

FORENSIC DNA PHENOTYPING: REGULATORY ISSUES

Bert-Jaap Koops* & Maurice Schellekens**

Forensic DNA phenotyping is an interesting new investigation method: crime-scene DNA is analyzed to compose a description of the unknown suspect, including external and behavioral features, geographic origin and perhaps surname. This method is allowed in some countries but prohibited in a few others. Most countries have not yet taken a stance on this. This article addresses the question to what extent this investigation method should be allowed. The relevant regulatory issues are analyzed: the right of people not to know what their DNA tells about propensities for diseases or other propensities, data protection and privacy, stigmatization and discrimination, and the “slippery slope” argument. These are serious issues indeed, but their importance should not be overestimated. Current literature and legislatures seem overcautious. Phenotyping should be allowed for externally perceptible traits, such as hair color, and for non-sensitive behavioral traits, like left-handedness or a propensity for smoking. It should not be allowed for many propensities for diseases and for sensitive other information like a propensity for homosexuality or aggressiveness. The middle category of somewhat but not too sensitive traits could be allowed, for example, for early apparent medical disorders, like albinism or teenage-onset alcoholism. Ethnic origin and surname phenotyping are also compatible with fundamental rights, provided measures are taken to contain the risk of discrimination. It is also worth considering informing the suspect only of the fact of forensic phenotyping, leaving it to the suspect himself to request the test results.

* Bert-Jaap Koops has an M.Sc. in mathematics, an M.A. in literature, and a Ph.D. in law. Professor of regulation & technology at TILT – Tilburg Institute for Law, Technology, and Society, of Tilburg University, the Netherlands.

** Maurice Schellekens has an M.Sc. in information science and an LL.M. and a Ph.D. in law. Assistant professor of law & technology at TILT, of Tilburg University, the Netherlands.

1. INTRODUCTION¹

Suppose that in a particularly violent rape and murder case, the police have investigated the few clues they have, but to no avail. No witnesses can be found and the DNA from the sperm trace and skin cells found on the victim does not yield a match in the DNA database. As a last resort, the DNA from the crime-scene material is analyzed for the information it contains about the person it came from. It turns out that the suspect is probably a Caucasian male of Scandinavian descent, likely to have red hair and freckled skin, to be left-handed and of above-average stature, and probably a smoker. This profile is published to the public, and after a few unsuccessful tip-offs, someone calls the police to say that he saw his tall, red-haired Norwegian neighbor come home in the middle of the night of the murder, and that his garden had been freshly turned over the day after. When the neighbor, Mr. Johansen refuses to make any statement, the garden is investigated and blood-stained clothes are found. A forced DNA test on the suspect now confirms that the crime-scene sperm and skin cells match Mr. Johansen's DNA, and he is swiftly convicted.

This tale is largely science fiction. Some knowledge exists about typical DNA segments that are peculiar for certain ethnic origins, and some gene variants are known related to red hair and freckled skin, but stature, left-handedness, and susceptibility to smoking are currently hidden in the unknown realms of DNA, even though there are indications of a genetic component influencing these. Nevertheless, even with our current knowledge of DNA's coding of personal characteristics ("phenotypes"),² it is useful to analyze crime-scene DNA for the information it contains. Moreover, it is generally expected that in the next decade or two, DNA research will reveal many correlations between genes ("genotypes") and traits ("phenotypes"), both external and internal bodily characteristics and propensities for certain types of behavior.³ This information could be used in criminal investigations in cases with an unknown suspect and with few clues to lead the investigation forward by narrowing down the circle of

¹ This article is the result of a research project funded by the Dutch Council for Scientific Affairs in its programme 'Societal Component of Genomics,' <<http://www.nwo.nl/mcg/>>. The project is outlined at <<http://www.dnanetwork.info/>>, and earlier articles from this project can be found at <http://rechten.uvt.nl/dna/files/page.asp?page_id=86>. The authors thank Merel Prinsen, who performed part of the research for this project, and the colleagues from TILT, the BOTS colloquium of Maastricht University, and the members of the advisory committee for their comments and suggestions for this paper.

² Genes do not 'code for' a certain characteristic in the sense that they cause the person to have this trait. Personal traits may have a strong genetic component but will always be influenced by combinations of several genes and a variety of environmental influences. For brevity's sake, however, we shall occasionally use formulations like 'gene for' trait X to indicate a correlation between the genes (genotype) and trait X (phenotype).

³ On the relationship between genes and behavior, see, for example, William R. Clark & Michael Grunstein, *Are We Hardwired?: The Role of Genes in Human Behavior* (Oxford University Press 2000), and the Human Genome Project on Behavioral Genetics, http://www.ornl.gov/sci/techresources/Human_Genome/elsi/behavior.shtml.

potential suspects. We shall call this “forensic DNA phenotyping.” Once the circle of potential suspects is narrowed down sufficiently, other more traditional investigation methods may take over, including taking by force a DNA sample from a suspect and matching DNA profiles.

It should be noted that phenotyping is not unique or completely new. DNA analysis is not the only way of discovering information about the source of a trace. Traditional (non-DNA) analysis of blood or urine can give information about blood type, for instance, or diabetes or drug use, which might help in focusing the investigation in a certain direction. Additionally, fingerprint analysis may be used for phenotyping purposes, as Canadian research suggests that the pattern of dermal ridges on fingers has a correlation with certain biological traits.⁴ The correlations between fingerprint and behavior as emerging from this research seem too weak to put them to forensic use, but it illustrates that DNA is not unique in its capacity to “tell something” about the traits of the source of a crime-scene trace. However, DNA holds the promise of knowledge about many traits unlikely to be ever derived through other means, such as eye color, hair shape, and stature, and with potentially higher correlations. Therefore, DNA phenotyping may become an important tool in the crime investigator’s toolbox.

In this article, we pose the question to what extent should forensic DNA phenotyping be allowed. We analyze the regulatory issues involved in this new investigation method. For this purpose, we have surveyed existing legislation on forensic DNA phenotyping, which turns out to be surprisingly scarce (section 3). From the available literature, we have distilled five issues that are viewed to be at stake: the right of people not to know what their DNA tells about propensities for diseases (section 4.1) or other propensities (section 4.2), data protection and privacy (section 4.3), the risk of stigmatization and discrimination (section 4.4), and the vision of a slippery slope leading, ultimately, to eugenics (section 4.5). Also, some practical issues have to be resolved (section 4.6). After an analysis of these arguments, we provide a tentative answer to the question to what extent forensic DNA phenotyping should be allowed (section 5).

Before starting our discussion with a brief outline of the technology of phenotyping (section 2), we must note two restrictions. First, this article is largely theoretical in character. Phenotyping has as yet little concrete value for tracing an

⁴ Most people have more ridges on their right-hand fingers; only about 20% have more ridges on their left hand. Women and homosexual men, however, have a greater chance of falling in the 20% group than heterosexual men. Furthermore, the asymmetry between left and right has a correlation with the (left- or right-) handedness of homosexual men. Finally, people with more ridges on their right hand are better at tasks in which men typically excel, whereas people with more left ridges are better at tasks in which women typically excel. See J.A.Y. Hall and D. Kimura, *Dermatoglyphic Asymmetry and Sexual Orientation in Men*, 108 *Behav. Neuroscience* 1203 (1994); Doreen Kimura, *Body Asymmetry and Intellectual Pattern*, 17 *Personality and Individual Differences* 53 (1994). See generally Doreen Kimura & Michael W. Carson, *Dermatoglyphic Asymmetry: Relation to Sex, Handedness and Cognitive Pattern*, 19 *Personality and Individual Differences* 471 (1995). Earlier, significant statistical differences in fingerprint patterns (arches, loops, and whorls) had been found among ethnic groups, and people with congenital heart diseases appeared to have statistically different ridge patterns from people with acquired heart diseases. See Andre A. Moenssens, *Fingerprint Techniques* 294-301 (Chilton Book Company 1971).

unknown suspect (although it can already be useful in excluding people from suspicion), and it will take a considerable number of years before it can yield sufficiently detailed information to make a useful profile of an unknown suspect. Finding genotypes with high correlations to phenotypes is difficult, and numerous phenotypical characteristics may be too multifactorial and complex to ever find a correlated genotype at all. Our argumentation is therefore theoretical. It is useful to discuss these issues, both because they are interesting for criminal investigation theory and because they may become relevant somewhere in the future after genotypes for certain traits are found and a debate about their use in forensics is triggered. Thus, we thought it better to jump the gun and discuss these issues beforehand.

Second, we restrict ourselves in this article to the use of phenotyping for tracing an unknown suspect, since this is currently the most relevant and realistic purpose of phenotyping.⁵ There may be other uses for phenotyping, such as crime-prevention policies, for instance, if genes related to pedophilia were to be found, but such applications involve another type of debate and merit separate treatment. Therefore, we only go into potential other purposes in the context of the argument that phenotyping to trace unknown suspects is the first step on a slippery slope (section 4.5).

2. WHAT IS FORENSIC DNA PHENOTYPING?

In order to clearly understand the regulatory issues, it is important to have some knowledge of the technical aspects of DNA phenotyping. How are characteristics actually determined, and which characteristics can be determined at present and in the near future? Minute quantities of cell tissue –some dozens of cells weighing around 100 picograms– are sufficient to extract DNA material for analysis.⁶ Gender determination through DNA is very simple. Women have two X chromosomes and men have an X and a Y chromosome. If the material contains a Y chromosome, then the DNA belongs to a man.⁷ Tracing other characteristics, however, is considerably more difficult. Nevertheless, there are two options.

2.1. Indirect phenotyping: geographic origin and surnames

First, external characteristics can be traced indirectly by determining the geographical or ethnic origin of a person. Often, this origin will be associated with perceptible characteristics such as skin color, hair shape, and shape of the eyes and face. A lot of research is being done in this area, allowing the inference of at least the broad

⁵ This is borne out by the pertinent Dutch legislation, which has precisely this aim. *See infra* Section 3.3.

⁶ One picogram is one trillionth (10^{-12}) of a gram.

⁷ In rare cases, the psychological, biological, or sociological gender diverges from what the absence or presence of a X-chromosome indicates.

geographical area where the person has her roots.⁸ There is even a commercial forensic test available for “deciphering of an individual’s race.”⁹ The latter term is unfortunate, since this type of phenotyping concerns geographical origin, not “race” as a cultural or social concept. The use of “race” is contested and should be avoided.¹⁰

It is possible to determine the geographical or ethnic origin with a certain degree of accuracy because during the course of many centuries, man has spread over the globe, and gradually groups of people have developed different looks and variations in their DNA. Some mutations in DNA have only occurred at certain places and have remained there because they offered evolutionary advantages. By studying a number of such mutations at the same time, a calculation can be made of the likelihood of that person originating from a certain region.¹¹ That, of course, does not mean that the person now lives in that region. The DNA of Central Africans who live in the United States will indicate their origins to be Central African and not American. Frequently, geographic origin will not be this clear. Because of interracial mingling, mixtures have arisen. Nonetheless, in those cases, it may still be possible to learn from DNA whether an individual has, for instance, both Chinese and North European ancestors.¹²

When making inferences about the geographic origin, the size of the region to which someone can be traced within a degree of probability is important to know: Can

⁸ For an early description of this method, see Ian W. Evett et al., *An Investigation of the Feasibility of Inferring Ethnic Origin from DNA Profiles*, 32 J. of the Forensic Sci. Soc’y 301 (1992). For recent research, see Oscar Lao et al., *Proportioning Whole-Genome Single-Nucleotide-Polymorphism Diversity for the Identification of Geographic Population Structure and Genetic Ancestry*, 78 Am. J. Hum. Genetics 680 (2006).

⁹ Insights into race from DNA profiles, http://www.bioforensics.com/conference07/Racial_Identification/index.html. “[DNA Witness 2.0] provides not only the majority population affiliation (i.e. Indo European, Sub-Saharan African, East Asian or Native American), but the admixture, as well (i.e. 82% East Asian and 18% Indo-European mix).” *Id.*

¹⁰ See Anil Ananthaswamy, *Under the Skin*, New Scientist, April 20, 2002, at 34; Robin Williams, Paul Johnson & Paul Martin, *Genetic Information & Crime Investigation: Social, Ethical and Public Policy Aspects of the Establishment, Expansion and Police Use of the National DNA Database*, University of Durham 112 (2004), <http://www.dur.ac.uk/resources/sass/sociology/Genetic%20Information%20&%20Crime%20Investigation.pdf>; Pilar Ossorio, *About Face: Forensic Genetic Testing for Race and Visible Traits*, 34 J.L. Med. & Ethics 277, 281-83 (2006).

¹¹ Several “developments will eventually enable trustworthy conclusions on the ethnic origin of an unidentified stain donor.” A.D. Kloosterman, *The Development and Implementation of Forensic DNA Typing Technologies in the Netherlands* 32 (2002) (unpublished Ph.D. dissertation, Universidad de Santiago de Compostela) (on file with author). See The International HapMap Project, <http://www.hapmap.org/thehapmap.html.en>, for a project that identifies genetic similarities and differences in human beings. The project currently uses data from four populations with African, Asian, and European ancestry that may yield markers characteristic of these populations.

¹² See *supra* note 9.

the potential region be narrowed down to Northern Europe, the Netherlands, or the town of Gouda? On one hand, this depends on the geographical stability of the population. The longer a certain group has lived at a certain location and the more reproduction that has taken place within that particular local group, the more the specific geographical origin can be indicated by DNA investigation. On the other hand, it also depends on the availability of databases with DNA characteristics of specific populations. As more data becomes available about characteristic DNA types of Dutch or Gouda indigenous inhabitants, possible geographical sources can be suggested more quickly. At the 2004 Genomics Momentum Conference, a Dutch forensic scientist appealed to the government to lend political support to the study of this type of data.¹³ Only with databases filled with distinguishing features of the most important populations in the country (e.g., for the Netherlands: indigenous inhabitants of the several provinces, Moroccans, Berbers, Turks, Surinamese, Antilleans, etc.) can forensic phenotyping be of importance to criminal investigations.

Creative use of DNA can reveal more information than just geographic origin. Recent research has revealed that, to a certain extent, surnames can be predicted on the basis of markers on the Y chromosome. Just like Y chromosomes, surnames pass on from fathers to sons in countries with patrilineal inheritance of surnames. In a small-scale investigation in Britain, the correct surname could be “predicted” from DNA in 19% of the cases. If a surname is less common, this percentage is higher. The 80 least occurring surnames involved in the investigation were correctly predicted in 34% of the cases.¹⁴ In another study, a researcher found a genotype occurring in 44% of men with his surname, Sykes, which did not occur in men with other surnames.¹⁵ The forensic usability of surname typing is limited, however, since it requires rare names and the absence of adultery by any of the ancestors.

This shows that DNA contains hitherto unimagined information about people. As DNA is passed on through the ages and as people develop in certain ways in society, territory, and family, parts of the DNA with characteristic mutations tend to develop more in certain groups than in others. It is this correlation between genotypes and groups

¹³ Peter de Knijff, *Genetic Consequences of 200,000 Years Human Gene Flow*, Genomics for Our World: Synopsis Genomics Momentum 2004, 46, 47 (2004). The Dutch Ministry of Justice has started a research program with respect to this topic, according to Kloosterman, *supra* note 11, at 32.

¹⁴ See Turi E. King, Stéphane J. Ballereau, Kevin E. Schürer & Mark A. Jobling, *Genetic Signatures of Coancestry within Surnames*, 16 *Current Biology* 384, 386 (2006).

¹⁵ See Bryan Sykes & Catherine Irven, *Surnames and the Y Chromosome*, 66 *Am. J. Hum. Genetics* 1417 (2000). For an interesting anecdote of the potential of DNA tracing, see Alison Motluk, *Tracing Dad Online: One Teenager's Detective Work Has Shown that Promises of Anonymity for Sperm Donors May Now Be Worthless*, *New Scientist*, Nov. 5, 2005, 6, available at <http://www.newscientist.com/article/mg18825244.200.html>. A 15-year old British boy, attempting to trace his anonymous sperm-donor father, sent his DNA to a genetic-genealogy company and was contacted independently by two men with similar Y-chromosomes who turned out to have the same, although differently-spelled, surname. Together with his father's date and place of birth, which his mother knew, he was able to find his father.

(ethnic groups, families) that allows the delineation for forensic purposes of a potential group to whom the suspect or, more precisely, the source of the DNA found at the crime scene is likely to belong. If this group can be sufficiently narrowed down by DNA phenotyping, investigation can then zoom in on this group with other investigation techniques.

2.2. Direct phenotyping: body features and behavioral characteristics

Apart from indirect determination through inferring the geographic background of a person, external characteristics such as eye color and hair color can also directly be linked to DNA. Unfortunately, there is not simply one gene that codes for eye or hair color. A human being's physical appearance and behavior depend on a combination of factors. There are not only several genes that interact with each other, but also numerous external factors, ranging from the embryo's position in the uterus and the substances it absorbs during pregnancy to complicated and mainly unknown processes in which genes are expressed. It is, however, clear that a considerable correlation exists between genes and appearance: "Many human phenotypes (for example, stature, facial features and pigmentation) have a strong genetic component."¹⁶ It is expected that in the years to come, more insight will be gained in the coincidence between certain genotypes (single or multiple genes or alleles) and phenotypes such as hair color, hair shape (curly, straight, frizzy), eye color, skin color, stature, build and shape of the face and skull, for which these genes supposedly code.¹⁷

Science is making rapid progress and already some insights exist into certain phenotypes. There are about thirty variants of the *MC1R* gene, of which three strongly coincide with red hair, fair skin and freckling. "Population studies show that . . . such a variant gives a >90% probability of having red hair."¹⁸ As to eye color, there are strong indications that the gene *OCA2* is a major determining factor.¹⁹ In addition, a genetic

¹⁶ Mark A. Jobling & Peter Gill, *Encoded Evidence: DNA in Forensic Analysis*, 5 *Nature Reviews* 739, 748 (2004).

¹⁷ See Online Mendelian Inheritance in Man (OMIM), <http://www.ncbi.nlm.nih.gov/sites/entrez?db=OMIM>. Information about recent findings can be found on the website by searching for terms such as "hair color" or "stature."

¹⁸ Jobling & Gill, *supra* note 16, at 748. The reverse need not be true: somebody may have red hair without having this specific gene variant. And, of course, somebody may dye his blond hair red or his red hair blond.

¹⁹ Gu Zhu et al., *A Genome Scan for Eye Color in 502 Twin Families: Most Variation is due to a QTL on Chromosome 15q, 7(2)* *Twin Research* 197, 197-98 (2004) ("We conclude that most variation in eye color in Europeans is due to polymorphism in *OCA2* but that there may be modifiers at several other loci. . . . The leading candidate gene for human eye color is the *OCA2* gene . . .").

eye-color test for forensic investigation is already available on the market.²⁰ For behavioral characteristics, chromosome areas have been pointed out that correlate with a propensity for smoking,²¹ left-handedness,²² and adult stuttering.²³ The experts' general expectation is that in the next decade or so, a correlation could be found between genotypes and phenotypes such as pigmentation, hair shape, shape of the face, and stature. Genotypes for behavioral traits will not so easily be found, but some are optimistic that, in the end, many will be discovered.²⁴ At best, however, only a suggestion or likelihood of these characteristics being present in the carrier of the genes will be possible: "the complexity of these quantitative traits, coupled with variability introduced by environmental and nutritional differences, means that even if the genes influencing them were identified there are no guarantees that simple deterministic tests would emerge."²⁵

3. LEGISLATION SURVEY

3.1. Methodology and limitations

To answer the question as to what extent forensic DNA phenotyping should be allowed, it is useful first to look at laws that currently regulate this issue. For this purpose, we have conducted a global survey of DNA phenotyping legislation in 2004 and early 2005.

We surveyed academic and other literature from around the world by searching the Internet, databases of legal journals, and the library of the Max Planck Institute for Foreign and International Criminal Law in Freiburg. This literature search was

²⁰ Press Release, DNAPrint, DNAPrint Announces the Release of RETINOME™ for the Forensic Market: Eye Color Prediction From Crime Scene DNA (Aug. 17, 2004), http://www.dnprint.com/welcome/press/press_recent/2004/august_17/. *But see* Jobling & Gill, *supra* note 16, at 748 (referring to research that indicates that several good "eye-color gene" candidates exist on 61 loci in the DNA that may explain 15% of the variation in eye color in a large population, "but probably do not provide useful predictive testing").

²¹ *See* OMIM, Tobacco Addiction, Susceptibility to, <http://www.ncbi.nlm.nih.gov/entrez/dispomim.cgi?id=188890> (last visited Mar. 31, 2008).

²² *See* OMIM, Handskill, Relative, <http://www.ncbi.nlm.nih.gov/entrez/dispomim.cgi?id=139900> (last visited Mar. 31, 2008).

²³ *See* OMIM, Stuttering, Familial Persistent 1, <http://www.ncbi.nlm.nih.gov/entrez/dispomim.cgi?id=184450> (last visited Mar. 31, 2008).

²⁴ Clark & Grunstein, *supra* note 3, at 278 ("There is every reason to believe that [over the next hundred years or so] we will have isolated and characterized the principal genes underlying human behavior, and identified most of their important allelic variant.").

²⁵ Jobling & Gill, *supra* note 16, at 748.

supplemented by a questionnaire²⁶ sent to experts in DNA forensics or DNA-related criminal law in Belgium, France, Germany, Italy, Poland, Spain, the UK, and Australia. Besides the United States for which we had literature available, we expected that Europe and Australia were the most likely to have laws on forensic phenotyping since they were so advanced in DNA forensics. We also sent the questionnaire to experts in Israel, South Africa, and Brazil in order to get an impression of developments in regions with less developed DNA forensics. In all, we received replies from experts in Belgium, France, Spain, Australia, Israel, South Africa, and Brazil.

At the outset, both the literature search and the questionnaire had limitations. First, the literature search was extensive and broad, but limited to literature in the English and Germanic languages. Because developments in legislation are often only published in local media in the country's native language, it is possible that legislation exists in countries outside the scope of our survey. Nevertheless, given the novelty and importance of the new phenomenon and the strong relationship with state-of-the-art genomics research, which is always published in English, any legislative developments in this field are likely to somehow be publicized in English-language media.²⁷ Thus, this limitation is not very grave. Second, the questionnaire, which was small-scale for practical and budgetary reasons, yielded information on the countries that responded but did not allow for generalization. With these caveats in mind, some tentative conclusions can be drawn from our survey about forensic DNA phenotyping legislation.

3.2. General outlook

Almost all surveyed countries have some form of DNA legislation, but these laws are generally confined to traditional DNA forensics, that is, making DNA profiles or fingerprints from crime-scene material and comparing these to profiles stored in forensic DNA databases. In some jurisdictions, it is explicitly provided that a DNA profile must not give phenotypical information. The European Council Resolution of June 25, 2001 on the exchange of DNA analysis urges member states to only exchange the results of DNA analysis of non-coding chromosome zones, "i.e. not known to provide information about hereditary characteristics."²⁸ Similarly, the 2005 Prüm Convention requires that

²⁶ Bert-Jaap Koops et al., Questionnaire on Forensic DNA Phenotyping, <http://rechten.uvt.nl/dna/upload/382004953760845363140.doc> (last visited Apr. 23, 2008).

²⁷ An important source of information about forensic DNA legislative developments is the weekly DNA Resource Report, compiled by Smith Alling Lane. See <http://www.dnaresource.com/> (follow "News Recent Stories" hyperlink) (last visited Apr. 23, 2008). Its information on International News includes reports from numerous countries around the world thereby providing a good indication of global DNA legislative developments.

²⁸ Council Resolution, art. III(1), 2001 O.J. C 187/1. See also art. III(2), 2001 O.J. C 187/1 ("Should science develop in such a way that it can be determined that any of the DNA markers recommended in this resolution provide information on specific hereditary characteristics, Member States are recommended to no longer use that marker when exchanging DNA analysis results.").

party states make available the reference data from their national DNA analysis files, but only those DNA profiles based on the non-coding part of DNA.²⁹ In Belgian law, the only purpose a forensic DNA investigation may serve is the comparison of DNA profiles in order to directly or indirectly identify persons involved in criminal behavior.³⁰ It is a criminal offense to conduct a DNA investigation for other purposes.³¹ In other countries, there is no legal provision on this, but in practice or doctrine, DNA forensics is restricted to non-coding DNA; for instance, this is the case in Australia,³² South Africa,³³ and Spain.³⁴ This indicates a precautionary approach in DNA forensics: for purposes of matching DNA profiles, non-coding DNA is sufficient, and hence, coding DNA should not be stored in databases. The question is, however, to what extent is DNA analysis allowed for other goals. Do other countries allow phenotyping for tracing unknown suspects?

Save a few exceptions, most notably Netherlands which passed a specific law on this in 2003, we have the strong impression that forensic DNA phenotyping has not yet come to the attention of legislatures. This emerges both from our literature search, which yielded few documents that focused on forensic DNA phenotyping,³⁵ and from the questionnaire, where all experts mentioned not only the absence of legislation in their countries, but also an almost complete absence of discussion about forensic phenotyping in the public or political debate. Only in Australia has there been a debate about forensic

²⁹ Convention on the Stepping Up of Cross-Border Cooperation, Particularly in Combating Terrorism, Cross-Border Crime and Illegal Migration art. 2(2), May 27, 2005, Council Secretariat, Brussels, 7 July 2005, Document no. 10900/05.

³⁰ See art. 44ter § 1 Belgian Code of Criminal Procedure, Act 22 March 1999, B.S. 20 May 1999.

³¹ See art. 6 § 3 Belgian DNA Act, Act 22 March 1999, B.S. 20 May 1999.

³² Australian Law Reform Commission, *Essentially Yours: The Protection of Human Genetic Information in Australia* (ALRC 96), 1026 (2003).

³³ Andra van der Merwe, Stellenbosch University, personal communication, 8 September 2004.

³⁴ Angel Carracedo, Spanish Institute of Legal Medicine, personal communication, 9 October 2004.

³⁵ See Lindsay Elkins, *Five Foot Two With Eyes of Blue: Physical Profiling and the Prospect of a Genetics-Based Criminal Justice System*, 17 Notre Dame J.L. Ethics & Pub. Pol'y 269, 305 (2003); Michelle Hibbert, *DNA Databanks: Law Enforcement's Greatest Surveillance Tool?*, 34 Wake Forest L. Rev. 767, 825 (1999); E.J. Imwinkelried & D.H. Kaye, *DNA Typing: Emerging or Neglected Issues*, 76 Wash. L. Rev. 413, 474 (2001); Kloosterman, *supra* note 11, at 32; Williams, Johnson & Martin, *supra* note 10, at 112; Australian Law Reform Commission, *supra* note 33, at 1026; Human Genetics Commission, *Inside Information: Balancing Interests in the Use of Personal Genetic Data* (2002), <http://www.hgc.gov.uk/Client/document.asp?DocId=131&CategoryId=10> (last visited Mar. 2, 2008); Kristina Staley, *The Police National DNA Database: Balancing Crime Detection, Human Rights and Privacy*, Genewatch UK (2005), <http://www.genewatch.org/pub.shtml?als%5Bcid%5D=492774> (last visited Mar. 2, 2008).

phenotyping, on the basis of a consultation by the Law Reform Commission. Submissions in the public consultation, including the New South Wales Police Service, generally supported the proposal to establish in legislation that only non-coding sections of DNA can be used in forensics. Only the Victoria Police opposed the proposal because it “would restrict the development of new DNA markers such as physical characteristics that are currently subject to increasing research worldwide.”³⁶ The Reform Commission did not provide a recommendation due to the early stage of this field, but stated that if law enforcement in the future wished to conduct forensic DNA phenotyping, “this would require considerable public consultation and fresh community agreement.”³⁷ The debate in Australia, however, has still never been triggered by political interest or discussed in any depth by the media or the community at large.³⁸ In Belgium, some debate took place in parliament on the use of coding versus non-coding DNA. However, the debate only concerned deriving medical information from DNA, not the possibility of deriving non-medical physical characteristics.³⁹ In Spain, attempts to initiate a debate about phenotyping proved unsuccessful.⁴⁰

Thus, the main finding of our survey is that the Netherlands is the only country to explicitly allow the use of DNA for forensic phenotyping.⁴¹ Apart from Belgium, a few other jurisdictions (Germany and three U.S. states) explicitly prohibit deriving physical traits other than gender from DNA.⁴² The legislation of most other countries is silent about DNA phenotyping, and the issue does not seem to be a subject of debate yet. This is not to say that, in those countries, forensic phenotyping is prohibited. Depending on the legal system and culture, it may be implicitly allowed as part of DNA forensic investigations, as in the UK, for instance.⁴³

³⁶ Australian Law Reform Commission, *supra* note 32, at 1029.

³⁷ *Id.* at 1030.

³⁸ Tony Raymond, Director of the Australian National Institute of Forensic Science, personal communication, Aug. 19, 2004.

³⁹ See Proceedings of the Belgische Kamer van volksvertegenwoordigers [Second Chamber], 5th Session of the 49th Legislature, 1047/6 – 96/97, Feb. 18, 1999 (Bel.).

⁴⁰ See Letter from Angel Carracedo, Spanish Institute of Legal Medicine, (Oct. 9, 2004) (on file with author).

⁴¹ See *infra* Section 3.3.

⁴² See *infra* Sections 3.4 and 3.5.

⁴³ See *infra* Section 3.6. Japan is also reported to be embarking on forensic phenotyping, by planning to set up a database with information “that could be used to distinguish different populations including data on ethnicity; blood type; genes affecting people’s metabolism, hair and skin colour; and different viral infections. It is thought to be the first database that will try to attach an ethnic profile to an individual’s DNA.” Staley, *supra* note 35, at 32.

3.3. The Netherlands⁴⁴

In 2003, an amendment to the Dutch Code of Criminal Procedure (*Wetboek van Strafvordering*) made it possible to derive phenotypical information from DNA found at a crime scene and belonging to an unknown suspect.⁴⁵ For the time being, only gender and race⁴⁶ may be determined, but in the future other traits may be included through an Order in Council. Traits to be included are limited, however, to externally perceptible traits.

According to the Dutch government, this limitation to externally perceptible traits has two limitations itself. First, only traits that can contribute to a criminal investigation may be investigated. It is clear that most externally perceptible traits satisfy this requirement, since they can be used to draw up a composite drawing or a description of the suspect. Second, the DNA source's⁴⁷ privacy and the right not to know must be respected. This implies that traits that the DNA source does not know about because they have not come to expression may not be investigated. As is apparent from the parliamentary history of the bill, the government takes a precautionary approach in this respect: if it is *uncertain* that the source knows about the trait, it may not be investigated. In the later stages of the legislative process, the government operationalized the precautionary approach by indicating in the parliamentary proceedings that the traits should be visible from birth. This operationalization has been disputed in literature, since it does not necessarily follow from the precautionary approach to take such a limited stance.⁴⁸ Some traits are very likely known to a person at a certain age even though they are not visible from birth.

⁴⁴ See generally Bert-Jaap Koops, Merel M. Prinsen & Maurice H. M. Schellekens, *Wanted: A Tall Blond Dutchman. Does the Netherlands Set the Stage in Regulating Forensic DNA Phenotyping?*, 13 *Tilburg Foreign L. Rev.* 206 (2006).

⁴⁵ See *Wet van 8 mei 2003 tot wijziging van de regeling van het DNA-onderzoek in strafzaken in verband met het vaststellen van uiterlijk waarneembare persoonskenmerken uit celmateriaal* [Act of 8 May 2003 To Adapt the Regulation Of Forensic DNA Investigation In Relation To Determining Externally Perceptible Personal Characteristics From Cell Material], *Staatsblad van het Koninkrijk der Nederlanden* 201 (2003) (Neth.).

⁴⁶ Although the law uses the term 'race' (*ras*), what is really meant is the geographic background of the ancestors of the person: the region where the ancestors – or in case of mixed marriages, most of the ancestors – originally lived. 'Geographic origin' would have been a better and more neutral term. Cf. Ananthaswamy, *supra*, note 10; Williams et al., *supra* note 10 and accompanying text.

⁴⁷ We use the term 'DNA source' to indicate the person from whom the crime-scene trace originated from which the DNA was derived.

⁴⁸ See Koops, Prinsen and Schellekens, *supra* note 44.

3.4. Germany

Article 81e of the German Code of Criminal Procedure (*Strafprozeßordnung*, hereinafter: StPO) allows investigation of DNA only for certain purposes. Two purposes are to determine parentage and to determine whether traces of DNA material stem from the suspect or from the victim. In the course of such an investigation, a third purpose is to determine the gender of the source of the material.⁴⁹ Other determinations, however, are not allowed. This prohibition is intended to prevent investigation into vulnerable genetic dispositions, which might lay bare characteristics of the personality.

The StPO, however, does not specify in what way the allowed determinations are to be made. In particular, the law does not prescribe that the investigations are limited to non-coding sequences of the genome. Thus, the development of technology will not be hampered by the law. In the Explanatory Memorandum to the bill that introduced Article 81e, the government indicated that, given the current state of the art, the admissibility of DNA investigations cannot be made dependent upon the distinction between coding and non-coding segments.⁵⁰ Furthermore, other forensic investigations, such as typing somebody's blood, also concern information about coding segments, since these investigations are ever more gene-based.⁵¹ Therefore, it would be inconsistent to categorically exclude investigation of coding segments.

Later, the legislature amended Article 81e to allow the determination of the gender of the DNA source through a bill introduced by the parliamentary parties SPD and Bündnis90/die Grünen.⁵² The Explanatory Memorandum mentioned two main reasons for allowing the determination of gender. First, it is seen as an important instrument in the investigation of a crime with an unknown perpetrator. This may be explained by the fact that the pertinent bill is about crimes against sexual self-determination. The provision about gender determination is, however, not limited to such crimes. Second, the sets of reagents available for DNA investigation regularly include gender determination, while alternative sets are not available. It seems that the practice of using these sets has necessitated legalization as a matter of practicality. Having stated the advantages, the Explanatory Memorandum pointed out that gender determination is consistent with the starting point that the investigation of genetic vulnerabilities to mental and physical diseases should not be allowed. A person's gender can readily be seen without further investigation, and thus does not require special protection. In the past, gender had also been determined from traces found at a crime scene using technologies

⁴⁹ See StPO [Code of Criminal Procedure] Apr. 7, 1987, Federal Law Gazette 2646, as amended, Art. 81e, *translation available at* <http://www.iuscomp.org/gla/statutes/StPO.htm#81e> (translated by the German Federal Ministry of Justice and reproduced by the Comparative Law Society) (last visited Mar. 24, 2008).

⁵⁰ BTDrucks [Bundestag Drucksachen] 13/667 (BTDrucks is the publication of the German Federal Parliament, specifically the Federal Diet).

⁵¹ *Id.*

⁵² BTDrucks 15/350.

other than DNA-related ones. The Explanatory Memorandum did, however, warn that this finding cannot automatically be extended to other externally perceptible characteristics of the source of a trace, since vulnerable characteristics of the personality may come to light when investigating such characteristics. Finally, it is remarked that such determinations are not yet possible given the state of the art.

In short, for the German legislature, the admissibility of allowing determination of externally perceptible characteristics mainly hinges upon the question whether genetic vulnerability to mental and physical diseases will be revealed in the course of investigation. Since it might not be avoidable that vulnerable information emerges even when externally perceptible traits are investigated, the only phenotyping that German law allows is for gender.

3.5. The United States

In the United States, there is no federal legislation on forensic phenotyping. In addition, most state laws do not cover the topic either, at least not explicitly. However, three states – Indiana, Rhode Island, and Wyoming – disallow the use of DNA submitted to their databanks to be used for determining phenotypical information of the DNA sources.⁵³ In Indiana, the law states that the “information contained in the Indiana DNA data base may not be collected or stored to obtain information about human physical traits or predisposition for disease.”⁵⁴ Similarly, Rhode Island law stipulates that “DNA samples and DNA records collected under this chapter shall never be used under the provisions of this chapter for the purpose of obtaining information about physical characteristics, traits or predispositions for disease.”⁵⁵ Additionally, Wyoming law states that the “information contained in the state DNA database shall not be collected or stored for the purpose of obtaining information about physical characteristics, traits or predisposition for disease.”⁵⁶ Finally, Vermont does not prohibit phenotyping at large, but forbids DNA analysis “for identification of any medical or genetic disorder.”⁵⁷

We have not been able to trace the exact reasons for these states to enact these laws. Rhode Island may have created its provision “to assure that the ACLU would not challenge the Rhode Island DNA database bill.”⁵⁸ This may suggest that pressure from, among others, civil society influenced the legislation in the U.S. states that prohibit phenotyping.

⁵³ Hibbert, *supra* note 35, at 791.

⁵⁴ Ind. Code Ann. § 10-13-6-16 (West 2004).

⁵⁵ R.I. Gen. Laws § 12-1.5-10 (2007).

⁵⁶ Wyo. Stat. Ann. § 7-19-404 (2007).

⁵⁷ Vt. Stat. Ann. tit. 20, § 1937 (2008).

⁵⁸ Aaron P. Stevens, *Arresting Crime: Expanding the Scope of DNA Databases in America*, 79 Texas L. Rev. 921, 934 (2001); *see also* Hibbert, *supra* note 35, at 794.

The fact that most states do not have explicit provisions on phenotyping may imply that they actually allow it. Michelle Hibbert argues that “other states’ laws implicitly allow the collection of genomically-derived physical and mental trait information because they allow these samples to be analyzed for information useful for law enforcement purposes.”⁵⁹ For example, Texas law allows forensic phenotyping in order to trace unknown suspects. This is evident as the law excludes “information about human physical traits or predispositions for disease unless the purpose for obtaining the information is related to a purpose described by this section;” and exceptions described are “the investigation of an offense, the exclusion or identification of suspects, and the prosecution of the case.”⁶⁰ And many other states’ laws use formulations that arguably cover forensic phenotyping for tracing an unknown suspect as well.⁶¹

3.6. The United Kingdom

The United Kingdom is one of the most advanced countries when it comes to DNA forensics. Not only was DNA fingerprinting first developed in the UK,⁶² but also forensic phenotyping was researched in the UK in the early 1990s.⁶³ However, there is no legislation specifically regulating forensic DNA phenotyping in the UK.⁶⁴ Instead, it is a technique that is simply being used in practice, apparently permissible by the general legislative framework.

The Forensic Science Service (FSS) in the UK provides two phenotyping services to police in order to “provide intelligence about the physical appearance of the offender.”⁶⁵ The first service is an “ethnic inference service,”⁶⁶ which calculates the

⁵⁹ Hibbert, *supra* note 35 at 791-92 (referring to Ky. Rev. Stat. Ann. § 17.175 (LexisNexis 2007)).

⁶⁰ *Id.* at 792 (referring to Tex. Gov’t Code Ann. § 411.143 (Vernon 2007)).

⁶¹ For example, “determine identification characteristics specific to the person,” (Connecticut, Georgia, New Hampshire), “DNA identification testing, typing, and analysis” (South Carolina), “those markers having value for law enforcement identification purposes” (New York), as quoted in Hibbert, *supra* note 35, at 792-93.

⁶² A.J. Jeffreys et al., *Individual-Specific ‘Fingerprints’ of Human DNA*, 316 *Nature* 76 (1985).

⁶³ Evett et al., *supra* note 8.

⁶⁴ The law on DNA forensics is the Police and Criminal Evidence Act 1984, *available at* <http://police.homeoffice.gov.uk/operational-policing/powers-pace-codes/pace-code-intro/>, which covers only taking and destroying DNA samples.

⁶⁵ Forensic Science Service, *Fact Sheet. Commonplace Characteristics* (2004), http://www.forensic.gov.uk/forensic_t/inside/news/docs/Commonplace.doc.

⁶⁶ *Cf. supra* Section 2.1.

probability of a person's ethnicity using FSS-developed software and statistics on genotypes within five British ethnic groups: white-skinned European, Afro-Caribbean, Indian Subcontinent, South-East Asian, and Middle Eastern. According to the FSS fact sheet, "British Afro-Caribbeans for example, display a greater number of differences and so are more easily discriminated."⁶⁷ This service was apparently used in April 2004 in a rape investigation, where the police announced that they were looking for a suspect from the Caribbean, based on the crime-scene DNA.⁶⁸ The second service is a red-hair test, which relies on differences in the MC1R gene. People inheriting a mutated version of this gene from both parents are likely to have red hair, and according to the FSS, the test "detects approximately 84% of redheads."⁶⁹ The FSS is also developing systems for determining other physical traits like skin color, facial structure, and height.⁷⁰

The UK Home Office has asserted commitment to furthering development of forensic phenotyping.⁷¹ In addition, the Human Genetics Commission recommended the establishment of an independent research ethics commission to approve research in this area. It also voiced concern over the use of phenotyping for behavioral traits and recommended that the Government's use of "sensitive personal genetic information for forensic purposes" requires "a full public debate in order to examine the ethical, consent and confidentiality issues."⁷²

3.7. Conclusion

In our survey of eleven countries the Dutch statute stands out as the only law to explicitly allow DNA phenotyping. The approach taken by the Dutch legislator is a cautious one. According to the legislative history, in order to respect an individual's right not to know, only those externally perceptible characteristics visible from birth may be derived. A similar regulation, although less explicit, can be found in Vermont law, which prohibits DNA analysis to derive medical information.

Some jurisdictions explicitly prohibit forensic DNA phenotyping. Belgium and three US states prohibit forensic DNA phenotyping across the board. Germany prohibits forensic DNA phenotyping for traits other than gender. Many other countries' legislations do not state which purposes forensic DNA analysis may serve. It would,

⁶⁷ Forensic Science Service, *supra* note 65.

⁶⁸ Staley, *supra* note 35, at 34.

⁶⁹ Forensic Science Service, *supra* note 65.

⁷⁰ Williams, Johnson & Martin, *supra* note 10, at 112; *Forensic DNA Databasing: A European Perspective*, <http://www.dur.ac.uk/>

[robin.williams/eu.html](http://www.dur.ac.uk/robin.williams/eu.html).

⁷¹ *Id.* (describing UK Home Office, *Police Science and Technology Strategy 2003-2008*).

⁷² Human Genetics Commission, *supra* note 35, at 31.

however, be a mistake to interpret such silence as an implicit prohibition of DNA phenotyping. In the UK, for example, phenotyping for ethnic origin and hair color is being done regularly, and a careful reading of many US states' legislation suggests that it may be allowed there as well.

4. REGULATORY ISSUES: FOOD FOR THOUGHT

Because forensic DNA phenotyping is allowed in some countries while prohibited in others suggests that forensic DNA phenotyping is contentious. This is understandable, since it raises several moral and regulatory issues. In this section, we review the issues we think are most important when considering forensic phenotyping legislation.

The primary concern, which emerges from the laws described above, is the specter of laying bare genetic information about propensities for diseases and other medical information that the DNA source does not know (section 4.1). The more specific problem, however, is the potential of revealing information hidden in DNA to a person who does not want to know or may be devastated with the knowledge (section 4.2). Closely related, but more general, is the issue of privacy and data protection: what information can be derived from DNA, and how may this impact privacy (section 4.3). Another issue raised in the literature is the danger of stigmatization and discrimination, particularly since "ethnic profiling" is one of the most prominent applications of phenotyping (section 4.4). Finally, there is the fear that once phenotyping for criminal investigation is accepted practice, phenotypical information will be used for other purposes as well, such as eugenics to redress bad genotypes related to aggression or pedophilia (section 4.5).

4.1. Propensities for diseases and the right not to know

4.1.1. The right not to know

Analysis of DNA may bring to light medical information that is unknown to the DNA source, such as a propensity for hereditary diseases or disorders. In a medical setting, random screenings, i.e., screenings unprompted by a clear medical purpose, are rather rare. Usually, there is a concrete reason for a person to decide whether to undertake a screening, such as developing a symptom of an undiagnosed disease or being a part of a family that suffers from a hereditary disorder and wishing to trade uncertainty for certainty.

The setting in which a person decides whether to learn about their DNA is significant. In the medical setting, the person is not in an absolute state of ignorance. The person already speculates that something is wrong or that she possibly has a deleterious gene. In a forensic setting, on the other hand, information about genetic predispositions may come unexpectedly. For instance, the DNA source may unintentionally learn information when his DNA profile detailing a propensity for an abnormal behavioral trait is released to the public. Moreover, information about the results of a DNA analysis may be included in the criminal file composed by the police

and prosecution. In that way, the subject might first learn about this DNA information through the file and, hence, read about genetic propensities that he may not have known about and might not want to know about. If so, forensic phenotyping may breach a basic principle in medical law, the right not to know.

The right not to know is uniformly recognized as an important principle. This principle holds that people should have self-determination of whether to gain information about their medical situation.⁷³ For instance, the Universal Declaration on the Human Genome and Human Rights of November 11, 1997 has codified this principle in its fifth article:

(c) The right of each individual to decide whether or not to be informed of the results of genetic examination and the resulting consequences should be respected.⁷⁴

Similarly, the European Convention on Human Rights and Biomedicine states in article 10.2:

Everyone is entitled to know any information collected about his or her health. However, the wishes of individuals not to be so informed shall be observed.⁷⁵

The right not to know has also been codified in national laws. For instance, Dutch law provides in its Civil Code:

[I]f the patient indicates that he does not want to receive information, then this is not provided, unless the potential resulting prejudice to himself or others outweighs the patient's interest in not knowing.⁷⁶

The latter provision shows that the right not to know is not absolute. Third-party or public interests may override this right.

Evidently, this principle is at stake when DNA is used indiscriminately for forensic phenotyping, since propensities for diseases may come to light. Therefore, the question arises whether the right not to know should be respected or whether the public interest in criminal investigations should outweigh it.

⁷³ For a discussion of the dilemmas of the right not to know, see generally *The Right to Know And The Right not to Know* (Ruth Chadwick et al. eds., 1997).

⁷⁴ Universal Declaration on the Human Genome and Human Rights, U.N. Educational, Scientific and Cultural Organization, 29th Sess., 29C/Resolution 19, art. 5(c). (Nov. 11, 1997).

⁷⁵ Convention for the Protection of Human Rights and Dignity of the Human Being with Regard to the Application of Biology and Medicine: Convention on Human Rights and Biomedicine, Europ. T.S. 164, art 10.2 (1997).

⁷⁶ Burgerlijk Wetboek, art. 7:449 (Dutch Civil Code) (authors' own translation).

4.1.2. *The approach of legislatures*

The legislatures we surveyed all approached the right not to know in similar fashions. Dutch law currently restricts phenotyping to determine only externally perceptible characteristics. This approach underscores the import the Dutch government gives to the right not to know personal medical information. When the characteristic is externally perceptible, the source of the DNA can reasonably be assumed to know about these features already. Therefore, his right not to know is not at stake. For the time being, race and gender are the only externally perceptible characteristics that may be derived under Dutch law. In the future, the government may permit other traits to be derived. Disease-related traits, however, will still be heavily restricted: where it is not certain whether the source of the DNA knows of a disease-related trait, the DNA may not be investigated with respect to this trait.⁷⁷ So, in cases of uncertainty, the right not to know prevails over the interests in criminal investigation. This raises the question, under what conditions the DNA source can be said to have knowledge of a trait? The government has sought to clarify this by stating that the traits must be visible from birth.⁷⁸ As a result, a disease or hereditary disorder relating to externally perceptible traits that manifest after birth may not be investigated. Clearly, the Dutch approach is very cautious when it comes to medical information, which implies that the Dutch government considers the medical right not to know absolute in relation to forensic phenotyping. The same approach can be seen in the laws of Germany, Belgium, and the four U.S. states with phenotyping prohibitions. Of which, the four U.S. states all explicitly prohibit obtaining information about ‘predisposition for disease.’⁷⁹ Also, most of the experts in our survey mentioned disease-related information as the major category to exclude from forensic phenotyping.

We feel that this absolutism of the right not to know is understandable but excessive. Although there are just concerns for deriving information about propensities for diseases, this need not require that all kinds of disease-related information should be discarded indiscriminately. For instance, a less conservative stance than the Dutch “birth approach” might be more appropriate. The threshold could have been placed at a later age, for instance, allowing analysis of disease-related traits that are usually manifest at puberty rather than at birth. More importantly, the right not to know is not absolute in medical law,⁸⁰ so why should it be absolute in criminal law, especially where the public’s interest in apprehending criminals is arguably as or more important? Rather than an outright prohibition of all medical information, a more nuanced approach placing more weight on the interest in criminal investigation might be considered (section 4.2.2).

⁷⁷ The only case the authors can think of in which medical information may be derived is when a disease or disorder relates to externally perceptible traits, such as albinism.

⁷⁸ *Kamerstukken*, Parliamentary Documents (First Chamber), 2002/03, 28 072, nr. 13b, at 4.

⁷⁹ See *supra* Sections 3.4, 3.5, and note 39 and accompanying text; cf. Australian Law Reform Commission 2003, *supra* note 32.

⁸⁰ See *supra* Section 4.1.1.

4.1.3. *Intermediate conclusion*

With regards to the right not to know, the jurisdictions surveyed seem to consider this right absolute in the criminal-law context; an approach that we feel is overcautious. The distinction between medical information and other information “hidden” in the DNA is understandable but somewhat misleading. The issue can be viewed in a more narrow perspective: to what extent should forensic phenotyping be allowed when it comes to deriving data that may lead to information that the DNA source has no knowledge of but which might seriously impact his or her life? In the following section, we go into this narrower problem.

4.2. Potentially unknown information and the right not to know

4.2.1. *Vulnerable information*

As contemporary research regarding genetic diseases has improved, investigators have conducted inquiries into genetic influence on propensities for other invisible and perhaps unknown personal characteristics, such as homosexuality,⁸¹ religiosity,⁸² and perfect pitch.⁸³ However, because of the potential impact that knowledge of these traits might have on a DNA source, it is necessary to analyze the pros and cons of allowing phenotyping to determine the propensity of these traits. Of course, there are no genes simply “coding for” these traits. However, studies of twins demonstrate that genes are a factor in explaining the incidence of at least one of these traits.

If significant correlations were indeed found between genetic profiles and traits such as these, the extent to which forensic phenotyping should be allowed to determine these propensities should be discussed. After all, an investigation could be significantly advanced if there is a likelihood that a person carrying the DNA is homosexual or a zealot, or whether he smokes or stutters or has perfect pitch. Some even imagine that phenotyping may be used for “mental profiling,” i.e., to “get into the mind of a criminal,”⁸⁴ which is relevant in cases of serial killers. Genotypically-derived information concerning propensities for impulsivity, aggression, or nocturnalness, to name a few candidates, could add to such a mental profile.

⁸¹ Cf., OMIM, Homosexuality 1, <http://www.ncbi.nlm.nih.gov/entrez/dispomim.cgi?id=306995> (last visited Apr. 25, 2008) (citing, *inter alia*, Sven Bocklandt et al., *Extreme skewing of X chromosome inactivation in mothers of homosexual men*, 118 *Hum. Genetics* 691 (2006) (“Human sexual preference is a sexually dimorphic trait with a substantial genetic component”).

⁸² See T.J. Bouchard et al., *Intrinsic and Extrinsic Religiousness: Genetic and Environmental Influences and Personality Correlates*, 2 *Twin Res.* 88 (1999).

⁸³ See S. Baharloo et al., *Familial Aggregation of Absolute Pitch*, 67 *Am. J. Hum. Genetics* 755 (2000).

⁸⁴ See Michelle Hibbert, *DNA Databanks: Law Enforcement’s Greatest Surveillance Tool?*, 34 *Wake Forest L. Rev.* 767, 790-91 (1999).

This creates similar questions as those raised by predispositions for diseases. Traits like perfect pitch are usually less poignant, and knowledge of them less burdensome, than propensity for diseases. Therefore, someone who never realized he had perfect pitch might come to feel he has missed the opportunity to try a career as a musician, but that does not seem a serious objection to using this trait for forensic phenotyping. Homosexuality, on the other hand, is a serious issue: if someone with suppressed homosexual feelings found out through forensic phenotyping about a genetic propensity for homosexuality, such a person might have a serious identity crisis. Moreover, were his wife also to find out about this genotype, for instance, because it was published in the newspaper as part of the suspect's profile, her suspicions that her husband was homosexual may be confirmed and she may request a divorce. Given the sensitivities with which homosexuality is still surrounded in most societies, these issues cannot be thought of lightly.

In addition to a person's present characteristics, DNA also contains information about a person's ancestry. It is possible that a subject of forensic phenotyping may be ignorant of the ancestral information in his DNA. For instance, it might be the case that someone who appears Caucasian has certain genotypes left from a Chinese ancestor three or four generations back. He might not look Chinese at all and so would not necessarily know of his Chinese connection. Or a Moroccan Arab may turn out to have had a Sephardic Jewish ancestor some generations back. The psychological impact of new knowledge of "racial roots" might sometimes lead a person to question his sense of identity. However, this is neither probable nor serious enough to warrant limiting forensic phenotyping that analyzes geographic background.

Another example where forensic phenotyping might help is when it would find a recessive gene, for example, one recessive gene related to red hair. Since having one recessive gene for red hair does not mean that the person's hair color is red, knowing this fact is of no use for the criminal investigation. Should the perpetrator be found by other means, however, and the fact of the red-hair gene be listed in the criminal file, the person would find out about this gene. In some admittedly far-fetched cases, this might lead the person to question his parentage. Consider an Italian with black hair, and with no occurrence of red hair in his family for generations back. This may simply be genetic coincidence, where it just so happened that in the previous few generations of his family, no person received two recessive red-hair genes. But, if the family photo album contains a series of pictures of his mother and her red-haired boyfriend when she studied in England, our Italian might justifiably have doubts about who his real father is. Admittedly, such cases are unlikely to happen and do not pose a serious objection to forensic phenotyping.

There is one application of forensic phenotyping, however, in which the parental problem seems more realistic: surnames analysis.⁸⁵ Suppose that crime-scene DNA suggests a certain likelihood that the DNA source has the surname of Bulstrode and the investigation thus is targeted at the group of Bulstrodes. This focus does not lead to an arrest, but the perpetrator, a man with the surname Harleth, is caught *in flagrante delicto* of a second crime. Later, his DNA profile is found to match the profile of the first crime

⁸⁵ See *supra* Section 2.1.

sample. He is then also accused of this first crime and becomes acquainted with the investigation in that case. When Harleth likely discovers that his Y chromosome probably belongs to an ancestral line of Bulstrodes, this fact will make him wonder where the Bulstrode genotype entered his family. Somewhere, the wife of one of his paternal ancestors must have committed adultery with a Bulstrode. This may be many generations back, but if Harleth knows that his mother's former boss when she was working as a secretary at a bank was named Bulstrode, he will have a very clear indication that his real father is someone other than who he has always thought. Admittedly, such a scenario is unlikely, but it will be more prevalent than the red-hair case sketched above: the informative value of surnames is simply greater and more precise than red hair, geographic background, or other phenotypes.

To summarize, forensic phenotyping risks laying bare to a DNA source information that he did not know before. Depending on what propensities for certain traits (other than diseases) the information relates to, the result may be burdensome and sometimes may trigger an identity crisis. Also, the information may relate to "normal" externally visible traits like hair color or to invisible but usually known information like surnames. In some cases, however, the information could cause a person to question who his real father is, which also can burden a person's psyche and seriously impact the person's life. Should the right not to know, then, also extend to these types of information and prevail over law-enforcement interests?

4.2.2. The scope of the right not to know

A first question is whether the right not to know extends beyond the medical context. After all, the codification of this right generally refers to medical information. The Universal Declaration on the Human Genome and Human Rights uses a broader wording, however, referring to the right "to decide whether or not to be informed of the results of genetic examination."⁸⁶ A forensic phenotyping test arguably qualifies as a genetic examination.

Regardless of the current codification of the right not to know, it is certainly justified to interpret this principle as valid in relation to all kinds of genetic information, not only medical information. As we argued in the previous section, certain DNA-derived information can also be burdensome for people and have serious consequences. Therefore, it is reasonable to extend the scope of the right not to know to genetic information in general.

There is a difference between direct and indirect knowledge. Direct knowledge is the knowledge of a certain genotype relating to a specific characteristic of the person: external traits like hair color, propensities for diseases or personality traits, or geographic background. Indirect knowledge is knowledge inferred from directly apprehended knowledge: the fact that someone has a certain genotype may lead to inferences about his parentage, in particular, that he may have a different parent or grandparent than he may have thought. This differs from a regular parenthood test, where the result is an answer

⁸⁶ See *supra* Section 4.1.1.

to the specific question whether someone is really the child of someone. Here, on the contrary, we are concerned with indirect inferences about parenthood which is not the result of the genetic test itself and where there is no conclusive evidence about parentage. The right not to know is irrelevant with respect to indirect knowledge, since the potentially burdensome knowledge at issue is not knowledge about the DNA itself, but knowledge subjectively derived from the combination of DNA information with external information (the family photo album; the former boss' name). We shall therefore restrict ourselves to applying the right not to know to direct knowledge.

We feel strongly that the right not to know should not be absolute. It should not preclude analysis of each and every characteristic unknown to the DNA source. In the medical context, the right not to know must be weighed against other interests, notably of relatives who might benefit from the information. Likewise, in the forensic context, the interests of law enforcement may sometimes override the suspect's right not to know.

4.2.3. A delicate balance

The weight of the right not to know is not equal in every situation. Learning of a Chinese ancestor three generations back is not the same as learning of a propensity for a genetic disease. Finding out about a disease for which a cure exists is not the same as finding out about a disease that is incurable. Finding out about a propensity for left-handedness is not the same as finding out about a propensity for homosexuality. Additionally, a propensity for (perhaps an incurable form of) early baldness is not as threatening as a propensity for (perhaps a curable form of) cancer. In other words: the relevance and weight of the right not to know depends greatly on the kind of trait and the impact that knowledge of this propensity may have on someone's life.

Should testing on imperceptible internal characteristics be allowed for forensic purposes at all? Two approaches can be envisioned: a principled approach and a trait-by-trait approach. The former approach builds on the principle that in the forensic context the right not to know implies the right not to be tested for any imperceptible trait. This gives the right not to know a new dimension specific for the criminal context and set apart from the right not to know in the medical context. This approach accords much value to the right not to know. In the trait-by-trait approach, on the other hand, the decision not to test on traits is based on a balancing of arguments by the legislature. This balancing may yield different results depending on the trait under consideration. Each time a new trait can be derived and forensic applications have been developed, a balancing can be done.

Given the wide range of traits at issue, ranging from trivial to very consequential, we feel a principled approach of disallowing all forensic phenotyping for all traits that sources may not be aware of is too strict. If analysis of a relatively trivial trait – like a propensity for left-handedness – has value for criminal investigation, the law-enforcement interest should easily outweigh the right not to know. Thus, as a general rule, a trait-by-trait approach is superior.

In this approach, on the one hand, some kinds of traits will be excluded outright. Many medical characteristics will fall in this category, since these are sensitive data with a potentially large impact on people's lives. Not all medical information should be disallowed, however. For propensities for relatively minor and curable diseases or

disorders with high likelihoods that people will develop them, the right not to know weighs less than the law-enforcement interest in phenotyping, provided that it has an added value in criminal investigation. To give an example: if a genotype were found to be closely related to men starting to bald around the age of twenty-five (assuming this is seen as a medical disorder, which in most Western cultures would seem to be the case), then this would be a helpful trait to determine for investigating a serious crime.⁸⁷ If the DNA source is found and confronted with this knowledge, this may be unpleasant knowledge for him if he is twenty-two and proud of his hair. But if there were a cure for this disorder, then the knowledge would not be very burdensome. Even if there is no known cure, it can be argued that given the relatively low impact of this disorder on the person's life, forensic phenotyping for this trait should be allowed, particularly as a last resort in cases of violent crimes like homicide or rape. In sum, there seems no reason not to let the law-enforcement interest outweigh the right not to know in this case.

Another important category to discuss is propensities for medical disorders or behaviors that may be associated with crime, such as alcoholism or drug abuse.⁸⁸ For example, one form of alcoholism ("type II alcoholism") – starting as a teenager, slowly becoming addicted, and leading to recurrent social problems – has "an estimated genetic component of about 90 percent with very little contribution from any environmental factors."⁸⁹ If the genotypes discovered were related to type II alcoholism, it would be quite relevant to include this in a profile of an unknown suspect given the high correlation between genotype and phenotype and the potential of this trait to narrow down the group of possible suspects. How strongly should the right not to know be valued in this case? If the person turns out to already be an alcoholic, the knowledge that this is genetically related need not be burdensome. On the contrary, it might open up ways of treatment if a genetic cause is known. If the person is not an alcoholic, chances are fair that he will not become one given the fact that this type mostly starts with heavy drinking in the teens. We feel, therefore, that the right not to know is less important than the law-enforcement interest in phenotyping for such a trait.

The examples of early baldness and type II alcoholism, however, concern only a minority of disease-related information. Many diseases or disorders will be more impactful, less certain of manifesting, and of too little use in criminal profiling, to allow them in forensic phenotyping.

Apart from most medical traits, other sensitive characteristics may need to be excluded. A propensity for homosexuality seems to us a good example of a trait where the right not to know should prevail over the need for forensic phenotyping, as helpful as it might be in a criminal investigation to know that a DNA source may be homosexual. After all, homosexuality is a sensitive issue even for considerable parts of society in

⁸⁷ Bearing in mind, of course, that the suspect can always be wearing a wig or baseball cap.

⁸⁸ Of course, we do not mean here that alcoholics or drug addicts usually commit crimes, but rather, that some forms of crime are related to these behaviors, for instance, drunk driving (alcoholism) or theft (drug addiction).

⁸⁹ William R. Clark & Michael Grunstein, *Are We Hardwired?: The Role of Genes in Human Behavior* 211 (2000).

traditionally liberal countries like the Netherlands, and the impact of knowledge about a propensity for homosexuality on a person's life may be very significant.

On the other hand, in the trait-by-trait approach, there are also certain traits with little reason to be excluded from forensic phenotyping. Most externally visible characteristics belong to this category.⁹⁰ The right not to know is not at issue for external characteristics, and there is a clear relevance for using these traits in criminal investigations. Of course, many external traits are changeable: hair can be dyed or shaved, and eyes can be hidden behind colored contact lenses, but that has never been an objection to using these in reports based on eye-witnesses. These traits can be used equally well in profiles based on phenotyping, provided the police are aware of the changeability of certain looks and do not overestimate the particular feature.

There are other traits that may be quite useful in a criminal investigation and where the right not to know is less relevant. Thus, we believe a more liberal approach than that of the Dutch legislature is warranted. Characteristics like voice type and propensities for left-handedness, perfect pitch, and smoking are relevant to include in the profile of an unknown suspect, and we see no serious consequences if the DNA source finds out afterwards about such genotypical information. The same holds true for indirect information, notably geographic origin, which the Netherlands and the UK allow already. Cases in which knowledge of geographic or ethnic background is unknown to a suspect and potentially burdensome, such as a Jewish connection for an Arab, should be extremely rare and moreover are unlikely to have a lasting disruptive impact on the person's sense of identity.

The difficult issue, however, is how to deal with the middle category of traits that do not obviously belong to the excludable or includable categories. This category includes traits that can help criminal investigations, but also have potentially substantial – but not devastating – consequences if the DNA source learns about them. First, since using forensic phenotyping should only be used to add value to the investigation, we should only consider traits with a relatively high likelihood of manifesting, say 75% or more (i.e., 75% or more of persons with this genotype actually develop the phenotype).⁹¹ Second, rather than devising criteria for legislatures to pick and choose among traits in this middle category, it may be helpful to develop ways to use forensic phenotyping while respecting the right not to know at the same time. If this is possible, then the entire

⁹⁰ There is a catch in that unexpected correlations may exist between trivial traits and sensitive information. For example, left-handed people appear to die more often in an accident than right-handers because a correlate of left-handedness seems to create an – as yet unknown – cause for accident-proneness. See, OMIM, Relative Handskill, <http://www.ncbi.nlm.nih.gov/entrez/dispmim.cgi?id=139900> (last visited Mar. 31, 2008) (citing Diane F. Halpern & Stanley Coren, *Handedness and Life Span*, 324 *New Eng. J. Med.* 998 (1991)). It is therefore possible that genotypes related to externally visible features like hair color or stature may turn out to have a correlation to a genotype related to a sensitive trait. If such a correlation is found, a re-assessment should be made of allowing the external trait in forensic phenotyping in light of the sensitive information this accidentally reveals.

⁹¹ Cf. *infra* Section 4.6.

middle category might be accepted for forensic phenotyping, and only traits where the risk of knowledge is too great need be excluded.

If information derived from DNA is not disclosed to the DNA source, the right not to know is, strictly speaking, respected. After all, the right not to know as codified in the above-mentioned conventions only concerns a right not to learn about the results of a test; they do not give a right not to be tested *per se*. This gives rise to two questions. The first question is whether there are any forensic uses for deriving characteristics that cannot be disclosed to the DNA source. At first glance, any use of phenotyping that is publically released in a DNA profile to help with the investigation appears not to be such a use. The phenotyping results would not only be known by the unknown suspect, but also by relatives for whom the information may be relevant as well. The consequences to the DNA source may be avoided, however, if how the information in the profile was obtained was not disclosed. For example, a TV program might announce that a nervous, red-haired Caucasian male smoker is sought without revealing that the assumed hair color, nervousness, and smoking are based on DNA analysis rather than on eye-witness testimony or other traditional clues. Another example is the derivation of the propensity for a rare disease. If the disease has manifested itself, doctors could help the investigation narrow down the circle of potential suspects by informing police of what the symptoms are. In this case, the right not to know is immaterial because the suspect already knows. If the disease has not manifested itself, the knowledge of the symptoms is of no use for identification purposes. Apart from published profiles, information may also be used without potential consequences to the DNA source if it is only used internally by police.

What happens after an arrest is made brings us to the second question. After the suspect is apprehended, should the use of forensic phenotyping and its results be made known to the suspect? The defense's right to access the same information as the prosecution (e.g., the principle of equality of arms), which is present in almost all criminal proceedings in some fashion, seems to require disclosure.⁹² Would it be acceptable, then, to inform the suspect only of the *fact* that a phenotyping test has been performed, possibly with a list of traits that have been examined, and leave it up to suspect to indicate whether he wants to be informed about the *results* of the test? This option would respect the right not to know but possibly infringe the principle of equality of arms. Since it is unlikely that the test results contain exonerating information (we at least cannot think of realistic examples where a propensity for certain phenotypes might exonerate someone, if the phenotype is otherwise unknown by the suspect), there seems to be no serious breach of equality of arms. Another objection, however, is that the suspect may deduce that he was caught through the use of forensic phenotyping and thereby partly infer the test results. Formally speaking, the right not to know may then be said to have been breached in practice. Still, all things considered, the chain of events leading to the DNA source unwillingly gaining knowledge that he did not have before in this way seems to us rather unlikely. Therefore, a plausible approach is to allow forensic phenotyping for the middle category of traits; only requiring that the suspect be informed of the fact of phenotyping and the traits researched, leaving it to the suspect to decide

⁹² See *infra* notes 101-102 and accompanying text.

whether or not to request the results. If this approach is not chosen, legislatures should individually weigh the usefulness of a trait in a criminal investigation against the harm that a subject will suffer should he involuntarily learn about his genotype for each trait, or group of traits, in this middle category.

One final category that we are not sure how to deal with is surname phenotyping. On one hand, surname phenotyping is comparable to the other type of indirect phenotyping, namely phenotyping of ethnic origin, which we have argued to be acceptable given the rare cases in which the right not to know would really be at issue. On the other hand, surnames are more distinct than ethnic origin, and therefore, surname phenotyping might more often cause suspects to question their parentage if they find they have a different “DNA surname” than their official surname. Although we suspect that this will occur only in a few cases, the potential consequences for the suspect and his family are great. Since surname phenotyping has no true analogue in existing criminal investigations and it is still an embryonic technique, we would welcome further academic, political, and societal debate on this issue.

4.2.4. Intermediate conclusion

On the basis of our arguments, it may be concluded that the right not to know precludes forensic phenotyping of many but not all disease-related propensities as well as propensities for other sensitive characteristics such as homosexuality. It is no obstacle, however, for determining externally visible traits, geographic origin, or other characteristics that are not as sensitive, such as voice type or a propensity for left-handedness or for smoking. For more, but not too, sensitive traits that have a considerable likelihood of manifestation and that have added value for criminal investigation, forensic phenotyping seems compatible with the right not to know if a choice is left for an eventual suspect to request the results. Finally, surname analysis is a complex issue that needs further analysis and discussion. Altogether, this brings a fair amount of characteristics within the ambit of forensic phenotyping, at least as far as the right not to know is concerned.

4.3. Data protection and privacy

4.3.1. Data protection

From DNA, much information can be derived about the individuality of a person. The investigative powers discussed in this article concern a first exploration of this information for forensics. In the previous sections, we have explored the implications of the availability of such information for the source of the DNA himself. Here, we address the implications of such information when it becomes available to third parties. Availability to third parties makes the person potentially vulnerable, as seen from a “knowledge is power” perspective. Thus, the question arises whether the DNA sources’ informational privacy is implicated by such investigations.

Data protection principles and rules can be found in international conventions, such as article 8 of the European Convention on Human Rights and Fundamental

Freedoms (ECHR) and article 17 of the International Covenant on Civil and Political Rights. In the United States, data protection is not generically regulated, but is spread across states' sector-specific laws. In Europe, the major convention codifying principles of data protection is Convention 108 of the Council of Europe⁹³ and Directive 95/46/EC, but the Directive does not apply to areas of criminal law.⁹⁴ Thus, the question of whether phenotypical information derived from DNA in a forensic setting constitutes personal data as defined in this directive need not be discussed.

There was, however, a 1992 recommendation of the Committee of Ministers of the Council of Europe on the use of DNA analysis within the framework of the criminal justice system. Taken literally, this recommendation applies to phenotypical use of DNA, since it covers "the collection of samples and use of DNA analysis for the purposes of the identification of a suspect or any other individual within the framework of the investigation and prosecution of criminal offences."⁹⁵ The provision stating that "[r]ecourse to DNA analysis should be permissible in all appropriate cases, independent

⁹³ Convention for the Protection of Individuals with Regard to Automatic Processing of Personal Data, C.E.T.S. No. 108, Strasbourg, 28 January 1981.

⁹⁴ See Directive 95/46/EC art. 32, L 281, 23/11/1995, p. 31. Oddly enough, this does not prevent the Article 29 Data Protection Working Party from discussing DNA samples found at crime scenes in the context of Directive 95/46/EC. See *Working Document on Genetic Data* (Art. 29 Data Protection Working Party, Paper No. 12178/03/EN WP 91, 2004), available at http://europa.eu.int/comm/justice_home/fsj/privacy/docs/wpdocs/2004/wp91_en.pdf. The working party indicates that genetic information is generally covered by the definition of personal data: "Nevertheless in some cases it is less clear, e.g. samples of DNA taken in a given place, such as traces at the scene of a crime. However, such samples may constitute a source of personal data in so far as it may be possible to associate samples of DNA with a given person, in particular once their origin has been confirmed by a court upon the forensic evidence." *Id.* at 5. So, applying the Working Party's reasoning to phenotypical information, phenotypical information is only personal data insofar as it can be associated with a known person. The Working Party is apparently content to operationalize "insofar" in a temporal way. At first, the source of the DNA may be unknown. The data derived from DNA are not personal data. Later on, the source may become identifiable or identified, and then the data have become personal data. It is peculiar that the Working Party indicates that such is the case if the relation between DNA and person "has been confirmed by a court." It is very well possible that the police know the identity of the DNA source long before a court comes to rule on the matter. Therefore, we think that the words of the Working Party must be understood to indicate that confirmation by a court is a sufficient condition to qualify the data as personal data, but not a necessary condition, so that if the source is identifiable earlier, the data already qualify as personal data at that stage.

⁹⁵ Council of Europe, Committee of Ministers, *Recommendation No. R (92) 1 of the Committee of Ministers to Member States on the Use of Analysis of Deoxyribonucleic Acid (DNA) Within the Framework of the Criminal Justice System*, (1992), available at <https://wcd.coe.int/com.instranet.InstraServlet?Command=com.instranet.CmdBlobGet&DocId=601408&SecMode=1&Admin=0&Usage=4&InstranetImage=43351>.

of the degree of seriousness of the offence” supports a broad application of DNA within the field of criminal law.⁹⁶

Moreover, in 2005, a proposal was launched for an EU Framework Decision on the protection of personal data processed in the framework of police and judicial cooperation in criminal matters. This framework, following an increasing call for harmonizing data-protection rules in the area of criminal law,⁹⁷ would have effectively established similar data protection rules for criminal law, for instance, through goal-binding and proportionality requirements.⁹⁸ For the purposes of this (future-oriented) article, we shall assume that data protection rules as laid down in the Data Protection Directive provide an important touchstone for forensic phenotyping, at least in Europe.

With the relevant framework out of the way, we may now return to the question at hand, whether the DNA source’s informational privacy is implicated by forensic phenotyping? DNA from which phenotypical traits are derived typically concerns DNA from unknown suspects (with a known suspect, the police would simply match the DNA profile from suspect and crime-scene sample, and phenotyping would not be necessary). This means that informational privacy is not affected, at least at the time of phenotyping.⁹⁹ Once the identity of the DNA source becomes known, however, such information can potentially be used to affect the person concerned, and at this stage, the data have become personal data.

To lessen the potential impact on the DNA source, one option is to immediately destroy the information derived as soon as the phenotyping information becomes personal data because the suspect is known, which will usually mean that a DNA test confirms that his DNA matches the crime-scene DNA. After all, the information was created with identification in mind, and as soon as the information has fulfilled its identifying purpose, the use limitation principle codified in the data-protection rules, implies that the information should be destroyed.¹⁰⁰ There are, however, two reasons why this is not the way to proceed. First, the criminal investigatory process is subject to internal transparency.¹⁰¹ This follows not only from ECHR article 6, paragraph 1, but

⁹⁶ *Id.*

⁹⁷ *See id.* at 2-3 (under “General Context”).

⁹⁸ *See* Council Framework Decision art. 4(1), *Proposal for a Framework Decision on the Protection of Personal Data Processed in the Framework of Police and Judicial Cooperation in Criminal Matters*, COM(2005) 475 final, Brussels (2005), available at http://europa.eu.int/eur-lex/lex/LexUriServ/site/en/com/2005/com2005_0475en01.pdf.

⁹⁹ *See* Convention, *supra* note 93, arts. 2-3.

¹⁰⁰ Convention, *supra* note 93, art. 5(e). *Cf.* Recommendation No. R(92) 1, *supra* note 95, art. 8; Council Framework Decision, *supra* note 98, arts. 4(1)(e) & 7. Instead of being destroyed, the data could also be anonymized, for instance for use in statistical research.

¹⁰¹ *See Edwards v. United Kingdom*, 15 Eur. Ct. H.R. 417, at §36 (1992) (“The Court considers that it is a requirement of fairness under paragraph 1 of Article 6 (art. 6-1), . . . , that the prosecution authorities disclose to the defence [sic] all material evidence for or against the accused . . .”).

also from ECHR article 8.¹⁰² A defendant charged with a criminal offense must be able to review all evidence for and against him. It could be argued that phenotyping is not relevant for internal transparency, since it is only used for tactical purposes and will never be used as evidence.¹⁰³ However, the fact of forensic phenotyping, and perhaps some of the resulting information, may still be relevant to the criminal case because it gives insight into the procedure the police used to trace down the unknown suspect. Errors made or powers abused during the criminal investigation may trigger a court to conclude that a violation of the right to a fair trial occurred, and in extreme cases lead to the exclusion of evidence resulting from the error, as “fruits from the poisonous tree.”¹⁰⁴ This suggests that phenotyping information should be included in the criminal file.

A second reason to retain the data is article 5 of the Universal Declaration on the Human Genome, which places the decision whether or not to be informed of the result of a genetic test in the hands of the tested individual. Destroying the information would preclude the suspect from deciding whether to be informed or not. The consequences of destroying the information is not as irreversible as automatically providing the information, however, since the suspect could always submit to a second genetic test but could never erase his memory.

Assuming for these reasons that the phenotyping information is not destroyed, the data-protection and privacy implications have to be faced.¹⁰⁵ In the context of ECHR article 8, a privacy infringement is allowed if it passes the three-prong test of the second paragraph. First, the infringement must be “in accordance with the law.”¹⁰⁶ Second, the infringement must serve one of the specific purposes of which the prevention of crime is one.¹⁰⁷ Third, and most importantly, the infringement needs to be “necessary in a democratic society.”¹⁰⁸

For the last prong, a proportionality test should be applied. The further reaching the privacy infringement, the more compelling the interest served by the infringement must be. The outcome of such a balancing process is difficult to predict for forensic

¹⁰² See *Leander v. Sweden*, 9 Eur. Ct. H.R. 433 (1987).

¹⁰³ This is because the match of DNA profiles rather than phenotyping is incriminatory, with a much higher evidential value than phenotyping information can ever attain.

¹⁰⁴ However, see *Khan v. United Kingdom*, 31 Eur. Ct. H.R. 1016 (2000), where an infringement of ECHR article 8 did not lead to a violation of ECHR article 6 and exclusion of evidence.

¹⁰⁵ DNA samples and the information that potentially can be derived from them raise privacy concerns. See, e.g., M.M. Prinsen, *De bestaande forensische DNA-databank en een verkenning van de mogelijkheden tot uitbreiding*, 68 *Privacy & Informatie* (2006).

¹⁰⁶ European Convention for the Protection of Human Rights and Fundamental Freedoms art. 8, Nov. 4, 1950, C.E.T.S. No. 005, available at <http://conventions.coe.int/Treaty/en/Treaties/Html/005.htm> (last visited May 1, 2008).

¹⁰⁷ *Id.*

¹⁰⁸ *Id.*

phenotyping without looking at specific traits to be analyzed. As we indicated in the discussion of the right not to know,¹⁰⁹ there is a category of trivial non-privacy-sensitive characteristics, which includes externally visible traits and relatively neutral traits like propensity for left-handedness or voice type, that would easily pass the proportionality test (provided, as always, that there is an added value for criminal investigation to determine the trait). For the category of sensitive traits, which includes most medical information and things like propensity for homosexuality, the proportionality test would likely be negative, since the privacy risk is serious. For example, if phenotypical information on a propensity for a serious disease or for homosexuality is made public, this information could be used by employers in job decisions, not only concerning the suspect but also concerning his next of kin. In this case, the limited use for law enforcement is not compelling enough to override the risk of privacy infringement to determine such sensitive information.

For the middle category of non-trivial and not too sensitive characteristics, the proportionality test is harder to make. Consider indirect phenotyping to determine ethnic origin or surname. Contrary to direct phenotyping of external characteristics, such as gender or hair color, these traits are not immediately clear once a suspect is identified. That is to say, in the majority of cases, the phenotypical information will not come as a surprise because the person looks in conformity with his ethnic background or carries the surname. However, forensic phenotyping may bring to light more detailed or more objective information about the suspect's ancestry than can be derived from his outer appearance,¹¹⁰ and a surname may surface that was not known to the police or to the DNA source and his family.

As privacy threatening as such information may be, we think that allowing forensic phenotyping with respect to ethnic origin and surnames is proportional with respect to data protection rules. It is important for criminal investigation, since the knowledge that there is a considerable likelihood that the unknown source of DNA found at a crime scene belongs to a certain ethnic group or has a certain surname can greatly help the search for a suspect. The privacy threat resulting from data protection infringement can also be considerable, but this threat will only surface in very few cases, notably where the DNA source is found with great likelihood to have a different parentage than was thought. This is not the case with ethnic origin phenotyping, but may happen occasionally with surname phenotyping.¹¹¹ It is not easy to think of privacy invasions with respect to this middle category. Far-fetched examples can be imagined, such as a popular right-wing politician with a tough-on-foreigners-ideology found to have some African blood, or the surname phenotyping yielding the infrequent name of a prominent debauchee, suggesting that the suspect is his illegitimate child and thus placing the father in an awkward position. All things considered, the general advantages for

¹⁰⁹ See *supra* Section 4.2.

¹¹⁰ See E.T. Juengst, *I-DNA-fication, Personal Privacy, and Social Justice*, 75 Chi.-Kent. L. Rev. 61, 75 (1999).

¹¹¹ See *supra* Section 4.2.1.

criminal investigation by allowing phenotyping of these traits seem greater than the disadvantages for the rare cases where privacy is really at stake.

This result only regards the phenotyping itself, including the storage of the resulting information for the purposes of the concrete criminal case. This does not imply that the crime-scene sample and the derived phenotypical information may be stored or used for other purposes, such as in forensic DNA databases. Since the forensic phenotyping only aims at creating leads to find a suspect, its purpose is served as soon as a suspect is traced and a DNA test confirms or rejects that he is the source of the DNA found at the crime scene. If DNA material is to be stored from this suspect, the regular rules for DNA testing and storing DNA profiles should be followed. There is no need to preserve phenotyping information for any other purpose than bringing the concrete case to court, and hence, the phenotyping data should be destroyed as soon as the case has ended.

4.3.2. *Physical integrity*

Hitherto, we have focused on privacy in the sense of informational privacy. But privacy has more dimensions: it also relates to the physical integrity of a person.¹¹² Is this relevant for forensic phenotyping? The question may seem pointless, since ECHR article 8 protects both informational privacy and physical integrity. However, there is one crucial difference. The protection of physical integrity is available from the start, that is, regardless of whether or not the person is identifiable. Just like letters may not be read by the postman irrespective of whether he knows who the sender is, it can be argued that a DNA sample may, in the absence of any justifications, not be analyzed simply because it is human tissue. This argument would, perhaps, warrant more limitations than the above-mentioned data protection test, since in cases where the DNA source ultimately remains unidentified, a privacy violation might occur. However, this argument fails. The physical taking of a DNA sample from a suspect is not at issue. Because phenotyping uses material found at a crime scene, the bodily integrity of the suspect is never violated by the police. But, does the right to physical integrity extend to body materials even after they have been separated from the body? It might, but only inasmuch as the use of body material somehow impacts the body itself. The right to bodily integrity is broader than the mere physical violation of a body, but relates to the right of an individual to do with his body as he pleases while respecting, of course, other people's rights. It could be argued that certain investigative powers have a chilling effect on this right, for instance, if body scanners induce people to refrain from nipple piercings.¹¹³ In the same vein,

¹¹² This is part of the protection of "private life" as mentioned in article 8 of the European Convention for the Protection of Human Rights and Fundamental Freedoms and codified as a constitutional right in the Netherlands. Grondwet [Gw.][Constitution] art. 11 (Neth.).

¹¹³ See Bert-Jaap Koops, Hanneke van Schooten & Merel Prinsen, *Recht naar binnen kijken. Een toekomstverkenning van huisrecht, lichamelijke integriteit en nieuwe opsporingstechnieken* [Looking Right Inside. Exploring the Future of Inviolability of the Home, Bodily Integrity, and New Investigation Techniques], Sdu Uitgevers Den Haag, 181-183 (2004), available at http://www.ejure.nl/mode=download/downloads/dossier_id=296/id=301/Deel_70_Koops.pdf.

phenotyping crime-scene DNA to determine all kinds of personal characteristics could be argued to incite people to wear gloves all the time or to shave their hair when they go out into the streets, for fear of leaving body material at places where a crime could be committed. This is extremely far-fetched, and a chilling effect on bodily integrity of forensic phenotyping cannot be assumed. It simply does not violate the right to integrity of the body.

4.3.3. *Intermediate conclusion*

Privacy is frequently mentioned as a concern with forensic phenotyping. For instance, “the use of genetic markers retrieved from a crime-scene sample to identify physical traits is likely to spark debates over privacy because of fears that the technology may be abused.”¹¹⁴ Often, a concern over privacy is voiced with regards to disease-related information.¹¹⁵ However, is there also a serious privacy risk in forensic phenotyping if (most) medical information is disallowed? As we have argued, forensic phenotyping in itself only poses a serious risk for privacy with respect to most medical and other sensitive information, such as a propensity for homosexuality. For other types of information, privacy will be infringed only rarely, and a decision to allow forensic phenotyping for these other traits can be positively motivated, provided they really enhance law enforcement and the analysis is restricted to gaining intelligence to trace suspects and not used for other purposes.

4.4. Stigmatization and discrimination

4.4.1. *Geographic origin*

The use of characteristics for a composite drawing or description of the perpetrator of a crime may lead to stigmatization of certain groups within society. Information on ethnic origin is the prototypical example of information that may have such an effect, especially if the ethnic group constitutes a minority in society. This makes the analysis of DNA to determine geographic origin contentious. The statement of the UK Forensic Science Service: “British Afro-Caribbeans for example, display a greater number of differences and so are more easily discriminated,”¹¹⁶ is meant to be scientifically neutral, but inadvertently raises the issue of discrimination and stigmatization. If crime scene DNA is likely to belong to an Afro-Caribbean, prejudices

¹¹⁴ Henry C. Lee & Frank Tirnady, *Blood Evidence: How DNA Is Revolutionizing the Way We Solve Crimes* 295 (Basic Books 2003).

¹¹⁵ Cf. Australian Law Reform Commission, *Protection of Human Genetic Information*, Issues Paper 26, at 13.110 (2001), available at <http://www.austlii.edu.au/au/other/alrc/publications/issues/26/>; Williams, Johnson & Martin, *supra* note 10, at 113.

¹¹⁶ Forensic Science Service, *supra* note 65, at 1.

against Afro-Caribbeans in relation to crime might come into play. This is an even greater risk if one ethnic background can be better determined than others, as the FSS indicates is the case with Afro-Caribbeans. This might lead to relatively more cases involving Afro-Caribbeans, simply because they can be determined where other DNA types would yield inconclusive information. A first task for ethnic-origin phenotyping, then, is to have more or less comparable levels of determinability of the various ethnic groups of the country in question.

If that is accomplished, there is still a twofold threat of discrimination. First, information about the likely ethnic origin of the source of crime-scene DNA (and hence, a potential suspect for the crime) may reinforce existing prejudices against the ethnic minority at large; especially if the same ethnic origin were to be found in a number of consecutive, non-related crimes in a relatively short period. If this were widely published in the newspapers, people might begin to think: “Aha, it’s a phenotypical Moroccan again? Must be something in their genes that makes them criminal.” Second, stigmatization might occur at the individual level when the ethnic origin of the unknown suspect is made public, for instance, in a broadcast description or as a selection criterion in a dragnet investigation, particularly in smaller communities with few representatives of the ethnic minority.¹¹⁷ Mrs. Jones might be tempted to think: “My neighbor Charlie is an Afro-Caribbean – could he have something to do with this rape?” and shun her completely innocent neighbor.

It should be asked, however, whether this is anything new. Witnesses since time immemorial give descriptions about suspects including their perceived ethnic background. The issue of whether or not to publish the ethnic origin of a suspect in a newspaper or television report is a well-known problem, and media have chosen their policies with respect to this. Also, the inclusion of ethnic background in a description or composite drawing made public by the police in order to trace an unknown suspect is nothing new. We could look at the rules already in existence for publication of composite drawings. For instance, in the pertinent Dutch rules, there are several requirements for including information: proportionality, the absence of adequate alternatives, the reliability of the information, and the quality of the experts who provided the information. Furthermore, a composite drawing must always be used in conjunction with other means of identification, such as a description, clothing, or means of transportation.¹¹⁸ However, in the United States including ethnic background in a suspect’s description based on witnesses does not per se violate the Equal Protection Clause.¹¹⁹

Does forensic phenotyping make this situation different? The fact that an inference of ethnic background is based on DNA research may give it an extra

¹¹⁷ See Australian Law Reform Commission, *Protection of Human Genetic Information*, 26 Issues Paper, at 13.110 (2001), available at <http://www.austlii.edu.au/au/other/alrc/publications/reports/96/>.

¹¹⁸ For the Netherlands, such rules can be found in *Aanwijzing opsporingsberichtgeving* [Instruction on Investigation Publications], Staatscourant, Nov. 16, 2004, at 9.

¹¹⁹ See Elkins, *supra* note 35, at 289.

dimension. First, if ethnic information is derived from DNA, the public may interpret that racial differences (which are essentially a socio-cultural construct) are a “hard” biological given. This might deepen the social divide between ethnic groups, as the adverse effects of DNA-based stigmatization could be further-reaching than stigmatization based on information from other sources. Second, for the same reason, the risk of establishing a link in people’s minds between certain minorities and crime is greater, i.e., “it’s in their DNA.” Third, should the phenotyping not only cover ethnic background, but also behavioral characteristics, racial prejudices might be reinforced. This could happen, for instance, if a Sicilian is sought with a propensity for aggression or an Asian with a propensity for phlegmatism to name a couple prejudices that are possible candidates for reinforcement by DNA-based information. Of course, the opposite could also occur, but unfortunately prejudices are probably more likely to be reinforced by corroborating information than to be diminished by negating information.

In short, phenotypical information derived from DNA is nothing new and may be comparable to information provided by, for example, witnesses. In that respect, increased discrimination is not a serious risk. However, phenotyping may carry a larger risk than traditional information in crime-scene investigations for racial prejudice because of the potential links between ethnic groups, crime, and DNA. We think that this may be more of an issue in the United States, where the debate over racial profiling and discrimination is particularly fierce,¹²⁰ and also in the area of DNA forensics,¹²¹ than it would be in Europe.¹²² The activities in the Netherlands and the UK in the area of “ethnic phenotyping” have not triggered a public debate, and it is significant that in the Dutch parliamentary debate on the characteristic of “race,” there has been hardly any discussion about the risk of discrimination or stigmatization. Nevertheless, Europe will likely face this risk, given the current debate on immigration and integration in many European countries and because of Europe’s own racial sensitivity, especially regarding the Jewish population.¹²³

¹²⁰ Cf. Oscar H. Gandy, Jr. & Lemi Baruh, *Racial Profiling: They Said It Was Against the Law!*, 3 U. Ottawa L. and Tech. J. 297.

¹²¹ The risk of stigmatization in relation to phenotyping is often invoked in the literature. This is usually done in a vague way, without indicating concrete threats, thus giving the statement somewhat the character of an obligatory mantra. For instance, Hibbert remarks in relation to phenotyping that it “potentially gives the possessor the power to stigmatize and discriminate against many subjects.” Hibbert, *supra* note 35, at 791.

¹²² The risk of race discrimination is not mentioned as a concern in the 2002 report by the UK Human Genetics Commission, *supra* note 35, or in Williams, Johnson & Martin, *supra* note 10. Interestingly, the Australian Law Reform Commission mentioned the risk of “unfair discrimination against persons within his or her community, based on race or ethnicity” as a concern in its 2001 report, *supra* note 117, but discrimination was no longer mentioned in its more extensive 2003 report, *supra* note 32, at 1026-30, which was based on public consultation.

¹²³ Some markers on the Y chromosome are known to be specific to certain Jewish lineages. See Lee & Tirnady, *supra* note 114, at 309; see also M.G. Thomas et al., *Origins of Old Testament priests*, 394 Nature 138 (1998) (finding a marker common to 10% of the general Jewish population

4.4.2. Other phenotypical information

What holds for racial information may also be relevant, to a lesser extent, for other types of phenotypical information. No one argues that publishing the sex of an unknown suspect reinforces gender discrimination; and many external characteristics are sufficiently neutral not to trigger stigmatization, perhaps with the exception of red hair in some countries. The same holds for most behavioral characteristics. Left-handed people would not be stigmatized at large if in three consecutive murder cases a left-handed suspect were sought. However, it might be a relevant issue for certain medical disorders. For example, in the 1970s, the XYY syndrome, a condition where men had an extra Y chromosome, was thought to be related to a propensity for crime and aggression.¹²⁴ If in a number of cases, forensic phenotyping would find the unknown suspect to have this syndrome, this could lead to reinforcing this perception. A current example might be albinism. If the police would publish a description of an unknown suspect in a brutal murder case as being an albino, people having read *The Da Vinci Code* might be tempted to believe in a link between albinism and violent crime. These are exceptional examples, however, and generally, phenotyping information other than ethnic origin is unlikely to lead to stigmatization of groups.

Nevertheless, stigmatization at the individual level is more of a possibility for other phenotypical information than racial background, especially when an individual has two rare traits. If Mrs. Jones has a left-handed and red-haired neighbor, she might look differently at him if the profile of a left-handed, red-haired unknown suspect were broadcast. This risk is related, of course, to the relevant community and the incidence of the trait in that community: four red-haired people in a small village are more likely to be stigmatized than 5,000 left-handed people in a middle-sized town. For that very reason, it may not be a serious problem: if the number of people with the trait in the area under investigation is sufficiently small, the police need not publish a profile but might ask these people discreetly to voluntarily give a blood sample for DNA profiling.¹²⁵ There is only a need for involving the public if the group of people carrying the trait is too large for other investigation methods, and in that case, the risk of individual stigmatization is proportionately smaller.

and absent in non-Jews).

¹²⁴ See, e.g., Philip Reilly, *Reflections on the Use of DNA Forensic Science and Privacy Issues*, DNA Technology and Forensic Science 43, at 46 (Ballantyne, Sensabaugh & Witkowski eds. 1989).

¹²⁵ Of course, “dragnet” investigations, where a group is asked to co-operate voluntarily (or “voluntarily”) in DNA profiling, carry their own ethical and legal problems, but these problems are caused by the instrument of dragnets and not by the instrument of forensic phenotyping. It is therefore not an argument against forensic phenotyping.

4.4.3. *Discrimination by the police*

So far, we have talked about the risk of discrimination by the public. Another issue is whether DNA-derived information that appeals to prejudices may steer the investigating authorities into a certain direction. Theoretically, information about an unknown suspect's race could be intentionally misused by a prejudiced police force. They could put more effort or place a higher priority on investigating crimes where DNA traces are found of members belonging to a certain minority group. It must, however, be kept in mind that information derived from DNA should be considered objective. It may therefore also have the opposite effect, in that in many cases, it proves that perpetrators do not belong to minority groups,¹²⁶ which might convince investigators with discriminatory tendencies to overcome their prejudices.

Problems with discriminatory tendencies are more likely to happen when the probabilities are closer together than when the probability of one outcome is almost certain. For example, instead of the results showing 99% certainty that the suspect is African, if the results of DNA research suggest a 60% probability of the DNA source being African and a 40% probability of being Caucasian or another race, there is a risk of biased interpretation of these results. Many police officers might be tempted to focus the investigation exclusively on African men.¹²⁷ In other words, forensic phenotyping for ethnic background might strengthen the tendency of "tunnel vision," concentrating on a single lead and disregarding relevant clues that oppose this lead. This is not only a bad and ineffective investigative practice, but it might also lead to discrimination of minorities, who are more likely to be the object of a tunnel vision.

This does not necessarily imply, however, that deriving ethnic origin should not take place, since the above concerns are not really phenotyping-specific issues. The problem might be better addressed by educating police officers and by strengthening control mechanisms in police practice. A further option is to establish guidelines for the way in which a forensic lab reports about phenotyping results. In addition to the scientific data (e.g., the percentages), the lab could include a preferred interpretation of the test results (e.g., "inconclusive"), or if the probability is too low – say, below 50% – refrain from mentioning the potential ethnic origin at all. Such guidelines can in fact already be found in existing legislation. For example, in the Netherlands, the police are only allowed to register data concerning somebody's race if this is indispensable 1) for his or her identification, 2) for the correct appraisal of a criminal offense and if the data concerns the victim or the motives of the perpetrator of the offense, or 3) with a view to assistance by the police. If data concerning somebody's race are registered, an indication of the reliability of the data must be included.¹²⁸

¹²⁶ Edward J. Imwinkelried & D.H. Kaye, *DNA Typing: Emerging or Neglected Issues*, 76 Wash. L. Rev. 413, 450-51 (2001).

¹²⁷ Cf. Staley, *supra* note 35, at 33 ("A major concern is that the police could misinterpret such DNA evidence as a *certainty*, whereas the tests can really indicate only a *probability*. It may be misguided to use predictive genetics to generate a description of a suspect.").

¹²⁸ Police Files Act (*Besluit Politiregisters*) art. 3 (1991) (Nor.).

4.4.4. *Intermediate conclusion*

Deriving ethnic background from crime-scene DNA involves a certain risk of reinforcing racial prejudice. Although the issue of publishing ethnic origin in criminal investigations is not new, DNA may add an extra dimension through the potential link in public perception between crime, race, and genes. This risk is not large enough, however, to prohibit outright forensic phenotyping on ethnic origin (although opinions on this might differ between, for instance, in the United States and European countries). This holds *a fortiori* for other kinds of forensic phenotyping, where the risk of stigmatization and discrimination is lower, perhaps with the exception of certain medical disorders. The question is, rather, how the risk of stigmatization can be contained while allowing phenotyping as such.

From a regulatory perspective, at what level should stigmatization be addressed? Should it be dealt with generically (i.e., leading to disallowing certain traits or combinations of traits that are potentially stigmatizing) or should it be dealt with on a case-by-case basis? Exclusion of certain information generically seems appropriate if the use of such information is unlikely ever to be justified from a stigmatization perspective, such as when the information technically cannot be derived from DNA with a sufficient likelihood. In those cases, phenotyping would presumably not be considered in the first place on the ground that it would not contribute to the criminal investigation. Therefore, a case-by-case approach seems preferable, in which phenotyping for ethnic origin or other traits is generally allowed. In specific cases, however, a decision to take precautionary measures or not to use phenotyping at all should be made. For instance, the investigating authorities should always determine *in concreto* whether the publication of information about unknown suspects is justified given the potential stigmatizing effect that may ensue from it. As Staley states:

There is also a danger that this type of information is used selectively to reinforce existing prejudices: for example, about race or skin colour. It is important for the police to be seen to be using information wisely and accurately if they want to maintain public trust in DNA profiling.¹²⁹

Existing guidelines on police reporting could therefore be extended with an instruction to be careful with combination of traits. As we noted above, a combination of characteristics (aggressive Sicilians) may have an augmenting effect on stigmatization.

In actuality, most of the stigmatizing risk of phenotyping concerning the public could be removed by not mentioning that the source of the information is DNA. The potentially added stigmatizing effect due to forensic phenotyping in addition to the general problem of stigmatization in police reporting that has always existed is caused by the perception that the trait embedded in the DNA is related to the criminal investigation. Since there is actually no reason to mention DNA as the source of the information in a published profile of an unknown suspect, it can simply be left out.

¹²⁹ Staley, *supra* note 35 at 34.

That leaves only the problem of reinforced discrimination by the police, where prejudices lead them to focus in a biased way on the results of forensic phenotyping. This should not be addressed by disallowing phenotyping, but by strengthening educating and monitoring policies to prevent biased policing. After all, the risk of “tunnel visions” misleading the police is a general investigation problem, not one caused by phenotyping.

4.5. The slippery slope of other applications

So far, we have concentrated on forensic phenotyping as a means to trace an unknown suspect. Is this the beginning of a slippery slope? DNA opens up a wealth of knowledge about the traits and the behavior of the source of the DNA. Genes responsible for aggression may be discovered, or alleles that correlate to a propensity for pedophilia. Could such knowledge be useful in fighting crime in other ways than tracing an unknown suspect? Once phenotypical information from DNA is derived, this information could be used for other aspects of crime detection and crime prevention, or perhaps, even for other non-criminal purposes, such as testing by insurance companies or employers. This section will briefly review other purposes to which phenotyping might be put.

4.5.1. Down the hill of phenotyping

First, the most horrifying prospect for many is the possibility that phenotyping might lead to a resurgence of eugenics. It is possible that the discovery of aggression-related genes may induce forced (or quasi-voluntary) medication, and the knowledge of pedophilia alleles may induce forced chemical (or “voluntary”) castration. Many countries have in the past forced sterilization upon people considered “inferior” or unfit to have offspring. In the United States in the 1960s and 1970s, babies were screened for the XYY syndrome (then considered to be related to a propensity for crime) and followed into adulthood.¹³⁰ The fact that research into the XYY syndrome was partly funded by law enforcement¹³¹ might suggest that it is not unrealistic to expect some form of pressure to establish similar policies once “aggression genes” are found.

Second, newly-found genes related to predispositions for crime-related behavior could be used to review the current population in prison or the population of released convicts through DNA databases. “Is it really so difficult to imagine that the development of direct gene tests for loci known to predispose to schizophrenia would stimulate law enforcement agencies to screen their DNA repositories for this condition?” Reilly asks rhetorically.¹³² One could imagine that prisoners carrying the gene at issue would be denied parole, or that they would be monitored after release from prison. This

¹³⁰ Jean E. McEwen, *State DNA Forensic Databanking: Legal, Ethical, and Social Policy Implications and Recommendations for the Future*, at 60 (Nov. 1995) (unpublished Ph.D. dissertation, Brandeis University).

¹³¹ Reilly, *supra* note 124, at 46.

¹³² *Id.* at 48.

is, in fact, not an issue particularly relevant to DNA testing, since there are better alternatives for determining (actual or potential) schizophrenia that could facilitate similar policies.

Third, related to the previous application, phenotypical information in forensic databases can be used for statistical research of relationships between traits and crime. This need not only involve “aggression genes.” For instance, it can also be scientifically interesting to research possible correlations between crime incidence and albinism or a propensity for nervousness or for smoking. Such research could be meritorious from a scientific point of view, but might also trigger new prejudices and lead to stigmatization of nervous or smoking people.¹³³ This is all the more so if the research would focus on correlations between ethnic background and criminality. This is a serious issue, but again not one particularly confined to DNA information: ethnic background, albinism, and smoking can all be noted through observation of convicts. Still, DNA analysis can be more precise than other measuring tools, such as in determining ethnic background. And, perhaps, in the future, unexpressed genetic propensities could still yield unexpected correlations with criminality.

Fourth, phenotyping reinforces a trend towards increasing use of statistics in law enforcement. Recently, statistics have been used in notorious judgments to convict people for murder because it was statistically too unlikely that the deaths had occurred by chance.¹³⁴ In criminal investigation and terrorism-fighting, data mining can be used to find persons fitting “suspect” profiles who are subsequently further investigated. Also for crime prevention, it is imaginable that people with statistically high likelihoods of committing crimes are selected and subjected to special treatment to contain the crime risk. Using phenotypical likelihoods could reinforce “probabilistic law enforcement” and acquaint society with using statistics to such an extent that profiles are gradually seen as certain predictors rather than mere likelihoods.

Related to this is a fifth risk: knowledge of genetic propensities for aggression, pedophilia, or schizophrenia could be used in specific criminal cases, not to trace an unknown suspect, but to establish probable cause¹³⁵ or even to be used as circumstantial evidence. However, we consider these steps unlikely given that “crime-related genes” can only suggest propensities and never certainties for aggressiveness or pedophilia, and that a propensity for aggression does not mean that someone is violent in a particular

¹³³ Cf. *supra* Section 4.4.2.

¹³⁴ In the United Kingdom, a mother was convicted when two children died from crib death; the conviction was later overturned. See Sally Clark: Home Page, <http://www.sallyclark.org.uk/> (last visited Apr. 26, 2008). In the Netherlands, nurse Lucia de B. was convicted for murdering several children and elderly people partly on the basis of statistical evidence that they died when she was on duty at the time of these deaths. See Court of Appeal ‘s-Gravenhage 18 June 2004, LJN-no. AP2846, and Dutch High Court 14 March 2006, LJN-no. AU5496.

¹³⁵ “[P]ositive test results combined with a prior criminal record might influence officials to raise their index of suspicion about such persons or even to consider surveillance of them.” Reilly, *supra* note 124, at 48.

case.¹³⁶ Taking these two steps in one stride to establish concrete levels of suspicion or evidence is not in line with standard criminal procedure.

Finally, phenotypical information, for instance, about propensities for diseases, could be (mis)used by insurance companies or employers, and the latter might also be interested in genes related to stubbornness, unsociability, or forgetfulness to name a few possibilities. As McEwen rightly points out, however, “to the extent that an insurance company, for example, sought to learn about an applicant’s predisposition to genetic disease, it could more easily request a blood sample from the applicant and conduct its own testing,”¹³⁷ and the same holds for employers. There is no reason to suppose that forensic phenotyping would lead to information being distributed outside the circle of law enforcement or that it would pose a higher risk of leaking than current forensic DNA databases already pose.

4.5.2. Assessment

It is of course difficult to predict whether society will go down the path of using such still-to-be-developed applications of genomics for crime-fighting purposes. The development of technology often has a dynamism of its own, and what can be used will usually be used. However, a certain *horror genomicorum* can be perceived in society. For instance, the perception of genetically modified food has been quite negative, particularly in Europe, and reproductive cloning is viewed with abhorrence in almost all countries. The great caution visible in the Dutch legislation about deriving any other characteristics than those externally perceptible from birth is also an indication that the path of phenotyping may sooner stop high on the slope than rush down it. Applications of genetic technology are generally *a priori* suspect unless used for unobjectionable purposes.

Although the potential other applications of phenotypical information each raise serious issues, this is not the place to study their precise implications. This article is not intended to discuss, in-depth, all potential uses of forensic phenotyping, but focuses on using phenotyping to trace an unknown suspect. For this purpose, we have discussed potential other uses of phenotypical information that are mentioned in the literature as a “slippery slope” argument. In our opinion, this is a valid but not a strong argument against forensic phenotyping. Most of the other applications are not exclusively enhanced by phenotyping but can be equally or better facilitated by other means. It is true that forensic phenotyping to trace unknown suspects will make society more familiar with deriving information from DNA in the context of criminal law, but it is a giant leap to use such information for eugenic-type purposes.

This is all the more so since most of the traits useful for tracing unknown suspects – directly derived traits like red hair, stature, or left-handedness, and indirectly derived information about ethnic background or surname – will likely not be directly related to

¹³⁶ For the same reasons, the “genetic defense” argument holds little promise to convince courts that someone “couldn’t help committing the murder” or was temporarily insane at the time of the murder.

¹³⁷ McEwen, *supra* note 130, at 60.

criminal propensities. The feared scenario of forced medication or chemical castration is suggested most by the prospect of finding genes related to aggression or pedophilia, but these are not particularly relevant genes in forensic phenotyping. After all, there is little added value in determining the likelihood that the unknown suspect of a murder has an aggressive nature, or that the suspect of a 10-year-old boy's rape has a propensity for pedophilia. In some cases, it could be accidentally useful if a kidnapping-scene trace were found to be of someone with a propensity for pedophilia, but such would be rare cases.

In short, the "slippery slope" argument is an insufficient reason to forbid forensic phenotyping to trace unknown suspects. Its consideration, however, should not be entirely foreclosed. At some point it might be appropriate to exclude propensities for aggression, pedophilia, and other crime-sensitive behaviors from forensic phenotyping, since these have relatively little added value in tracing unknown suspects and might – albeit with a giant step in political decision-making – bring closer the prospect of forced or voluntary treatment of people with genes related to these propensities.

4.6. Practical issues

We have thus far focused on normative and fundamental issues related to forensic phenotyping. If from a normative perspective forensic phenotyping is allowed to some extent, several practical issues will have to be addressed. A crucial aspect of phenotyping is the likelihood with which a profile can be made of an unknown suspect. The smaller this likelihood, the less useful phenotyping is for criminal investigation and the less an infringement of fundamental rights is warranted.

A profile's likelihood is particularly useful where several features are combined that all have a certain likelihood. For independent features, the overall likelihood decreases rapidly with the number of features. For example, with a 100% likelihood of maleness, an 80% likelihood of having red hair, a 60% likelihood of being over six feet tall, and a 70% likelihood of being left-handed, there is only a 34% likelihood that the DNA source is a tall, left-handed, red-haired man. For dependent features, like blondness and Scandinavian origin or red hair and Irish origin, the overall likelihood may be larger than the product of the separate likelihoods, but it will nevertheless decrease with each added feature (the only exception being, of course, when the feature is certain to appear because it correlates for 100% with another feature).

From this calculus, it follows that features with low likelihoods should not be used in phenotyping, because the overall likelihood of a profile would then approach zero. As a rule of thumb, one could use a threshold of 75% for external features, since then at least a profile with two (independent) features would have a likelihood of 56% and a profile with three features would have a chance of 42% of being correct. There is in fact a difficult trade-off to be made here. A profile of an unknown suspect is only useful when it contains several features; searching for a "blond man" will rarely help. This, however, decreases the profile correctness significantly and hence lowers the chances of finding the suspect. It is probably not useful to use more than three or four features in the profile, if the investigation is to avoid a serious risk of going in a wrong direction. Even so, with three or four features the overall likelihood of the profile will

rarely exceed 50%. Therefore, the police must make an effort to avoid focusing only on persons fitting all of the characteristics included in the profile.

Another practical issue is the influence of phenotyping on probable cause. Although this will not always be an issue, there should be some rules for the judiciary to decide when it is warranted to acquire a DNA sample from a person fitting the phenotyping profile. For example, if a rape was committed near a village and the DNA appears in all likelihood to originate from a red-haired person, and there are only two red-haired men living within a radius of 20 kilometers, is there probable cause against these two men? What if there are 15 such men fitting the profile? Then, probable cause cannot be assumed, since the suspicion is not individualized enough, but the circle of “suspects” is sufficiently narrow to justify a dragnet investigation. It may be a different story, however, if the rape was committed in a city crowded with red-haired men. Surely, no hard and fast rules can be given for all situations, but policy-makers should at least try and develop guidelines for dealing with phenotyping-related probable cause and dragnet thresholds.

These practical issues do not pose fundamental objections to phenotyping, but they should be addressed by legislatures if they decide to allow forensic phenotyping.

5. CONCLUSION

In theory, forensic DNA phenotyping is a promising new investigation method for cases in which no clues point directly to a suspect. Information derived from crime-scene DNA, then may be used to compose a description or profile of the unknown suspect. As a result, the circle of possible suspects might be narrowed down sufficiently to allow other investigation methods to be used, ranging from traditional detective work to a dragnet investigation.¹³⁸

Currently, forensic DNA phenotyping is explicitly regulated only in the Netherlands, which allows the determination of race and gender and, in the future, other externally visible characteristics from crime-scene DNA. In Belgium, Germany and a few states in the United States, forensic DNA phenotyping is by and large forbidden. Most legislatures do not address the topic, which, depending on the legal tradition and culture, may imply that forensic phenotyping is implicitly allowed. The United Kingdom is an example where this is being done in practice without explicit regulation. The overall impression of our legislation survey is that we are still at the beginning of a new development and that countries are still exploring the field.

In addition to surveying various legislatures, we have evaluated regulatory issues relevant to forensic phenotyping. There are serious issues, but their importance should not be overestimated. The arguments posed in some of the literature and the approach of some legislatures seem overcautious when the actual implications of forensic phenotyping are considered. It is useful here to distinguish between the two types of

¹³⁸ We do not discuss in this article the pros and cons of dragnet investigations as such, which merits separate study. *Cf., supra* note 125.

phenotyping: direct (to derive what the suspect looks or acts like) and indirect (to derive markers from the DNA known to correlate to certain ethnic or family groups).

Direct phenotyping should be allowed for two categories, namely for externally perceptible traits, such as hair color or stature, and for non-sensitive internal or behavioral traits, like voice type, left-handedness, perfect pitch, or a propensity for smoking. These raise no objections based on the right not to know, privacy and data protection, or the risk of stigmatization. For two other categories, forensic phenotyping should not be allowed, namely for many propensities for diseases or disorders, and for other very sensitive information like a propensity for homosexuality or aggressiveness. This would infringe the right not to know and privacy in a way not legitimized by the need for law enforcement, or in the case of aggressiveness and pedophilia, risk sliding down the slippery slope towards forced treatment while these traits hardly have added value for tracing unknown suspects.

What merits debate is the middle category of traits that are somewhat sensitive but that can add real value to criminal investigations to trace unknown suspects. Arguably, the right not to know plays some role here although it must certainly not be made absolute. Data protection, privacy, and the risk of stigmatization may also warrant limits to deriving information about these traits. This does not mean, however, that these traits should be excluded outright. Rather, a trait-by-trait approach is appropriate. Under this approach, the legislature would weigh various factors: the likelihood that someone with the genotype actually develops the phenotype (which must be considerable, say, over 75%), the number of genes or alleles involved in the phenotype (not too complex), the age at which the phenotype usually manifests itself (the younger, the less contentious), the alterability of the phenotype by environmental factors (not too influenceable), and the usefulness of the phenotype in narrowing down the circle of possible suspects (it must have added value in describing or profiling the unknown suspect).

Indirect phenotyping is compatible with the fundamental rights we discussed and also should be allowed. Determining geographic background and surnames are promising lines of phenotyping that can significantly help criminal investigations narrow down the circle of potential suspects. The right not to know, privacy, and data protection are not at stake by this except in very rare cases. Discrimination is a risk that can be contained by making sure that no ethnic groups or surnames are disproportionately used simply because they happen to have more easily determinable markers and by educating the police to deal prudently with this type of information, in line with existing guidelines for police reporting.

Apart from the specific categories of traits that legislatures allow for forensic phenotyping, some safeguards can be recommended to take away a substantial part of the objections to this new investigation measure. First, the primary purpose of phenotyping is identification of the DNA source of a crime-scene sample, who is a potential but unknown suspect. This method becomes less relevant as databanks with DNA profiles grow and the chances of finding a match increase. It is, so to say, a niche instrument, suitable for those particular cases where there is no match in the database and where eye-witness reports about the appearance of the perpetrator or other clues are lacking or unusable. Forensic phenotyping should therefore be seen only as an *ultimum remedium*,

and in that respect, it could be allowed only for the most serious crimes, notably those involving violence.

Second, many problems concerning the right not to know, data protection, privacy, and stigmatization are particularly relevant when the information is linked to the DNA source once he is found. By that time, however, a traditional DNA test can easily confirm or deny that the crime-scene sample belongs to this person, and phenotyping is then no longer relevant.¹³⁹ That means that, in principle, the information found in the phenotyping analysis regardless of whether it was useful in fact to trace the suspect could be destroyed, so that there is no longer a data-protection violation or a risk of the information becoming known to other persons, including the suspect. Criminal procedure does not, however, allow this, since the fact of phenotyping, and possibly the results, should be available in the criminal case for the defense. But a phenotyping regulation should at least provide that the results can only be used in the particular criminal case and should be destroyed as soon as the case has ended. Moreover, it is an option to establish a construction to inform the suspect only of the fact that forensic phenotyping was used, but not to give him the results, leaving it to the suspect himself to request cognizance if he so wishes.

Most countries have not yet taken a stance on forensic DNA phenotyping, and few have had a substantial debate take place within the public, the media, or the legislature. Perhaps, this is because the technique has yet to be fully developed. Nevertheless, it is wise to discuss this new investigation technique over the next couple of years in order to be prepared when science comes up with certain correlations between genotypes and phenotypes. Eventually, a forensic expert or a politician will fasten upon this finding and propose that it be used in forensic practice. Without a timely societal debate in the upcoming years, rash or ill-considered legislation is likely. Thus, we hope this article is useful for triggering and structuring such a debate.

¹³⁹ As noted, in this article, we do not go into the use of phenotypical information for other purposes, for instance, in court as circumstantial evidence.