Social and Ethical Aspects of Forensic Genetics: A Critical Review

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ABSTRACT: This review describes the social and ethical responses to the history of innovations in forensic genetics and their application to criminal investigations. Following an outline of the three recurrent social perspectives that have informed these responses (crime management, due process, and genetic surveillance), it goes on to introduce the repertoire of ethical considerations by describing a series of key reports that have shaped subsequent commentaries on forensic DNA profiling and databasing. Four major ethical concerns form the focus of the remainder of the paper (dignity, privacy, justice, and social solidarity), and key features of forensic genetic practice are examined in the light of these concerns. The paper concludes with a discussion of the concept of "proportionality" as a resource for balancing the social and ethical risks and benefits of the use of forensic genetics in support of criminal justice.

KEYWORDS: Ancestry informative markers, dignity, DNA databasing, DNA profiling, ethics, externally visible characteristics, forensic DNA phenotyping, justice, privacy, proportionality, SNPs, STRs.

INTRODUCTION

Since their first appearance in the 1980s, forensic DNA profiling technologies have become an increasingly important aspect of criminal, security, and mass disaster investigations. This has been made possible by a combination of technical, organizational, and legislative developments that include improvements in DNA collection, extraction, and analysis processes; the establishment of national and international laboratory standards; judicial acceptance of the robustness of DNA evidence; and the growth of national forensic DNA databases as a means of storing, searching, and comparing crime scene DNA profiles with profiles obtained from known individuals and retained under a variety of legal regimes. It is generally accepted that the majority of these applications are more effective in supporting investigations and prosecutions 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.

Scientific and technical features of these developments have been described in detail elsewhere (*see* for example [8,20,21,136]). Advances in the chemistry and uses of standardized STR multiplexes have occurred globally, and there has been increasing use of Y-STRs and of mitochondrial sequencing to support more specialized investigatory uses like familial searching for offenders, and the identification of human remains [89]. Recently, there has been a significant growth of research and innovation concerned with the analysis of genetic data where crime scene DNA samples are available, but where profiles derived from these samples have not matched databased profiles obtained from known subjects. Three areas of work have become increasingly prominent: the inference of externally visible characteristics (EVCs) [70]; biogeographic ancestry-informative markers (AIMs) [117]; and the increasingly comprehensive genetic analyses that are made available by so-called "next generation sequencing" (NGS) or "massively parallel sequencing" (MPS) technologies [12]. Alongside these efforts there is also ongoing work which attempts to identify the source of the body fluids from which biological samples have been extracted in order to more rigorously test assertions about the potential significance of DNA evidence in particular cases [137].

Forensic genetics technologies have been introduced into routine criminal justice uses alongside collective discussions of their ethical legitimacy and legal evaluation of their reliability. The history of these social considerations remind us that it is important that forensic genetics researchers and claims-makers avoid the promotion of "technologies of hubris" [64] in which scientific certainty and technological robustness are overstated, and social consent is assumed in advance of detailed deliberation. Scientific knowledge production and technological innovation are part of the ordering of contemporary societies and impact on personal and communal life in significant ways: scientific knowledge influences how we understand the world, while technologies guide us in the ways we can engage with it. Over the last decades it has become apparent that research and innovation are not independent of society but are social processes interwoven with other social domains such as education, health, law, politics, the economy, and the environment (*see* for example [10,49,53,65,80]). Social structures and cultural narratives shape scientific and technological endeavors. Accordingly it is vital for researchers, as well as the commissioners and users of research, to develop an understanding of the various

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Robin Williams received his bachelor's degree in sociology from the London School of Economics and Political Science (London, UK). Following posts at Southampton University (Southampton, UK) and Manchester University (Manchester, UK), he is now a professor emeritus in the School of Applied Social Sciences at Durham University (Durham, UK), a professor of forensic science studies in the Faculty of Health and Life Sciences at Northumbria University (Newcastle upon Tyne, UK), and a visiting professor at the Policy, Ethics, and Life Sciences Research Centre, Newcastle University (Newcastle upon Tyne, UK).

Prof. Williams was a member of the UK Nuffield Council of Bioethics Working Party on the Police Uses of Bioinformation and co-author of the council's report published in 2008. More recently he worked (with Carole McCartney and Tim Wilson) on the Nuffield Foundation-funded project on "The Future of Forensic Bioinformation". His previous studies of the organization of forensic science support to policing and the growth of forensic DNA databasing have been funded by the UK Home Office and the Wellcome Trust. As well as being the Northumbria University Centre for Forensic Science lead investigator on EUROFORGEN (the European Forensic Genetics Network of Excellence), he currently holds a Wellcome Trust grant to support a study of the use of "familial searching" in serious crime investigations, and is a co-investigator on a Leverhulme Trust-funded study of the use of forensic science to support homicide investigations in England and Wales.

Along with a large number of academic journal publications, his published work includes (with Paul Johnson) "*Genetic Policing: The Use of DNA in Criminal Investigations*" (Willan, 2008) and (edited with Jim Fraser) "*The Handbook of Forensic Science*" (Willan, 2010).

Matthias Wienroth received his M.A. degree in political science and adult education from Leipzig University (Leipzig, Germany) in 2005, and his Ph.D. in sociology from Newcastle University (Newcastle upon Tyne, UK) in 2009. He has conducted research at Durham, Edinburgh, and Northumbria Universities as well as at King's College London, and is currently a research associate at the Policy, Ethics, and Life Sciences Research Centre at Newcastle University.

Dr. Wienroth began his work on science and technology studies during his Ph.D. on research practices in nanotechnology, and continued studying this field's governance as a research associate at Durham University from 2009. In 2010–2011, he was the Robert W. Gore Materials Innovation Project Scholar (Chemical Heritage Foundation: Philadelphia, PA) before moving to Newcastle University to work on medical technology governance issues, and to Edinburgh University to attend to aspects of genomics in society, where he was principal investigator on a pilot project bringing together artists and scientists, and edited (together with Eugenia Rodrigues) "*Knowing New Biotechnologies: Social Aspects of Technological Convergence*" (Routledge, 2015). He is currently principal investigator of the Economic and Social Research Council (ESRC) "Seminar Series on genetics, technology, security and justice: Crossing, contesting and comparing boundaries." Dr. Wienroth studies science-society relationships and the practices and opportunities of cross-disciplinary knowledge production for socially responsible technology development.