research is ongoing; what its aims and achievements are and have been; what developments are likely to occur in the near future; and what their contributions will be to criminal justice. Trust is an issue of knowledge management, specifically in cases of ‘asymmetric technology partnerships’ in which some stakeholders know much more about the capacities of technologies than others but both are necessarily involved in the uses – and material and/or discursive development – of such technologies. For public discussion to happen, and this asymmetry to be addressed, it is necessary to move beyond the promotion, exchange or interrogation of ‘visions, promises and expectations’ (Lucivero, Swierstra, and Boenink 2011, 130) to a more informed assessment of technical feasibility, operational utility and social acceptability. We

think that an important precursor to the production of that informed assessment is adequate recognition of the porous boundaries that separate scientific considerations from social ones, and the gathering together of a range of viewpoints – from knowledge producers and users including criminal justice stakeholders, publics and policy makers – about the role, place and organisation of forensic genetic innovations in a societal and human context.

Conclusion

We have suggested in the course of this report that scientific innovations in forensic genetics are continuous and diverse. Like all scientific activity, forensic genetics necessarily is situated in specific cultural, social and political contexts. The development of DNA-related research for forensic uses is fuelled by the desire to develop the scientific ability to capture genomic attributes of individuals, relationships and social groupings, and to use that knowledge to improve processes and outcomes with the criminal justice system. The criminal justice system, in turn, is part of the balance of power in a liberal state – observing certain rights of the individual – that fundamentally understands its role as provider of security for its subjects. The scientific research and understanding of DNA as well as the development of methodologies of utilising DNA for criminal justice ends, are therefore, shaped by a variety of perspectives – including on how to use and regulate the use of DNA – that are supported by, and positioned within, a range of national and international scientific, societal, political, legal and other domains.

Our aim is to distil and disseminate the essence of these perspectives in order to raise awareness of the issues that have proved controversial in one or several jurisdictions. Our intention is not to bolster claims of objectivity, or overstate what is known about benefits (what Jasanoff (2003) refers to as ‘technologies of hubris’). Nor is our aim to assert the presence of widespread social dangers where they can only be imagined rather than documented. Rather, we want to find a balance between critical engagement, transparency about technology development and capacities, and support for the development of societally relevant, useful and acceptable technology. It is this pluralistic input, an openness to learning, and ‘informed dissent’ which comprises what some consider to be an appropriate ‘European’ approach to science and technology (Jasanoff 2003; Expert Group on Science and Governance 2007). We would like this review to contribute to such an approach.

REFERENCES

- Abraham, J., and R. Ballinger. 2012. "Power, expertise and the limits of representative democracy: genetics as scientific progress or political legitimation in carcinogenic risk assessment of pharmaceuticals?" *Journal of community genetics* no. 3 (2):91-103.
- Aitken, Colin, Paul Roberts, and Graham Jackson. 2010. Practitioner Guide No 1: Fundamentals of Probability and Statistical Evidence in Criminal Proceedings. Guidance for Judges, Lawyers, Forensic Scientists and Expert Witnesses. In *Communicating and Interpreting Statistical Evidence in the Administration of Criminal Justice*. London: Royal Statistical Society.
- Allen, Garland. 2004. "DNA and human-behaviour genetics. Implications for the criminal justice system." In *DNA and the criminal justice system. The technology of justice*, edited by David Lazer, 287-314. Cambridge MA; London: The MIT Press.
- Amorim, Antonio. 2011. "A comment on "The hare and the tortoise: One small step for four SNPs, one giant leap for SNP-kind"." *Forensic Science International: Genetics* no. 5:358–360.
- . 2012. "Opening the DNA black box: demythologizing forensic genetics." *New Genetics and Society* no. 31 (3):259-270.
- Amorim, Antonio, and Luisa Pereira. 2005. "Pros and cons in the use of SNPs in forensic kinship investigation: a comparative analysis with STRs." *Forensic Science International* no. 150:17-21.
- Ansell, Ricky, and Birgitta Rasmusson. 2008. "A Swedish Perspective." *BioSocieties* no. 3 (01):88-92. doi: doi:10.1017/S174585520800598X.
- Asari, M., T. Omura, K. Oka, C. Maseda, Y. Tasaki, H. Shiono, K. Matsubara, M. Matsuda, and K. Shimizu. 2012. "Multiplex PCR-based Alu insertion polymorphisms genotyping for identifying individuals of Japanese ethnicity." *Genomics* no. 99(4):227-232.
- Atkinson, P., P.E. Glasner, and M.M. Lock. 2009. *Handbook of genetics and society: mapping the new genomic era*. Oxon: Routledge.
- Balding, D J, and P. Donnelly 1994. "The prosecutor's fallacy and DNA evidence." *Criminal Law Review*: 711-721.
- Ball, Kirstie. 2005. "Organization, surveillance and the body: towards a politics of resistance." *Organization* no. 12 (1):89-108.
- Barbour, E.C. 2011. DNA Databanking: Selected Fourth Amendment Issues and Analysis. Washington DC: Congressional Research Service.
- Barry, Andrew. 2001. *Political Machines: Governing a Technological Society*. London: Athlone Press.
- Beck, U. 1986. *Risikogesellschaft: Auf dem Weg in eine andere Moderne*: Suhrkamp Frankfurt.
- Børsting, C., M. Mikkelsen, and N. Morling. 2012. "Kinship Analysis with Diallelic SNPs-Experiences with the SNPforID Multiplex in an ISO17025 Accredited Laboratory." *Transfusion Medicine and Hemotherapy* no. 39 (3):195.
- Borup, M., N. Brown, K. Konrad, and H. Van Lente. 2006. "The sociology of expectations in science and technology." *Technology Analysis & Strategic Management* no. 18 (3-4):285-298.
- Bostanci, Adam. 2011. "Genetic Ancestry Testing as Ethnic Profiling." *Science as Culture* no. 20 (1):107-114.
- Bramley, B. 2009. "DNA Databases." In *Handbook of Forensic Science*, edited by J. Fraser and R. Williams, 309-336. Cullompton: Willan.
- Briody, M. 2006. "The Effects of DNA Evidence on Property Offences in Court." *Current Issues in Criminal Justice* no. 17 (3):380-396.
- Briody, M., and T. Prenzler. 2005. "DNA Databases and Property Crime: A False Promise?" *Australian Journal of Forensic Sciences* no. 37 (2):73-86.

- Briody, Michael. 2004. *The Effects of DNA Evidence On The Criminal Justice Process*, School of Criminology and Criminal Justice, Griffith University.
- Brown, N., B. Rappert, and A. Webster. 2000. *Contested futures: A sociology of prospective technology*: Ashgate Aldershot.
- Brown, Nik, and Mike Michael. 2003. "A sociology of expectations: retrospecting prospects and prospecting retrospects." *Technology Analysis and Strategic Management* no. 15:3-18.
- Budowle, B., and A. Van Daal. 2008. "Forensically relevant SNP classes." *BioTechniques: The international journal of life science methods* no. 44 (5):603.
- Bugert, P., and H. Klüter. 2012. "100 Years after von Dungern & Hirschfeld: Kinship Investigation from Blood Groups to SNPs." *Transfusion Medicine and Hemotherapy* no. 39 (3):161.
- Burchell, Kevin. 2007. "Boundary work, associative argumentation and switching in the advocacy of agricultural biotechnology." *Science as Culture* no. 16 (1):49-70.
- Caddy, Brian, G R Taylor, and Adrian Linacre. 2008. *A Review of Low Template DNA Analysis*. London: The Home Office.
- Capps, Benjamin. 2012. "The public interest, public goods, and third-party access to UK Biobank." *Public Health Ethics* no. 5 (3):240-251.
- Capron, A. M., A. Mauron, B. S. Elger, A. Boggio, A. Ganguli-Mitra, and N. Biller-Andorno. 2009. "Ethical Norms and the International Governance of Genetic Databases and Biobanks: Findings from an International Study." *Kennedy Institute of Ethics Journal* no. 19:101.
- Chadwick, R., and K. Berg. 2001. "Solidarity and equity: new ethical frameworks for genetic databases." *Nature Reviews Genetics* no. 2 (4):318-321.
- Cheng, E.K., and A.H. Yoon. 2005. "Does Frye or Daubert matter? A study of scientific admissibility standards." *Virginia Law Review* 91: 471-513.
- Cho, Mildred K, and Pamela Sankar. 2004. "Forensic genetics and ethical, legal and social implications beyond the clinic." *Nature Genetics Supplement* no. 36:S8-S12.
- Chow-White, Peter A, and Troy Duster. 2011. "Do Health and Forensic DNA Databases Increase Racial Disparities?" *PLoS Medicine* no. 8 (10):e1001100. doi: 10.1371/journal.pmed.1001100.
- Clayton, T. M., J. Whitaker, and C. N. Maguire. 1995. "Identification of bodies from a scene of a mass disaster using DNA amplification of short tandem repeat (STR) loci." *Forensic science International* no. 76:7-15.
- Cohen, S. 1985. *Visions of Social Control. Crime, Punishment and Classification*. New York: Blackwell.
- Cole, Simon A. 2004. "Fingerprint Identification and the Criminal Justice System: Historical Lessons for the DNA Debate." In *DNA and the Criminal Justice System*, edited by David Lazer, 63-90. Cambridge Mass: MIT Press.
- Cook-Deegan, Robert M. 1994. *The gene wars: Science, politics, and the human genome*: WW Norton & Company.
- Council of Europe. 2008. *Case of S. and Marper vs. the United Kingdom, Applications nos. 30562/04 and 30566/04, 4 December*. Strasbourg: European Court of Human Rights.
- Criminal Justice and Public Order Act*. 1994.
- Cutter, A.M. 2006. "To clear or to convict? The role of genomics in criminal justice." *Genomics, Society and Policy* no. 1 (3):1-15.
- Dario, P., T. Ribeiro, R. Espinheira, D. Dias, H. Geada, and F. Corte-Real. 2011. "20 SNPs as supplementary markers in kinship testing." *Forensic Science International: Genetics Supplement Series* no. 3(1): e508-e509.
- de Keijser, Jan, and Henk Elffers. 2011. "Understanding of forensic expert reports by judges, defense lawyers and forensic professionals." *Psychology, Crime & Law* no. 18 (2):191-207.
- Deftos, L.J. 1994. "Daubert & Frye: Compounding the Controversy over the Forensic Use of DNA Testing." *Whittier L. Rev.* no. 15:955.
- Duff, Peter. 1998. "Crime Control, Due Process and 'The Case for the Prosecution'." *British Journal of Criminology* no. 38:611-615.
- Duster, Troy. 2003. *Backdoor to Eugenics*. 2nd ed. New York: Routledge.

- . 2004. "Selective Arrests, an Ever-Expanding DNA Forensic Database, and the Specter of an Early-Twenty-First Century Equivalent of Phrenology." In *DNA and the Criminal Justice System: The Technology of Justice*, edited by David Lazer, 315-334. Cambridge Mass: MIT Press.
- . 2005. "Race and Reification in Science." *Science* no. 307:1050-1051.
- . 2006a. "Explaining differential trust of DNA forensic technology: grounded assessment or inexplicable paranoia?" *Journal of Law, Medicine and Ethics* no. 34 (2):293-300.
- . 2006b. "The molecular reinscription of race: unanticipated issues in biotechnology and forensic science." *Patterns of Prejudice* no. 40 (4-5):427-441.
- Edmond, Gary. 2012. "Just truth? Carefully applying history, philosophy and sociology of science to the forensic use of CCTV images." *Studies in History and Philosophy of Science Part C: Studies in History and Philosophy of Biological and Biomedical Sciences*. doi: 10.1016/j.shpsc.2012.09.004.
- Ericson, R. V., and C D Shearing. 1986. "The Scientification of Police Work." In *The Knowledge Society: The Growing Impact of Scientific Knowledge on Social Relations*, edited by G. Bohme and N. Stehr, 129-159. Dordrecht: D. Reidel Publishing Company.
- Etzioni, Amitai. 1999. "Enhancing Privacy, Preserving the Common Good." *Hastings Center Report* no. 29 (2):14-23.
- . 2004. "DNA tests and databases in criminal justice. Individual rights and the common good." In *DNA and the criminal justice system. The technology of justice*, edited by David Lazer, 197-224. Cambridge MA; London: The MIT Press.
- . 2006. "A communitarian approach: a viewpoint on the study of the legal, ethical and policy considerations raised by DNA tests and databases." *The Journal of Law, Medicine & Ethics* no. 34 (2):214-221.
- Evvett, Ian, Sue Pope, and Gillian Tully. 2012. Forensic science. The police piper calls the tune. *The Law Society Gazette* (07 November 2012), <http://www.lawgazette.co.uk/68187.article>
- Expert Group on Science and Governance. 2007. Taking European Knowledge Society Seriously. Report of the Expert Group on Science and Governance to the Science, Economy and Society Directorate, Directorate-General for Research, European Commission. Brussels.
- Farahany, Nita A., and William Bernet. 2006. "Behavioural Genetics in Criminal Cases: Past, Present and Future." *Genomics, Society and Policy* no. 2 (1):72-79.
- Fereday, Lyn. 2004. Transforming the use of Forensics through the DNA Expansion Programme. Paper read at Beyond DNA in the UK - Integration and Harmonisation, 17th-19th May 2004, at Newport, South Wales.
- Fradella, H.F., L. O'Neill, and A. Fogary. 2003. "The Impact of Daubert on Forensic Science." *Pepp. L. Rev.* no. 31:323.
- Gallie, W.B. 1956. "Essentially Contested Concepts." *Proceedings of the Aristotelian Society* no. 56:167-198.
- Garland, D. 1996. "The Limits of the Sovereign State: Strategies of Crime Control in Contemporary Society." *British Journal of Criminology* no. 36:445-471.
- Gaskell, G., N. Allum, and S. Stares. 2003. Europeans and Biotechnology in 2002. Eurobarometer 58.0: Report to the EC Directorate General for Research, London: London School of Economics. http://ec.europa.eu/public_opinion/archives/ebs/ebs_177_en.pdf
- Gen-ethisches Netzwerk e.V. 2012. *Finger weg von meiner DNA [Stop the DNA collection frenzy!]* 2011 [cited 12 December 2012], <http://fingerwegvonmeinerdna.blogspot.eu/>.
- Genewatch UK. 2005. The Police National DNA Database: Balancing Crime Detection, Human Rights and Privacy. Bixton.
- Gerlach, Neil. 2004. *The Genetic Imaginary: DNA in the Canadian Criminal Justice System*. Toronto: University of Toronto Press.

- . 2009. "From bodily integrity to genetic surveillance. The impacts of DNA identification in criminal justice." In *Surveillance. Power, problems, and politics*, edited by Sean P. Hier and Josh Greenberg, 135-150. Vancouver: UBC Press.
- Gibson, M. 2001. "The Truth Machine: Polygraphs, Popular Culture and the Confessing Body." *Social Semiotics* no. 11:61-73.
- Gill, P., P. L. Ivanov, C. Kimpton, R. Piercy, N. Benson, G. Tully, I. Evett, E. Hagelberg, and K. Sullivan. 1994. "Identification of the Remains of the Romanov Family by DNA Analysis." *Nature Genetics* no. 6 (2):130-135.
- Gill, Peter, June Guinness, and Simon Iveson. *The Interpretation of DNA Evidence (including low-template DNA)*. UK Forensic Science Regulator 2012. Available from <http://www.homeoffice.gov.uk/publications/agencies-public-bodies/fsr/interpretation-of-dna-evidence?view=Binary>.
- González Fuster, Gloria, Serge Gutwirth, and Paul de Hert. 2009. D.2.2 Analysis of the value dimensions of European law relevant to current and anticipated challenges of the internal/external security continuum. In *FP7 Project, Converging and Conflicting Ethical Values in the Internal/External Security Continuum in Europe (INEX)*. Brussels.
- Goodman, Alan H., Deborah Heath, and M. Susan Lindee. 2003. *Genetic Nature/Culture. Anthropology and Science beyond the Two-Culture Divide*. Berkeley; Los Angeles; London: University of California Press.
- Goodwin, William, Adrian Linacre, and Sibte Hadi. 2007. *An Introduction to Forensic Genetics*. London: Wiley.
- Greer, S. 2000. The margin of appreciation. Interpretation and discretion under the European Convention on Human Rights. In *Human Rights Files No.17*. Strasbourg: Council of Europe.
- Hagelberg, Erika, Ian C. Gray, and Alec J. Jeffreys. 1991. "Identification of the skeletal remains of a murder victim by DNA analysis." *Nature* no. 352 (6334):427-429.
- Hansson, Sven Ove, and Barbro Björkman. 2006. "Bioethics in Sweden." *Cambridge Quarterly of Healthcare Ethics* no. 15 (3):285-293.
- Harris, J. 2005. "Scientific research is a moral duty." *Journal of medical ethics* no. 31 (4):242-248.
- Häyry, M. 2003. "European values in bioethics: why, what, and how to be used." *Theoretical medicine and bioethics* no. 24 (3):199-214.
- . 2004. "Another look at dignity." *Cambridge Quarterly of Healthcare Ethics* no. 13 (1):7-14.
- . 2006. "Public health and human values." *Journal of medical ethics* no. 32 (9):519-521.
- Häyry, M., and T. Takala. 2007. "American principles, European values and the mezzanine rules of ethical genetic databanking." In *The Ethics and Governance of Human Genetic Databases: European Perspectives*, edited by M. Häyry, R. Chadwick, V. Arnason and G. Arnason, 14-36. Cambridge: Cambridge University Press.
- Hedgecoe, A., and P.A. Martin. 2008. "Genomics, STS and the Making of Sociotechnical Futures." In *The Handbook of Science and Technology Studies*, edited by E.J Hackett, O. Amsterdamska, M. Lynch and J. Wajcman, 817-840. Cambridge Mass.: MIT Press.
- Hedgecoe, Adam, and Paul Martin. 2003. "The Drugs Don't Work: Expectations and the Shaping of Pharmacogenetics." *Social Studies of Science* no. 33 (3):327-364.
- Hepple, Bob. 2009. "Forensic databases: implications of the cases of S and Marper." *Medicine, Science & The Law* no. 49:77-87.
- Hindmarsh, Richard, and Barbara Prainsack. 2010. *Genetic Suspects: Global Governance of Forensic DNA Profiling and Databasing*. Cambridge: Cambridge University Press.
- Holder Jr., Eric H., Mary Lou Leary, and John H. Laub. 2012. DNA for the Defense bar. In *DNA Initiative*, edited by National Institute of Justice. Washington D.C.: U.S. Department of Justice Office of Justice Programs.
- Home Office. 2009. Keeping The Right People on the DNA Database: Science & Public Protection. London: The Home Office.

- Houck, M.H. 2009. *Science versus crime*. Edited by Suzanne Bell, *Essentials of Forensic Science*. New York: Facts on File.
- Hsu, Spencer S. 2012. Justice Dept., FBI to review use of forensic evidence in thousands of cases. *The Washington Post*, http://www.washingtonpost.com/local/crime/justice-dept-fbi-to-review-use-of-forensic-evidence-in-thousands-of-cases/2012/07/10/gJQAT6DlbW_story.html.
- Human Genetics Commission. 2001. *Public Attitudes to Human Genetic Information*. London: HGC.
- . 2009. *Nothing to Hide, Nothing to Fear? Balancing individual rights and the public interest in the governance and use of the National DNA Database*. London: HGC.
- Hungarian Civil Liberties Union. 2012. *The HCLU has issued its opinion on the draft of the Act on the Protection of Humangenetic Data 2008* [cited 12 December 2012], <http://tasz.hu/en/data-protection/hclu-has-issued-its-opinion-draft-act-protection-humangenetic-data>.
- Informal High Level Advisory Group on the Future of European Home Affairs Policy ('The Future Group'). 2008. *Freedom, Security, Privacy: European Home Affairs in an open world*, <http://www.statewatch.org/news/2008/jul/eu-futures-jha-report.pdf>.
- Jacobs, Francis G. 1999. "Recent developments in the principle of proportionality in European Community law." In *The principle of proportionality in the laws of Europe*, edited by Evelyn Ellis, 1-22. Oxford; Portland OR: Hart Publishing.
- Jasanoff, Sheila. 1995. *Science at the Bar: Law, Science and Technology in America*. Cambridge Mass: Harvard University Press.
- . 2003. "Technologies of humility: citizen participation in governing science." *Minerva* no. 41:223-244.
- . 2004. *States of Knowledge: The Co-Production of Science and Social Order*. Routledge: London.
- . 2005. *Designs on Nature: Science and Democracy in Europe and the United States*. Princeton NJ: Princeton University Press.
- . 2012. "Genealogies of STS." *Social Studies of Science* no. 42 (3):435-441.
- Jeffreys, Alec, V Wilson, and S.L. Thein. 1985. "Hypervariable 'Minisatellite' Regions in Human DNA." *Nature* no. 314:67-73.
- Jobling, Mark A, and P Gill. 2004. "Encoded Evidence: DNA in Forensic Analysis." *Nature Reviews* no. 5:739-751.
- Johnson, P., and R. Williams. 2007. "Internationalizing new technologies of crime control: forensic DNA databasing and datasharing in the European union." *Policing & Society* no. 17 (2):103-118.
- Jonas, H. 1979. *Das Prinzip Verantwortung*. Frankfurt/Main: Insel-Verlag.
- Kaye, D.H. 2010. *The Double Helix and The Law of Evidence*. Cambridge Mass: Harvard University Press.
- Kaye, D.H., and George Sensebaugh. 2011. "Reference guide on DNA identification evidence." In *Reference manual on scientific evidence*, edited by Federal Judicial Centre - National Research Council, 129-210. Washington D.C.: The National Academies Press.
- Kaye, D.H., and Michael Smith. 2003. "DNA Identification Databases: Legality, Legitimacy and the Case for Population-Wide Coverage." *Wisconsin Law Review* 413-460.
- Kaye, J. 2008. "Regulating Human Genetic Databases in Europe." In *The Ethics and Governance of Human Genetic Databases: European Perspectives*, edited by M Hayry, R Chadwick, V Arnason and G Arnason, 91-96. Cambridge: Cambridge University Press.
- Kayser, M., and P.M. Schneider. 2009. "DNA-based prediction of human externally visible characteristics in forensics: motivations, scientific challenges, and ethical considerations." *Forensic Science International: Genetics* no. 3 (3):154-161.
- Kidd, J.R., F.R. Friedlander, W.C. Speed, A. J. Pakstis, F.M. De La Vega, and K. K. Kidd. 2011. "Analyses of a set of 128 ancestry informative single-nucleotide polymorphisms in a global set of 119 population samples." *Investigative Genetics* no. 2 (1):1-13.

- Kidd, K.K., J.R. Kidd, W.C. Speed, R. Fang, M.R. Furtado, FCL Hyland, and A.J. Pakstis. 2012. "Expanding data and resources for forensic use of SNPs in individual identification." *Forensic Science International: Genetics* no. 6(5):646-652.
- Klatt, Matthias, and Moritz Meister. 2012. *The constitutional structure of proportionality*. Oxford: Oxford University Press.
- Koehler, J. 1997. "Why DNA likelihood ratios should account for error (even when a national research council report says they should not)." *Jurimetrics Journal* no. 37:425.
- Koehler, J., and DH Kaye. 1991. "Can Jurors Understand Probabilistic Evidence?" *Journal of the Royal Statistical Society, Series A* no. 154 (1):75-81.
- Koehler, Jonathan J. 2001. "The Psychology of Numbers in the Courtroom: How to Make DNA Match Statistics Seem Impressive or Inefficient." *Southern California Law Review* no. 74:1275-1306.
- Krimsky, Sheldon, and Tania Simoncelli. 2011. *Genetic Justice: DNA Databanks, Criminal Investigations, and Civil Liberties*. New York: Columbia University Press.
- Krohn, W., and J. Weyer. 1994. "Society as a laboratory: the social risks of experimental research." *Science and Public Policy* no. 21 (3):173-183.
- Lander, Eric S. 1992. "DNA fingerprinting: science, law, and the ultimate identifier." In *The Code of Codes. Scientific and Social Issues in the Human Genome Project*, edited by Daniel J. Kevles and Leroy Hood. Cambridge, MA & London: Harvard University Press.
- Lander, Eric, S., and Bruce Budowle. 1994. "DNA Fingerprinting Dispute Laid to Rest." *Nature* no. 371:735-738.
- Latour, Bruno. 1983. "Give me a laboratory and I will raise the world." In *Science observed: perspectives on the social study of science*, edited by Karin Knorr-Cetina and Michael Mulkey. London: SAGE Publications. 141-170.
- . 1987. *Science in Action : How to Follow Scientists and Engineers through Society*. Milton Keynes: Open University Press.
- Lave, R., P. Mirowski, and S. Randalls. 2010. "Introduction: STS and neoliberal science." *Social Studies of Science* no. 40 (5):659-675.
- Lawless, Christopher James. 2012. "The low template DNA profiling controversy: Biolegality and boundary work among forensic scientists." *Social Studies of Science* no. 43(2):191-214.
- Lazer, David. 2004. *DNA and the Criminal Justice System: The Technology of Justice*. Cambridge, MA: MIT Press.
- Lempert, R. 1996. "After the DNA wars: skirmishing with NRC II." *Jurimetrics* no. 37:439.
- . 1997. "After the DNA Wars: A Mopping Up Operation." *Isr. L. Rev.* no. 31:536.
- Lente, H. 1993. *Promising technology: the dynamics of expectations in technological developments*, Universiteit Twente.
- Leung, W. 2002. "The Prosecutor's Fallacy--A pitfall in interpreting probabilities in forensic evidence." *Medicine Science and the Law* no. 42 (1):44-50.
- Levitt, M., and F. Tomasini. 2006. "Bar-coded children: an exploration of issues around the inclusion of children on the England and Wales National DNA database." *Genomics Society and Policy* no. 2 (1):41-56.
- Levitt, Mairi, and Neil Manson. 2007. "My Genes Made Me Do It? The Implications of Behavioural Genetics for Responsibility and Blame." *Health Care Analysis* no. 15 (1):33-40.
- Liss-Schultz, Nina. 2012. Justice department and FBI launch largest ever post-conviction review. *ThinkProgress*, Center for American Progress Action Fund (11 July 2012), <http://thinkprogress.org/justice/2012/07/11/514416/justice-department-and-fbi-launch-largest-ever-post-conviction-review/>.
- Lucivero, F., T. Swierstra, and M. Boenink. 2011. "Assessing expectations: towards a toolbox for an ethics of emerging technologies." *NanoEthics* no. 5 (2):129-141.
- Lynch, Michael. 2003. "God's signature: DNA profiling, the new gold standard in forensic science." *Endeavour* no. 27 (2):93-97.

- Lynch, Michael, Simon A. Cole, Ruth McNally, and Kathleen Jordan. 2008. *Truth machine. The contentious history of DNA fingerprinting*. Chicago, London: The University of Chicago Press.
- Lynch, Michael, and Ruth McNally. 2009. "Forensic DNA databases and biolegality: the co-production of law, surveillance technology and suspect bodies." In *Handbook of Genetics and Society: Mapping the New Genomic Era*, edited by Paul Atkinson, Peter Glasner and Margaret Lock, 283-301. London: Routledge.
- M'charek, Amade. 2000. "Technologies of Population: Forensic DNA Testing Practices and the Making of Differences and Similarities." *Configurations* no. 8:121-158.
- . 2008. "Silent witness, articulate collectives: DNA evidence and the inference of visible traits." *Bioethics* no. 22 (9):519-528.
- M'charek, A., V. Toom, and B. Prainsack. 2012. "Bracketing off population does not advance ethical reflection on EVCs: A reply to Kayser and Schneider." *Forensic Science International: Genetics* no. 6 (1):e16-e17.
- Machado, H., F. Santos, and S. Silva. 2011. "Prisoners' Expectations of the National Forensic DNA Database: Surveillance and Reconfiguration of Individual Rights." *Forensic Science International* no. 210:139-143.
- Machado, H., and S. Silva. 2012. "Criminal Genomic Pragmatism: Prisoner's Representations of DNA Technology and Biosecurity." *Journal of Biomedicine and Biotechnology* no. 2012.
- Machado, Helena, and Silvana Silva. 2010. "Portuguese forensic DNA database: political enthusiasm, public trust and probable issues in future practice." In *Genetic Suspects. Global Governance of Forensic DNA Profiling and Databasing*, edited by Richard Hindmarsh and Barbara Prainsack, 218-239. Cambridge: Cambridge University Press.
- Mansel, C., and S. Davies. 2012. "Minors or suspects? A discussion of the legal and ethical issues surrounding the indefinite storage of DNA collected from children aged 10–18 years on the National DNA Database in England and Wales." *Medicine, Science and the Law*.
- Marris, C., and N. Rose. 2012. "Let's get real on synthetic biology." *New Scientist* no. 214 (2868):28-29.
- Martin, P., N. Brown, and A. Kraft. 2008. "From bedside to bench? Communities of promise, translational research and the making of blood stem cells." *Science as Culture* no. 17 (1):29-41.
- McCartney, C. 2006a. *Forensic Identification and Criminal Justice: Forensic Science, Justice and Risk*. Cullompton: Willan.
- McCartney, C., R. Williams, and T. Wilson. 2010. *The Future of Forensic Bioinformation*. London: Nuffield Foundation.
- McCartney, Carole. 2006b. "The DNA Expansion Programme and Criminal Investigation." *British Journal of Criminology* no. 46:175-192.
- . 2012. "Of weighty reasons and indiscriminate blankets: The retention of DNA for forensic purposes." *The Howard Journal of Criminal Justice* no. 51 (3):245-260.
- Metropolitan Police Authority Civil Liberties Panel. 2011. *Protecting the innocent. The London experience of DNA and the National DNA Database*. London: Metropolitan Police Authority.
- Michaelis, Ron, Robert Flanders, and Paula Wulff. 2008. *A Litigator's Guide to DNA. From the Laboratory to the Courtroom*. Burlington MA, San Diego CA, London: Academic Press.
- Mooki, Omphemetse. 1997. "DNA typing as a forensic tool: applications and implications for civil liberties." *South African Journal on Human Rights* no. 13:565-580.
- Morling, Niels. 2003. "International Recommendations for Paternity Testing Standards." *International Journal of Legal Medicine* no. 117 (1):1-1.
- Moulton, Benjamin W. 2006. "DNA fingerprinting and civil liberties." *J.L. Med. & Ethics* no. 34 (1):147-148.
- Mullis, KB, FA Faloona, SJ Scharf, RK Saiki, GT Horn, and H. Erlich. 1986. Specific enzymatic amplification of DNA in vitro: the polymerase chain reaction. Paper read at Cold Spring Harbor Symposium on Quantum Biology.

- Murphy, Erin. 2009. The Art in the Science of DNA: A Layperson's guide to the subjectivity inherent in Forensic DNA Typing, *Emory Law Journal* no. 58:489-512.
- National Policing Improvement Agency. 2012. *Police National Computer* [cited 19 December 2012]. Available from <http://www.npia.police.uk/en/10508.htm>.
- National Research Council. 1992. *DNA Technology in Forensic Science*. Washington D.C.: National Academy Press.
- . 1996. *The Evaluation of Forensic DNA Evidence*. Washington D.C.: National Academy Press.
- . 2009. *Strengthening Forensic Science in the United States: A Path Forward*. Washington DC: National Academy Press.
- Nelkin, Dorothy, and Lori Andrews. 1999. "DNA identification and surveillance creep." *Sociology of Health & Illness* no. 21(5):689-706.
- Nelkin, Dorothy, and M.S. Lindee. 1995. *The DNA Mystique: The Gene As Cultural Icon*. New York: Freeman.
- Neufeld, P. 2000. "Legal and ethical implications of post-conviction DNA exonerations." *New Eng. L. Rev.* no. 35:639.
- Nordmann, A. 2009. "European experiments." *Osiris* no. 24 (1):278-302.
- Nuffield Council on Bioethics. 2007. *The Forensic Uses of Bioinformation: Ethical Issues*. London: The Nuffield Council.
- Onay, Ozan. 2006. "The true ramifications of genetic criminality research for free will in the criminal justice system." *Genomics, Society and Policy* no. 2 (1):80-91.
- Ossorio, Pilar, and Troy Duster. 2005. "Race and Genetics: Controversies in Biomedical, Behavioural and Forensic Sciences." *American Psychologist* no. 60 (1):115-128.
- Owen, R., and N. Goldberg. 2010. "Responsible innovation: a pilot study with the UK Engineering and Physical Sciences Research Council." *Risk Analysis* no. 30 (11):1699-1707.
- Owen, Richard, David Baxter, Trevor Maynard, and Michael Depledge. 2009. "Beyond Regulation: Risk Pricing and Responsible Innovation." *Environmental Science & Technology* no. 43 (18):6902-6906.
- Owen, Richard, Phil Macnaghten, and Jack Stilgoe. 2012. "Responsible research and innovation. From science in society to science for society, with society." *Science and Public Policy* no. 39:751-760.
- Pereira, R., V. Pereira, I. Gomes, C. Tomas, N. Morling, A. Amorim, M.J. Prata, Á. Carracedo, and L. Gusmão. 2012. "A method for the analysis of 32 X chromosome insertion deletion polymorphisms in a single PCR." *International Journal of Legal Medicine* no. 126 (1):97-105.
- Peterson, J L, G Lin, M Ho, Y Chen, and R E Gaensslen. 2003a. "The Feasibility of External Blind DNA Proficiency Testing. I. Background and Findings." *Journal of Forensic Science* no. 48 (1):21-31.
- . 2003b. "The Feasibility of External Blind DNA Proficiency Testing. II. Experience with Actual Blind Tests." *Journal of Forensic Science* no. 48 (1):32-40.
- Peterson, Joseph, Ira Sommers, Deborah Baskin, and Donald Johnson. 2010. *The Role and Impact of Forensic Evidence in the Criminal Justice Process*. Washington: National Institute of Justice.
- Pickersgill, M. 2012. "The co-production of science, ethics and emotion." *Science, Technology & Human Values* no. 37(6):579-603.
- Prainsack, B. 2010a. "Key issues in DNA profiling and databasing. Implications for governance." In *Genetic suspects. Global governance of forensic DNA profiling and databasing*, edited by Richard Hindmarsh and Barbara Prainsack, 15-39. Cambridge: Cambridge University Press.
- Prainsack, B., and A. Buyx. 2011. "Solidarity. Reflections on an Emerging Concept in Bioethics." *London: Nuffield Council on Bioethics*.
- Prainsack, Barbara. 2010b. "Partners in crime: on the use of forensic DNA technologies in Austria." In *Genetic Suspects. Global Governance of Forensic DNA Profiling and Databasing*, edited by Richard Hindmarsh and Barbara Prainsack, 153-174. Cambridge: Cambridge University Press.
- Prainsack, Barbara, and Martin Kitzberger. 2009. "DNA behind bars: other ways of knowing forensic DNA technologies." *Social Studies of Science* no. 39 (1):51-79.

- Prainsack, Barbara, and Victor Toom. 2010. "The Prüm regime: Situated dis/empowerment in transnational DNA profile exchange." *British Journal of Criminology* no. 50 (6):1117-1135.
- Puch-Solis, Roberto, Paul Roberts, Susan Pope, and Colin Aitken. 2012. Practitioner Guide No 2: Assessing the probative value of DNA evidence. Guidance for Judges, Lawyers, Forensic Scientists and Expert Witnesses. In *Communicating and Interpreting Statistical Evidence in the Administration of Criminal Justice*. London: Royal Statistical Society.
- Raymond, J.J. 2010. *A Criminalistic Approach to Biological Evidence: Trace DNA and Volume Crime Offences*. Sydney University of Technology Sydney.
- Raymond, J.J., R.A.H. van Oorschot, P.R. Gunn, S.J. Walsh, and C. Roux. 2009. "Trace DNA success rates relating to volume crime offences." *Forensic Science International: Genetics Supplement Series* no. 2 (1):136-137.
- Raymond, J.J., R.A.H. van Oorschot, S.J. Walsh, C. Roux, and P.R. Gunn. 2009. "Trace DNA and street robbery: A criminalistic approach to DNA evidence." *Forensic Science International: Genetics Supplement Series* no. 2 (1):544-546.
- Roberts, Paul. 1996. "What price a Free Market in Forensic Science Services? The Organisation and Regulation of Science in the Criminal Process." *British Journal of Criminology* no. 36:37-60.
- Roeder, Kathryn. 1994. "DNA Fingerprinting: A Review of the Controversy." *Statistical Science* no. 9 (2):222-278.
- Roewer, L., and J.T. Epplen. 1992. "Rapid and sensitive typing of forensic stains by PCR amplification of polymorphic simple repeat sequences in case work." *Forensic Science International* no. 53 (2):163-171.
- Roman, J.K., S. Reid, J. Reid, A. Chalfin, W. Adams, and C. Knight. 2008. *The DNA Field Experiment: Cost-Effectiveness Analysis of the Use of DNA in the Investigation of High-Volume Crimes*. Washington: Urban Institute.
- Rose, N. 2000. "The Biology of Culpability: Pathological Identity and Crime Control in a Biological Culture." *Theoretical Criminology* no. 4:5-34.
- Rose, Nikolas. 2006. *The Politics of Life Itself. Biomedicine, Power, and Subjectivity in the Twenty-First Century*. Princeton: Princeton University Press.
- Ruiz, Y., C. Phillips, A. Gomez-Tato, J. Alvarez-Dios, M. Casares de Cal, R. Cruz, O. Maroñas, J. Söchtig, M. Fondevila, and MJ Rodriguez-Cid. 2012. "Further development of forensic eye color predictive tests." *Forensic Science International: Genetics* no. 7(1):28-40.
- Scheck, B, P Neufeld, and J. Dwyer. 2000. *Actual Innocence*. New York: Doubleday.
- Schneider, P.M. 2007. "Scientific standards for studies in forensic genetics." *Forensic Science International* no. 165:238-243.
- Schwark, T., P. Meyer, M. Harder, J.H. Modrow, and N. von Wurmb-Schwark. 2012. "The SNPforID assay as a supplementary method in kinship and trace analysis." *Transfusion Medicine and Hemotherapy* no. 39 (3):187.
- Selin, C. 2007. "Expectations and the Emergence of Nanotechnology." *Science, Technology & Human Values* no. 32 (2):196-220.
- Skinner, David. 2012. "Mobile Identities and Fixed Categories: Forensic DNA and the Politics of Racialized Data." In *Identity Politics and the New Genetics*, edited by K Schramm, D Skinner and R Rottenburg, 53-78. Oxford: Berghahn Books.
- Spichenok, Olga, Zoran M. Budimlija, Adele A. Mitchell, Andreas Jenny, Lejla Kovacevic, Damir Marjanovic, Theresa Caragine, Mechthild Prinz, and Elisa Wurmbach. 2011. "Prediction of eye and skin color in diverse populations using seven SNPs." *Forensic Science International: Genetics* no. 5 (5):472-478.
- Stenson, Kevin. 2005. "Sovereignty, biopolitics and the local government of crime in Britain." *Theoretical Criminology* no. 9 (3):265-287.
- Steventon, Beverley. 1995. "Creating a DNA Database." *Journal of Criminal Law* no. 59 (4):411-419.

- The Council of the European Union. 2010. Initiative for a Directive of the European Parliament and of the Council regarding the European Investigation Order in criminal matters, Brussels: Consilium.
- The Forensic Science Service. 2005. Guide to DNA for lawyers and investigating officers. Marston Green: FSS Communications Department.
- The Law Commission. 2011. Expert Evidence in Criminal Proceedings in England and Wales. London.
- The Supreme Court of Ohio. 2012. State v. Emerson, Slip Opinion No. 2012-Ohio-5047. Columbus.
- Thompson, W., and D. Krane. 2003. "Chapter 11: DNA in the Courtroom." *Psychological and Scientific Evidence in Criminal Trials*, West Group, <http://www.bioforensics.com/articles/Chapter11.pdf>.
- Thompson, W.C. 1997. "The National Research Council's second report on forensic DNA evidence. A critique." *Jurimetrics J.* no. 37:405-424.
- . 2006. "Tarnish on the 'gold standard': Understanding recent problems in forensic DNA testing." *The Champion* no. 30 (1):10-16.
- . 2008. The potential for error in forensic DNA testing (and how that complicates the use of DNA databases for criminal identification). New York: Council for Responsible Genetics.
- Thompson, William C, and Ford. 1989. "DNA Typing: acceptance and weight of the new genetic identification tests." *Virginia Law Review* no. 75(1):45-108.
- Thorisson, G.A., and L.D. Stein. 2003. "The SNP Consortium website: past, present and future." *Nucleic acids research* no. 31 (1):124-127.
- Toom, V. 2012. "Bodies of science and law: forensic DNA profiling, biological bodies, and biopower." *Journal of Law and Society* no. 39 (1):150-166.
- Townley, Lynne, and Roger Ede. 2004. *Forensic Practice in Criminal Cases*. London: The Law Society.
- Tozzo, P., L. Caenazzo, and D. Rodriguez. 2012. "Genetic Testing for Minors: Comparison between Italian and British Guidelines." *Genetics Research International* no. 2012. doi:10.1155/2012/786930.
- Tozzo, P., R. Pegoraro, and L. Caenazzo. 2010. "Biobanks for non-clinical purposes and the new law on forensic biobanks: does the Italian context protect the rights of minors?" *Journal of medical ethics* no. 36 (12):775-778.
- Tutton, Richard. 2012. "Personalizing medicine: Futures present and past." *Social Science & Medicine* no. 75 (10):1721-1728.
- US Presidential Commission for the Study of Bioethical Issues. 2012. Privacy and progress in Whole Genome Sequencing. Washington, D.C.
- Valier, C. 2001. "Criminal Detection and the Weight of the Past: Critical Notes on Foucault, Subjectivity and Preventative Control." *Theoretical Criminology* no. 5:425-443.
- Van Camp, N., and C. Dierickx. 2007. National Forensic DNA Databases: Current Practices in the EU. European Ethical-Legal Papers 9. Leuven.
- van der Ploeg, I. 2005. The Machine-readable Body: Essays on Biometrics and the Informatization of the Body. Maastricht: Shaker Publishing.
- van Dijck, Jose. 1998. *Imagination. Popular Images of Genetics*. New York: New York University Press.
- van Lente, H., and S. Bakker. 2010. "Competing expectations: the case of hydrogen storage technologies." *Technology Analysis & Strategic Management* no. 22 (6):693-709.
- van Zoonen, Liesbet, Pam Briggs, Aletta Norval, Sandra Wilson, Lilia Gomez Flores, Jasmine Harvey, Elpida Prasopoulou, Lisa Thomas, and Sharon Walker. 2012. Scenarios of identity management in the future. Loughborough: Loughborough University.
- von Schomberg, Rene. 2011. *Towards responsible research and innovation in the information and communication technologies and security technologies fields*. Edited by European Commission Services, *Research and Innovation Policy*. Luxembourg: Publications Office of the European Union.

- Walsh, S., A. Lindenberg, S.B. Zuniga, T. Sijen, P. de Knijff, M. Kayser, and K.N. Ballantyne. 2011. "Developmental validation of the IrisPlex system: determination of blue and brown iris colour for forensic intelligence." *Forensic Science International: Genetics* no. 5 (5):464-471.
- Weir, B.S. 1996. "The second National Research Council report on forensic DNA evidence." *American journal of human genetics* no. 59 (3):497.
- Welch, L.A., P. Gill, C. Phillips, R. Ansell, N. Morling, W. Parson, J.U. Palo, and I. Bastisch. 2012. "European Network of Forensic Science Institutes (ENFSI): Evaluation of new commercial STR multiplexes that include the European Standard Set (ESS) of markers." *Forensic Science International: Genetics* no. 6:819-826.
- Whitehead, Tom, and Andrew Porter. 2010. "Britons to be spied on by foreign police." *The Telegraph*, 26 July.
- Williams, Robin, and Paul Johnson. 2004. "'Wonderment and Dread': Representations of DNA in Ethical Disputes about Forensic DNA Databases." *New Genetics & Society* no. 23:205-222.
- . 2005. "Inclusiveness, Effectiveness and Intrusiveness: Issues in the Developing Uses of DNA Profiling in Support of Criminal Investigations." *Journal of Law and Medical Ethics* no. 33 (3):545-558.
- Williams, Robin, and Jason Weetman. 2012. "Enacting forensics in homicide investigations." *Policing and Society: An International Journal of Research and Policy* no. 23(3):376-389.

APPENDICES

Appendix 1: EUROFORGEN agenda-relevant EU projects summary table

Appendix 2: EUROFORGEN agenda-relevant EU projects detailed table

Ethical, Social and Policy Dimensions of Forensic Genetics

APPENDIX 1: EUROFORGEN agenda-relevant EU projects summary table

	EU project	Time	Content	Weblink
1	Basic ethical principles in European bioethics and biolaw (BIOMED II)	1994-98	This project aimed to identify ethical principles that enable the practical observance of individuals' autonomy, dignity, integrity and vulnerability. These values and principles were developed as guidelines reflecting specifically the European political and cultural context.	http://cordis.europa.eu/biomed/home.html
2	Biometrics and Information Technology Ethics (BITE)	2005-07	BITE's purpose was to prompt a debate about the bioethics of biometrics and suggested that biometric data might be used particularly against vulnerable groups.	http://www.biteproject.org/
3	GENetic bio and data-BANKing: Confidentiality and protection of data towards a European harmonisation and policy (GeneBanC)	2006-09	This pan-European project set out to describe and compare the practical, legal and ethical issues of 'population' and 'disease-specific' biobanks, and how these have been addressed. The activities of the collaborators were aimed at informing scientists and policy makers' decisions on whether to develop future retrospective versus prospective biobanks. Some effort went into understanding the commercial aspects of rationales behind biobank developments.	http://cordis.europa.eu/search/index.cfm?fuseaction=proj.document&PJ_RCN=9548325
4	Converging and conflicting ethical values in the INTERNAL/EXTERNAL security continuum in Europe (INEX)	2008-11	With a focus on security technologies, the project enquired into ethical consequences of the proliferation of such technologies; the legal dilemmas that arise from transnational security arrangements; and the ethical and value questions that stem from the shifting role of security professionals. Findings emphasised the necessary prevalence for upholding fundamental rights; proportionality and necessity as guiding principles for data processing; transparency and justifiability for profiling techniques; and a review of the notion of privacy.	http://www.inexproject.eu/
5	Rising pan-European and international awareness of biometrics and security ethics (RISE)	2009-12	Deepening the work of BITE, RISE aims to foster on-going ethically informed dialogue about biometrics and security technologies in the European Union, the United States of America, and Asia. Core themes of this project are public trust and the definition of 'sensitive' data; identity management and the categorisation of people via biometrics; the balance of privacy and technological utility; and commercial and technological push and pull factors for the deployment of security technologies.	http://www.riseproject.eu/
6	PRivacy and Emerging SCIENces and Technologies (PRESCIENT)	2010-13	This on-going project has set out to develop a state-of-art analysis of ethical, legal and social aspects pertaining to privacy and data protection. The project studies exemplary cases and draws on public surveys in order to draft a new framework for privacy and ethical impact assessments using scenarios. This approach is of interest for anticipatory	http://prescient-project.eu/

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			governance and the use of scenario building and ‘scenario play’.	
7	Cost-benefit analysis of current and future security measures in Europe (ValueSec)	2011-14	This ambitious network proposed to develop a tool-set for supporting policy decision makers in balancing decisions with overall policy objectives, cost-benefit considerations, political and ethical values, and societal concerns.	http://www.valuesec.eu/
8	Supporting fundamental rights, Privacy and Ethics in surveillance Technologies (SAPIENT)	2011-14	By compiling a surveillance state-of-art report, and by analysing stakeholder views, the SAPIENT consortium engages with smart surveillance technologies and their existing legal framework in order to develop and test Privacy Impact Assessment (PIA) and publish a standard handbook for such a methodology.	http://www.sapientproject.eu/
9	The effectiveness of security and SURVEILLance technology, and the Ethical and legal issues raised by their use in serious crime and counter-technology operations (SURVEILLE)	2012-15	This recently commenced project will compile a comprehensive overview of surveillance technologies currently in use in Europe, and assess the benefits and costs of surveillance technology. ‘Benefits’ refers to the delivery of improved security; ‘costs’ to the economic costs, negative public perceptions, negative effects on behaviour and infringement of fundamental rights. As such, this project also explores the legal and ethical issues – including those related to fundamental rights – raised by the use of surveillance technology in the prevention, investigation and prosecution of terrorism and other crime.	http://www.surveille.eu/
10	The PRIVacy and Security MirrorS: Towards a European framework for integrated decision making (PRISMS)	2012-15	Whilst many other projects have adopted the binary model of security versus privacy, PRISM proposes to re-evaluate this trade-off model. Its consortium sets out to devise an evidence-based perspective for reconciling the values of security and privacy, including an analysis of public assessment of security technologies, and of security and privacy technologies and policies. This work will be supplemented by discourse analysis of media attention to privacy, security and trust, and an EU-wide public opinion poll on these.	http://prismsproject.eu/
11	Surveillance, Privacy and Security: A large-scale participatory assessment of criteria and factors determining acceptability and acceptance of security technologies in Europe (SurPriSe)	2012-15	Led by the Austrian Academy of Sciences, this project promises an alternative analysis to PRISMS of the relationship between security and privacy, including a citizen consultation and exploration of public understanding of privacy protection laws, their use, and their acceptance of Surveillance-Oriented Security Solutions (SOSS), in order to develop a set of context-dependent dimensions for decision support.	http://surprise-project.eu/
12	Increasing Resilience in Surveillance Societies (IRRISS)	2012-15	The IRRISS consortium’s goal is to investigate the emergence, development and deployment of surveillance technologies; their impact on basic rights, and their social and economic costs; and citizens’ views and understanding of surveillance and their options to	http://irissproject.eu/

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			exercise their democratic rights in surveillance societies. The project eventually aims to identify and analyse the options for enhancing social, economic and institutional resilience in European societies.	
13	Public perception of security and privacy: Assessing knowledge, Collecting evidence, Translating research into action (PACT)	2012-15	The last project in our list, PACT, will assess existing knowledge about the relationship between security and privacy, and the role played by trust and concern. By conducting a pan-European survey on the public perception of the relation between privacy, fundamental rights, and security, this consortium of public and private companies aims to undertake an analysis of the main factors that affect public assessment of the privacy implications of security technology. Insights from this work are expected to support the development and validation of an evidence-based Privacy Reference Framework for Security Technology and Decision Support System that may assist end users and policy makers to consider privacy and fundamental rights when they evaluate pros and cons of specific security investments.	http://www.projectpact.eu/

APPENDIX 2: EUROFORGEN agenda-relevant EU projects detailed table

A large number of these are related to, or part of the European Research Council Security theme in the Framework Programme funding projects in 2007-13. The security theme aims to enhance European citizen’s security and the European security sector’s competitiveness.

FP6/7 project	Duration	Aims	Partners	Findings	Notes
BIOMED II – Basic Ethical Principles in European Bioethics and Biolaw	1995-98	1. identify ethical principles for respect of autonomy, dignity, integrity & vulnerability	22 partners	1. basic ethical principles function as reflective guidelines and values in Europe, and are not universal or transcendental	Rendtorff, JD (2002) Basic ethical principles in European bioethics and biolaw. Autonomy, dignity, integrity and vulnerability – Towards a foundation of bioethics and biolaw, Medicine, Health Care and Philosophy 5, 235-244.
BITE – biometrics and information technology ethics	2005-07	1. prompt debate about bioethics of biometrics	Centre for Science, Society and Citizenship (CSSC, Rome) Centre for Clinical Research and Bioethics (CERBIC, Roma) CESAGen, UK ESA Communication (Rome) BioID GmbH (Nuernberg) IBMG, University of Rotterdam International Biometric Group (IBG, New York) International Organisation for Migration (IOM) OPTEL, Wroclaw (Corp.) European Institute of Bioethics (IEB, Brussels)	1. Biometric information can provide individual biomedical information (issue of second order/hand data) 2. Biometrics might be used for vulnerable groups (to combat benefit fraud)	
GeneBanC – Genetic bio and dataBanking: Confidentiality and protection of data. Towards a European harmonisation and policy	2006-09	Workpackage 2: 1. To describe the practical, legal and ethical issues faced by population and small scale biobanks and how these have been addressed 2. To examine the advantage and disadvantages of classical biobanks (disease specific case control studies) versus population biobanks (prospective) 3. To inform scientists and policy makers when making decisions as to whether to develop future	Workpackage 2: Kris Dierickx (coordinator) & Pascal Borry, Center for Biomedical Ethics and Law, Katholieke Universiteit Leuven (CBEL); Herbert Gottweis. Department for Political Sciences, University of Vienna; Jan Helge Solbakk. Section for Medical Ethics, University of Oslo; Judit Sandor. Faculty of Political Science, Legal	Workpackage 2: 1. Biobanks’ main concern is lack of funding and continuation of funding 2. Biobanks unlikely to destroy samples 3. Biobanks cautious about being seen as ‘selling’ human tissue	

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		retrospective versus prospective biobanks 4. To improve governance arrangements by better understanding the problems faced by existing biobanks	Studies and Gender Studies, Central European University, Budapest; Herman Nys. University of Maastricht; Darren Shickle, Leeds Institute of Health Sciences, University of Leeds	4. Intellectual property rights often not addressed	
ForeSec - cooperation in the context of complexity. European security in light of evolving trends, drivers, and threats	2008/09	Foresight project on Europe's security landscape towards a shared vision and holistic approach to threats and challenges to European security using an expert workshop and a Delphi study	Crisis Management Initiative (CMI, Helsinki), Austrian Institute for Technology (AIT, Vienna), Centre for Liberal Strategies (CLS, Sofia), International Institute for Strategic Studies (IISS, London), Joint Research Centres (Ispra, Italy), Swedish Defence Research Agency (FOI, Stockholm)	1. growing concerns about terrorism in European and the balance to strike between new and more traditional forms of threat 2. increasing common security space in Europe – blurring of boundaries between internal and external security as well as national territorial defence [indicates cross-border sharing of data] 3. security issues encompass state, private and social sectors [distinction between civil and defence programmes increasingly difficult to maintain – cross-sector sharing of data and tasks, communication vital] 4. building resilience [proactive forensic methodologies?]	Coordinated with European Security and Research Innovation Forum (ESRIF)
DETECTER – Detection Technologies, Counter-Terrorism Ethics, and Human Rights	2008-11	1. Work with/ disseminate to manufacturers and law enforcement agencies 2. Review technologies according to ethical and moral risks	Abo Academy University; University of Birmingham; Danish Institute for Human Rights; European University Institute; Norwegian Centre for Human Rights; Raoul Wallenberg Institute of Human Rights and Humanitarian Law; University of Zurich	1. Profiling raises risks to privacy and equality (related to pre-conceived categories) 2. Risks from generalisation and association, and profiling for ethnicity – should only be used for exclusion of suspects 3. Precautionary profiling is intrusive 4. Data-mining based exclusively on race, ethnicity or sex may not be compatible with non-discrimination laws and amounts to profiling	Consider the differences between policing and counter-terrorism ethics and moral risks

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<p>INEX – Converging and conflicting ethical values in the internal/external security continuum in Europe</p>	<p>2008-11</p>	<p>1. The ethical consequences of the proliferation of security technologies, 2. The legal dilemmas that arise from transnational security arrangements, 3. The ethical and value questions that stem from the shifting role of security professionals and 4. The consequences of the changing role of foreign security policy in an era when the distinction between the external and internal borders grows less distinct. In Eastern Europe and around Mediterranean</p>	<p>International Peace Research Institute Oslo (PRIO), Ericsson Defense and Security Systems (corp); Centre d’Etudes sur les Conflits (CetC, Belgium), Research Group on Law, Science, Technology & Society (LSTS) at Vrije Universiteit Brussel (VUB), Vrije Universiteit Amsterdam (VUA), Collegium Civitas, Poland, The Centro de Investigación de relaciones Internacionales y Desarrollo (CIDOB Foundation, Barcelona), Department of International Relations at Bilkent University, Ankara, Center for European Policy Studies (CEPS, Brussels)</p>	<p>1. European ruling on fundamental rights to have precedence over national data protection laws etc. 2. Fundamental rights to apply to both European Area of Freedom, Security and Justice (AFSJ) and to border management (third-country nationals) 3. Data processing practices to be based on proportionality and necessity; applied with safeguards 4. Profiling techniques need to be transparent (variables) and justified 5. Notions of privacy to be reviewed (“impossibility of privacy by design”) 6. Prüm Treaty in part responsible for DNA database proliferation in European member states 7. Fundamental rights seem to operate only as a corrective in EU strategy (e.g. for the EU Information Model) 8. Prospective monitoring increasing 9. Assumption that Information Technology is most appropriate tool for AFSJ</p>	<p>Burgess, JP (2011) The ethical subject of security. Geopolitical reason and the threat against Europe, Routledge.</p>
<p>FESTOS – Foresight of Evolving Security Threats Posed by Emerging Technologies</p>	<p>2009-11</p>	<p>1. identify and assess evolving security threats posed by the abuse or inadequate use of emerging technologies and new scientific knowledge, 2. propose means to reduce their likelihood</p>	<p>Interdisciplinary Centre for Technology Analysis and Forecasting at Tel-Aviv University, Israel; Finland Futures Research Centre (FFRC), University of Turku; Centre for Technology and Society, Technical University of Berlin; University of Lodz; EFP Consulting (UK) Ltd</p>	<p>1. A number of future technologies are evaluated according to ‘easiness of malicious use’ and ‘severity of their impact’ to create a potential reading for their risk</p>	

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<p>RISE - rising pan-European & intl awareness of biometrics & security ethics</p>	<p>2009-12</p>	<ol style="list-style-type: none"> 1. Deepen engagement from BITE; 2. Foster on-going ethically informed dialogue about ethical aspects of biometrics and security techs in EU, US and Asia; 	<p>Centre for Science, Society, Citizenship (CSSC, Rome), Aristotle University of Thessaloniki (AUTH, Greece), Biometric Research Centre (BRC, Hong Kong), Center for Policy on Emerging Technologies (C-PET, US), Data Security Council of India (DSCI), European Biometrics Forum (EBF), Global Security Intelligence LLC (GSI, US) (corp), University of Tartu, Lancaster University</p>	<ol style="list-style-type: none"> 1. Public trust and the definition of 'sensitive data'; 2. 'ID management' and categorisation of people via biometrics; 3. The balance of privacy and technological utility; 4. Commercial and technological push and pull factors 	
<p>PRESCIENT – Privacy and Emerging Sciences and Technologies</p>	<p>2010-13</p>	<ol style="list-style-type: none"> 1. state-of-art ELSA analysis privacy & data protection 2. identify the privacy, data protection and ethical issues arising from five different emerging technologies and their applications (case studies) 3. analyse various existing surveys to assess citizen concerns and knowledge of the way in which their data are collected, stored and used and their concerns about new technologies and how their concerns have changed over time 4. development of a new framework for privacy and ethical impact assessments (scenarios) 	<p>Fraunhofer Institute for Systems and Innovation Research (ISI) Karlsruhe; Trilateral Research & Consulting LLP, London (corp); Vrije Universiteit Brussel, Research Group on Law Science Technology & Society (LSTS), Brussels;</p>		
<p>MIDAS – Development and Validation of a Rapid Millifluidic DNA analysis system for forensic casework samples</p>	<p>2010-13</p>	<ol style="list-style-type: none"> 1. deliver a self-contained, portable instrument to produce DNA database compatible results from crime samples in 2 hours 	<p>Forensic Science Service (FSS), UK; Medical University Innsbruck; Netherlands Forensic Institute (NFI); Bundeskriminalamt (BKA); Arizona Board of Regents, US; Grid XITEK Ltd, UK (corp)</p>		<p>Coordinator FSS dissolved 2012</p>
<p>ValueSec – Cost-benefit analysis of current and future security measures in Europe</p>	<p>2011-14</p>	<ol style="list-style-type: none"> 1. develop and test a tool-set to support policy decision makers in balancing decisions with overall policy objectives, political and ethical values, and societal concerns 2. stake off the field of security economics, the field of applicability of cost-benefit-tools and their links to societal issues relevant to security 3. evaluate the results from the different perspectives of decision makers in security, from the policy, economic and societal point of view 4. measure the research challenges and progress and to give recommendation for further R&D 	<p>Fraunhofer Institute for Factory Operation and Automation IFF, Magdeburg; VTT Technical Research Centre of Finland; Centre for European Security Strategies (CESS) Muenchen; Peace Research Institute Oslo (PRIO); Centre for Risk Management and Societal Safety, Stavanger University, Norway; Atos Research & Innovation, Spain (corp); EMAG, Poland (corp); WCK-GRC, Israel (corp); Valencia Local Police</p>		

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<p>SAPIENT – Supporting fundamental rights, Privacy and Ethics in surveillance Technologies</p>	<p>2011-14</p>	<ol style="list-style-type: none"> 1. smart surveillance state-of-art report 2. analysis of stakeholder views 3. developing & testing privacy impact assess. methodology 4. handbook 	<p>Fraunhofer Institute for Systems and Innovation Research (ISI); Trilateral Research & Consulting LLP, London; King’s College London; University of Lugano; Research Group on Law Science Technology & Society at the Vrije Universiteit Brussel (LSTS); Centre for European Policy Studies (CEPS); Centre for Science, Society & Citizenship (CSSC Rom)</p>	<p>SoA report: 1. conceptual work: security issues as assemblages (heterogeneity, Deleuze and Guattari; Haggerty and Ericson 2000) and rhizomatic system (horizontal bottom-up forms of surveillance)</p>	<p>Smart Surveillance – State of the Art Report (2012)</p>
<p>SMART – Scalable Measures for Automated Recognition Technologies</p>	<p>2011-14</p>	<ol style="list-style-type: none"> 1. Determine the state of the art and likely future trends of smart surveillance, its proportionality and impact on privacy in four key application area. 2. Identify dependency and vulnerability of smart surveillance on underlying technology infrastructures (especially telecommunications networks) and explore system integrity and privacy issues therein. 3. Identify and explore smart surveillance and privacy issues in cyberspace. 4. Map out characteristics of laws governing surveillance and identify lacunae/new safeguards as well as best practices. 5. Map out characteristics of laws governing interoperability and data exchange and identify lacunae/new safeguards as well as best practices. 6. Explore the attitudes and beliefs of citizens towards smart surveillance. 7. Establish best-practice criteria developed on the basis of operational efficiency, established legal principles and citizen perceptions. 8. Develop a toolkit for policy-makers, police and security forces to implement and promote the best practice approach, including the development of system design guidelines and a model law balancing privacy and security concerns which would be capable of pan-European application 	<p>School of Forensic and Investigative Sciences, University of Central Lancashire; University of Malta; University of Ljubljana; Laboratorio di Scienze della Cittadinanza (LSC), Italy; Babes-Bolyai University of Cluj Napoca, Romania; University of Oslo; University of Leon; Law and Internet Foundation, Bulgaria; Masarykova univerzita, Czech Republic; Edith Cowan University, AUS; Georg-August-Universität Göttingen; Sheffield University; Gottfried Wilhelm Leibniz Universität Hannover; CNR National Research Council, Italy; Comenius University, Bratislava; Groningen University; University of Vienna; Morpho, France (corp.); INTERPOL, France</p>		
<p>ETTIS – European Security Trends and Threats In Society</p>	<p>2012-14</p>	<ol style="list-style-type: none"> 1. to identify, understand and assess in a scenarios framework future threats, needs and opportunities for societal security, 2. to develop and test a methodological approach and model for a revolving process of security research priority setting, 3. to derive research priorities geared towards the needs of user organisations, as well as rationales and 	<p>Peace research Institute Oslo (PRIO); Swedish Defence Research Agency (FOI); The Hague Centre for Strategic Studies (HCSS); Trilateral Research & Consulting LLP, London; Fraunhofer Institute for Systems and Innovation Research (ISI); Fraunhofer Institute for Technological Trend Analysis (INT);</p>		

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		options for policy intervention, and 4. to help increase awareness of and attention to security research results, and contribute to overcoming barriers by advancing and testing a range of intelligence tools and techniques.	Centre for Irish and European Security (CIES) The Austrian Institute of Technology (AIT); Morpho, France (corp); Magen David Adom (National Emergency Medical Service Israel); Police Service of Northern Ireland (PSNI)		
SURVEILLE – The effectiveness of security and surveillance technology, and the ethical and legal issues raised by their use in serious crime and counter-technology operations	2012-15	1. Comprehensive survey of the types of surveillance technology deployed in Europe. 2. To assess the benefits and costs of surveillance technology. ‘Benefits’ refers to the delivery of improved security; ‘costs’ to the economic costs, negative public perceptions, negative effects on behaviour and infringement of fundamental rights. 3. Explore the legal and ethical issues raised by the use of surveillance technology in the prevention, investigation and prosecution of terrorism and other crime – including those related to fundamental rights.	European University Institute (EUI), University of Birmingham (UoB), Raoul Wallenberg Institute of Human Rights and Humanitarian Law (RWI), Delft University of Technology (TU Delft), Albert-Ludwig-University Freiburg (ALU-FR), Fraunhofer Gesellschaft zur Förderung der angewandten Forschung e.V. (Fraunhofer), Université Libre de Bruxelles – Institute d’Etudes Européennes (ULB), European Forum for Urban Security (EFUS), Merseyside Police (MERPOL)	Technoscience extends the human reach spatially and temporally	
PRISMS – The Privacy and Security Mirrors: Towards a European framework for integrated decision making	2012-15	1. Analysis of trade-off model ‘security vs. privacy’ 2. Devise evidence-based perspective for reconciling security and privacy 3. Analysis of public assessment of security technologies (and trade-off) 4. Analysis of security & privacy technologies and policies 5. Discourse analysis of media attention to privacy, security & trust 6. EU-wide public opinion poll on these	Fraunhofer Institute; Trilateral Research & Consulting LLP, London; LSTS, Vrije Universiteit Brussel; TNO, Limburg; University of Edinburgh; Eötvös Károly Institute, Budapest; Market & Opinion Research International Ltd, London; Stichting Hogeschool Zuyd, Limburg		
SurPriSe – Surveillance, Privacy and Security: A large-scale participatory assessment of criteria and factors determining acceptability and acceptance of security technologies in	2012-15	1. Analysis of relationship security-privacy 2. Citizen consultation 3. Citizen understanding of privacy protection laws, their use, and their acceptance of surveillance-oriented security solutions (SOSS) 4. Develop set of context-dependent dimensions for decision support	Institute of Technology Assessment, Österreichische Akademie der Wissenschaften (OeAW-ITA, Wien); Supreme Council of Scientific Investigations (CSIC, Madrid); The Danish Board of Technology, Copenhagen; Open University, Milton Keynes; Institute for the Sociology of Law and Criminology (IRKS, Wien); European University Institute (EUI, Italy); Unabhaengiges Landeszentrum fuer Datenschutz, Kiel (ULD); The Norwegian Board of Technology, Oslo; TA-Swiss, Akademie der Wissenschaften, Bern; Median Opinion And Market Research Limited		

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Europe			Company, Budapest; Data Protection Agency of the Madrid Region		
RESPECT – Rules, Expectations & Security through Privacy-Enhanced Convenient Technologies	2012-15	<ol style="list-style-type: none"> 1. Exploring ‘levels of balance’ of ICTs for surveillance regarding issues of privacy, convenience, profitability, public safety and security 2. Focus on CCTV, database mining and interconnections, online social network analysis, RFID and geo-location/sensor devices and financial tracking 3. Qualitative and quantitative analysis of citizen awareness and attitudes to modern forms of surveillance 4. Develop tools to enable policy makers to better understand socio-cultural, operational and economic significance of surveillance techs 	University of Central Lancashire; Edith Cowan University, Perth; Oslo University; Ljubljana University; University of Sheffield; Leibniz University Hannover; University of Groningen; Vienna University; Metropolitan Police Service, London; Interpol; Uppsala University; Centre for Communication Technology Malta, University of Malta; Georg-August University Göttingen; Babes-Bolyai University, Romania; Masaryk University, Czech Republic; University of Leon, Spain; National Research Council, Italy; Laboratory of Citizenship Sciences, Italy; Comenius University, Slovak Republic; Law and Internet Foundation, Bulgaria		
IRISS – Increasing Resilience in Surveillance Societies	2012-15	<ol style="list-style-type: none"> 1. To investigate the emergence, development and deployment of surveillance technologies, their impact on basic rights and their social and economic costs. 2. To design a framework which captures core dimensions of the relationship between surveillance and democracy and which can be utilised to explore these relations empirically. 3. Explore citizens’ views and understanding of surveillance and their options to exercise their democratic rights in surveillance societies. 4. To identify and analyse the options for enhancing social, economic and institutional resilience in European societies. 	Institute for the Sociology of Law and Criminology (IRKS, Wien); Trilateral Research & Consulting Ltd, London; University of Stirling; University of Edinburgh; Eötvös Károly Institute, Budapest; Institute of Technology Assessment (OeAW-ITA, Wien); University of Sheffield; University of Hamburg; Vrije Universiteit Brussel; Open University; Universitat Oberta de Catalunya; Fraunhofer Institute for Systems and Innovation Research; Peace Research Institute Oslo (PRIO); Università Cattolica del Sacro Cuore (UCSC, Italy); Comenius University, Bratislava; Universitaet der Bundeswehr Muenchen		

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<p>PACT – Public perception of security and privacy: Assessing knowledge, Collecting evidence, Translating research into action</p>	<p>2012-15</p>	<p>1. Security and Privacy - to assess existing knowledge about the relation between security and privacy and the role played by trust and concern; 2. pan-European survey - to collect empirical evidence through a pan-European survey on the public perception of the relation between privacy, fundamental rights, and security, and to analyze the main factors that affect public assessment of the privacy implications of security technology; 3. Privacy Reference Framework - to develop and validate an evidence-based Privacy Reference Framework for Security Technology and Decision Support System that may assist end users and policy makers to consider privacy and fundamental rights when they evaluate pros and cons of specific security investments.</p>	<p>VITAMIB, Grenoble (corp); Atos Research & Innovation, Spain (corp); Centre for Irish and European Security (CIES); Ipsos Market & Opinion Research International (MORI, UK); Center for Security Studies, Greece; Ministry of Public Security, Israel; National Center for Scientific Research “Demokritos” Greece; Rand Europe Cambridge Peace Research Institute Oslo (PRIO); Uppsala University; Centre for Science, Society and Citizenship (CSSC, Italy)</p>		
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