Forensic DNA Phenotyping: Regulatory Issues

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ABSTRACT
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 to inform the suspect only of the fact of forensic phenotyping, leaving it to the suspect himself to request the test results.

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1. Introduction

Suppose that in a particularly violent rape and murder case, the police has 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 from 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 that he saw his tall, red-haired Norwegian neighbor come home in the middle of the night of the murder, and that the day after his garden had been freshly turned over. When 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 current knowledge of the personal characteristics (‘phenotypes’) that DNA codes for, 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. This information could be used in criminal investigations in cases with an unknown suspect and with few clues to lead the investigation forward, in order to narrow down the circle of potential suspects, or – equally important – to certain persons or groups from the investigation. We shall call this ‘forensic DNA phenotyping’. Once the circle of potential suspect is narrowed down sufficiently, other – 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. Moreover, Canadian research shows that the pattern of dermal ridges on fingers has a correlation with certain biological traits, allowing fingerprint analysis for phenotyping purposes. 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 should 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

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3 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.

4 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).


6 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 D. Kimura and M.W. Carson, Dermatoglyphic asymmetry: relation to sex, handedness and cognitive pattern, *Personality and Individual Differences* 19 (1995), no. 4, p. 471-478. See also, J.A.Y. Hall and D. Kimura, Dermatoglyphic Asymmetry and Sexual Orientation in men, *Behavioral Neuroscience* 108 (1994), no. 6, p. 1203-1206 and D. Kimura, Body Asymmetry and Intellectual Pattern, *Personality and Individual Differences* 17 (1994), no. 1, p. 53-60. 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*, Philadelphia etc.: Chilton Book Company 1971, pp. 294-301.
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). On the basis of our 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 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 for 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, once genotypes for certain traits are found and a debate about their use in forensics is triggered. Then, it will be better to have thought about 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.\textsuperscript{7} There may be other uses for phenotyping, such as crime-prevention policies if genes related, for instance, to pedophilia were to be found, but such applications involve another type of debate and merit separate treatment. 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.\textsuperscript{8} 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 this belongs to a man.\textsuperscript{9} Tracing other characteristics is considerably more difficult. 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 geographical area where the person has her roots.\textsuperscript{10} There is even a commercial forensic test available for ‘deciphering of an individual’s race’.\textsuperscript{11} (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.\textsuperscript{12}) 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

\begin{itemize}
\item[-] This is borne out by the pertinent Dutch legislation, which has precisely this aim. See infra, section 3.3.
\item[-] One picogram is one trillionth ($10^{-12}$) of a gram.
\item[-] In rare cases, the psychological, biological, or sociological gender diverges from what the absence or presence of a X-chromosome indicates.
\end{itemize}
the likelihood of that person originating from a certain region. That, of course, does not mean that the person now lives in that region. The DNA of Central Africans who live in the US 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.

When making inferences about the geographic origin, the size of the region within which someone can be traced to with a degree of probability is important to know: can we narrow it down to Northern Europe, the Netherlands, or the town of Gouda? This depends, on the one hand, on the geographical stability of the population. The longer a certain group has lived at a certain location and the more reproduction 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 become available about characteristic DNA types of Dutch or Gouda indigenous inhabitants, the quicker a possible geographical source can be suggested. At the 2004 Genomics Momentum Conference, a Dutch forensic scientist appealed to the government to finance the study into this type of data. 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 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. 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.

This shows that DNA contains information about persons hitherto unimagined. As DNA is passed on through the ages, and as people develop in certain ways in society — territory, family —, parts of the DNA with characteristic mutations tend to develop more in certain groups than others. It is this correlation between genotypes and groups (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 can also directly be linked to DNA, for instance eye color and hair color. Unfortunately, there is not simply one gene that codes for eye or hair color. What a human being looks and behaves like depends 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 proteins that are responsible for the development of the specificity of each individual. For instance, little is known about the role of the X chromosome in determining eye color and hair color. But it is clear that, depending on the genotype, the person is likely to be blond or brown-haired. A person who has two alleles for brown hair is likely to have brown hair, whereas a person with a brown-haired father and a blonde-haired mother may have blonde hair. For eye color, this is not always the case. The X chromosome appears to be very important in determining eye color, whereas the Y chromosome plays only a minor role.

It is not only the expression of the genes that is of importance in determining eye color and hair color. There are also environmental factors that play a role in the development of these characteristics. For instance, the color of the eyes may be influenced by the color of the iris, the color of the hair by the amount of melanin in the hair. The development and implementa
tion of forensic DNA typing technologies in the Netherlands

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17 Several ‘developments will eventually enable trustworthy conclusions on the ethnic origin of an unidentified stain donor.’ A.D. Kloosterman (2002), The development and implementation of forensic DNA typing technologies in the Netherlands, diss. Santiago de Compostela, p. 32. Cf. the International HapMap Project, available at http://www.hapmap.org/thehapmap.html.en, which identifies genetic similarities and differences in human beings, currently using data from four populations with African, Asian, and European ancestry, which may yield markers characteristic of these populations.

18 The commercial test, supra n. 11, claims to be able to determine an admixture of ancestry, ‘i.e. 82% East Asian and 18% Indo-European mix.’

19 P. de Knijff, Humans on the move: the genetic consequences of 200,000 years of human gene flow, Genomics Momentum 1 September 2004, De Doelen, Rotterdam. The Dutch Ministry of Justice has started a research program with respect to this topic, according to Kloosterman, supra n. 13, p. 32.


appearance: ‘Many human phenotypes (for example, stature, facial features and pigmentation) have a strong genetic component.’ 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.

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, light skin and sunspots. ‘Population studies show that (...) such a variant gives a 90% probability of having red hair’. As to eye color, there are strong indications that, for instance, the gene OCA2 is a major determining factor; a genetic eye-color test for forensic investigation is already available on the market. For behavioral characteristics, chromosome areas have been pointed out that correlate, for example, with a propensity for smoking, left-handedness, and adult stuttering.

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 and possibly the 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.

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’.

3. Legislation Survey
3.1. Methodology and limitations
To answer the question 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 on DNA phenotyping legislation in 2004 and early 2005.

We surveyed academic and other literature from around the world, through the Internet, databases of legal journals, and at the library of the Max Planck Institute for Foreign and International Criminal Law in Freiburg. This literature search was supplemented by a questionnaire sent to experts in DNA forensics or DNA-related criminal law in Belgium, France, Germany, Italy, Poland, Spain, the UK, and Australia – Europe and Australia being (besides the United States, for which we had literature available) the most advanced in DNA forensics and hence the most likely to have laws on forensic phenotyping. We also sent the questionnaire to experts in other continents (Israel, South Africa, Brazil), in order to get an impression of developments in regions with less developed DNA forensics. We received replies from experts in Belgium, France, Spain, Australia, Israel, South Africa, and Brazil.

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. Since developments in legislation are often only published in local media in the 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, so that this limitation is not very grave.

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19 Information about recent findings can be found on the website Online Mendelian Inheritance in Man (OMIM), <http://www.ncbi.nlm.nih.gov/>, for instance by searching for terms like ‘hair color’ or ‘stature’.
20 Jobling and Gill, supra, n. 18, 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 hair red, or his red hair blond.
21 The leading candidate gene for human eye color is the OCA2 gene (...). 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.’ Zhu et al. (2004), ‘A Genome Scan for Eye Color in 502 Twin Families: Most Variation is due to a QTL on Chromosome 15q’, Twin Research 7(2), pp. 197-210.
22 DNAPrint Announces the Release of RETINOME(TM) for the Forensic Market: Eye Color Prediction From Crime Scene DNA!, <http://biz.yahoo.com/prnews/040817/fltu014_1.html>. Jobling and Gill, supra, n. 18, at 748, however, refer 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.’
26 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.’ Clark & Grunstein, supra n. 5, at 278.
27 Jobling and Gill, supra, n. 18, at 748.
29 An important source of information about forensic DNA legislative developments is the weekly DNA Resource Report, compiled by Smith Alling Lane, available at <http://www.dnaresource.com/>. Its section on International News includes reports from
Second, the questionnaire survey, for practical and budget reasons, was small-scale and indicative, to supplement the literature search, yielding information on the countries that responded but not allowing for generalization. With these caveats, 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 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 does not give phenotypical information. The European Council Resolution of 25 June 2001 on the exchange of DNA analysis urges member states to exchange only results of DNA analysis of non-coding chromosome zones, i.e. not known to provide information about hereditary characteristics.\(^3\) Similarly, the 2005 Prüm Convention implies that party states make available the reference data from their national DNA analysis files, but only including DNA profiles based on the non-coding part of DNA.\(^3\) 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;\(^3\) it is a criminal offense to conduct a DNA investigation for other purposes.\(^3\) In other countries, there is no legal provision on this, but in practice or doctrine, DNA forensics is restricted to non-coding DNA; this is the case in, for instance, Australia,\(^3\) South Africa,\(^3\) and Spain.\(^3\) 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 DNA analysis for other goals is allowed. Do other countries allow phenotyping for tracing unknown suspects?

We have the strong impression that forensic DNA phenotyping has not yet come to the attention of legislatures, with a few exceptions, most notably the Netherlands which passed a specific law on this in 2003. This emerges both from our literature search, which yielded altogether few documents that go into forensic DNA phenotyping,\(^3\) 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 phenotyping, on the basis of a consultation by the Law Reform Commission. Submissions in the public consultation, including of 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.’\(^3\) The Reform Commission did not provide a recommendation, however, given the early stage of this field, but stated that if law enforcement in future would wish to conduct forensic DNA phenotyping, ‘this would require considerable public consultation and fresh community agreement.’\(^3\) The debate in Australia has, however, never really been triggered by political interest or canvassed and discussed in any depth by the media or the community at large.\(^3\)

In Belgium, some debate took place in parliament on the use of coding versus non-coding DNA, but the only concern was about deriving medical information from DNA, not the possibility to

numerosous countries around the world, and hence, this newsletter gives a good indication of global DNA legislative developments.

\(^3\) Art. III(1) of the Council Resolution of 25 June 2001 on the exchange of DNA analysis results (2001/C 187/01), CJ 3.7.2001. See also art. III(2): ‘[i]f 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.’

\(^3\) Art. (2)(2) of the Convention between the Kingdom of Belgium, the Federal Republic of Germany, the Kingdom of Spain, the French Republic, the Grand Duchy of Luxembourg, the Kingdom of the Netherlands and the Republic of Austria on the stepping up of cross-border cooperation, particularly in combating terrorism, cross-border crime and illegal migration, Prüm, 27 May 2005.

\(^3\) See art. 44ter 1 Belgian Code of Criminal Procedure.

\(^3\) See art. 6.3 Belgian DNA Act.


\(^3\) Andra van der Merwe, Stellenbosch University, personal communication, 8 September 2004.

\(^3\) Angel Carracedo, Spanish Institute of Legal Medicine, personal communication, 9 October 2004.


\(^3\) Australian Law Reform Commission 2003, supra n. 34, pp. 1028-1029.

\(^3\) Ibid., p. 1030.

\(^3\) Tony Raymond, Director of the Australian National Institute of Forensic Science, personal communication, 19 August 2004.
derive non-medical physical characteristics. 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. Apart from Belgium, a few other states (Germany and three US states) explicitly prohibit deriving physical traits other than gender from DNA. For the rest, the legislation of most countries is silent about DNA phenotyping, and the issue does not seem 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; this is the case in the UK, for instance.

3.3. The Netherlands

In 2003, an amendment to the Dutch Code of Criminal Procedure (Wetboek van Strafvoering) made it possible to derive phenotypical information from DNA found at a crime scene and belonging to an unknown suspect. For the time being, only gender and race may be determined, but in 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 government, the limitation to externally perceptible traits has a twofold rationale. In the first place, 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. In the second place, the DNA source’s privacy and the right not to know must be respected. This implies that traits the DNA source does not know about because they have not come to expression may not be investigated. It must after all be prevented that he learns from his criminal file about a predisposition to develop certain characteristics such as a disease. 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. Some traits are very likely known to a person at a certain age even though they are not visible from birth.

3.4. Germany

Art. 81e German Code of Criminal Procedure (Strafprozeßordnung, hereinafter: StPO) allows investigation of DNA only for certain purposes: for the determination of parentage or for determining whether traces of DNA material stem from the suspect or from the victim. In the course of such an investigation, the gender of the source of the material may be determined as well. Other determinations are not allowed. This prohibition is intended to prevent that vulnerable genetic dispositions are investigated and that genetically determined, vulnerable characteristics of the personality are laid bare.

The Code of Criminal Procedure, however, does not prescribe 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. In this way, the development of technology will not be

41 See the parliamentary proceedings in Belgische Kamer van volksvertegenwoordigers [Second Chamber] 18 February 1999, 1047/6 – 96/97.
42 See infra, section 3.3.
43 See infra, sections 3.4 and 3.5.
44 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 (2005), supra n. 37, p. 32.
46 Act of 8 May 2003 To Adapt the Regulation Of Forensic DNA Investigation In Relation To Determining Externally Perceptible Personal Characteristics From Cell Material (Wet van 8 mei 2003 tot wijziging van de regeling van het DNA-onderzoek in strafzaken in verband met het vaststellen van uiterlijk waarnembare persoonskenmerken uit cellmateriaal), Staatsblad 2003, 201, in force since September 1, 2003.
47 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., supra, n. 12 and surrounding text.
48 We use the term ‘DNA source’ to indicate the person from whom the crime-scene trace originated from which the DNA was derived.
49 Koops, Prinsen and Schellekens (2006), supra n. 46.
50 See art. 81e StPO (German Code of Criminal Procedure).
hampered by the law. In the Explanatory Memorandum to the bill that introduced art. 81e StPO, the government indicated that the admissibility of DNA investigations cannot be made dependent upon the distinction between coding and non-coding segments, given the current state of the art. Furthermore, other forensic investigations, e.g., for typing somebody’s blood, also concern information about coding segments, since these investigations are ever more gene-based. Therefore, it would be inconsistent to categorically exclude investigation of coding segments.

The provision allowing the determination of the gender of the DNA source was added later to art. 81e StPO by a bill introduced by the parliamentary parties SPD and Bundes90/die Grünen. 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, there is a practical reason: 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. Having stated the advantages, the Explanatory Memorandum set out that gender determination is consistent with the starting point that the investigation of vulnerable genetic dispositions and the determination of genetically determined, vulnerable characteristics of the personality 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, with other technologies 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. When investigating such characteristics, vulnerable characteristics of the personality may come to light. Finally, it is remarked that such determinations are anyhow not yet possible given the state of the art.

In short, for the German legislator, the admissibility of allowing determination of externally perceptible characteristics mainly hinges upon the question whether vulnerable genetic dispositions or genetically determined, vulnerable characteristics of the personality are laid bare. Since it cannot be excluded 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

There is no federal legislation on forensic phenotyping in the US, and 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. In Indiana, 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.’ Rhode Island 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.’ Finally, in Wyoming, 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.’ Vermont does not prohibit phenotyping at large, but forbids DNA analysis ‘for identification of any medical or genetic disorder.’

We have not been able to trace the exact reasons for these states to enact these laws. According to Stevens, Rhode Island created this provision ‘to assure that the ACLU would not challenge the Rhode Island DNA database bill.’ This may suggest that pressure from, among others, civil society influenced the legislation in the US states that prohibit phenotyping.

The fact that most states do not have explicit provisions on phenotyping may imply that they actually allow it. 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

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53 BTDrS 13/667, 6.
54 BTDrS 15/350.
55 See Hibbert (1999), supra n. 37.
56 IC 10-13-6-18. Prohibitions against use of information.
57 RI ST § 12-1-5-10, Procedures for conduct, disposition and use of DNA analysis, under (5).
58 WY ST § 7-19-404, Access to database; information authorized to be stored, under (c).
information useful for law enforcement purposes.\textsuperscript{61} For example, Texas allows forensic phenotyping to trace unknown suspects, since 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,’ which includes ‘the investigation of an offense, the exclusion or identification of suspects, and the prosecution of the case.’\textsuperscript{62} And many other states’ laws use formulations that arguably cover forensic phenotyping for tracing an unknown suspect.\textsuperscript{61}

\textbf{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,\textsuperscript{64} but also, forensic phenotyping was already researched in the UK in the early 1990s.\textsuperscript{65} However, there is no legislation specifically regulating forensic DNA phenotyping in the UK.\textsuperscript{66} It is a technique that is simply being used in practice, apparently being allowed by the general legislative framework.

The Forensic Science Service (FSS) in the UK provides two phenotyping services to police, ‘to provide intelligence about the physical appearance of the offender.’\textsuperscript{67} The first service is an ‘ethnic inference service,’\textsuperscript{68} which calculates the 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.’\textsuperscript{69} This service was apparently used in April 2004 in a rape investigation, where the police announced they were looking for a suspect from the Caribbean, based on the crime-scene DNA.\textsuperscript{70}

The second service is a red-hair test, based 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.’\textsuperscript{71} The FSS is also developing systems for determining other physical traits like skin color, facial structure, and height.\textsuperscript{72}

The Home Office has asserted commitment to furthering development of forensic phenotyping.\textsuperscript{73} The Human Genetics Commission recommended the establishment of an independent research ethics commission to approve research in this area. It voiced concern over the use of phenotyping for behavioral traits, and recommended the Government that the use of ‘sensitive personal genetic information for forensic purposes’ requires ‘a full public debate in order to examine the ethical, consent and confidentiality issues.’\textsuperscript{74}

\textbf{3.7. Conclusion}

In our survey of eleven countries, at first sight, 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. Externally perceptible characteristics may be derived, but according to the legislative history, these are restricted to external characteristics visible from birth, in order to rigorously respect the right not to know. A similar regulation, although less explicit, can in effect be found in Vermont, which prohibits DNA analysis to derive medical information.

Some jurisdictions explicitly prohibit forensic DNA phenotyping at large (three US states and Belgium) or for other traits than gender (Germany). Many other countries’ legislations do not state which purposes forensic DNA analysis may serve. It would however be a mistake to interpret such silence as an implicit prohibition of DNA phenotyping. In the UK, for example, phenotyping for ethnic

\textsuperscript{61} Hibbert (1999), supra n. 37, at pp. 791-2, referring to Kentucky (Ky. Rev. Stat. Ann. § 17.175).
\textsuperscript{62} Ibid., at p. 792.
\textsuperscript{63} 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 (1999), supra n. 37, at pp. 792-3.
\textsuperscript{65} Evett & Pinchin (1992), supra n. 10.
\textsuperscript{66} The law on DNA forensics is the Police and Criminal Evidence Act 1984, which covers only taking and destroying DNA samples.
\textsuperscript{68} Cf., supra, section 2.1.
\textsuperscript{69} Forensic Science Service (2004), supra n. 67.
\textsuperscript{70} As mentioned in Staley (2005), supra n. 37, p. 34.
\textsuperscript{71} Forensic Science Service (2004), supra n. 67.
\textsuperscript{72} Williams, Johnson & Martin 2004, supra n. 12, p. 112; ‘Forensic DNA Databasing: A European Perspective’, http://www.dur.ac.uk/p.j.johnson/eu.html.
\textsuperscript{73} UK Home Office, Police Science and Technology Strategy 2003-2008, as mentioned in ibid.
\textsuperscript{74} Human Genetics Commission, supra n. 37, p. 31.
origin and hair color is regularly being done, and a careful reading of many US states’ legislation suggests that it is allowed there as well.

4. Regulatory Issues: Food for Thought

The fact that forensic DNA phenotyping is allowed in some countries and 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, as also emerges from the laws described above, is the specter of laying bare genetic information about propensities for diseases and other medical information (section 4.1). This is in fact part of a more general problem of information being ‘hidden’ in DNA that the person having this DNA may not be aware of (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 the private sphere (section 4.3)? Another issue raised in 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, some fear that once phenotyping for criminal investigation is accepted practice, phenotypical information will be used for other purposes as well, for instance, 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 the DNA source is unaware of, such as a propensity for hereditary diseases or disorders. In a medical setting, random screenings – i.e., screenings without any reason to think that it is worthwhile to subject this particular person to a certain screening – are rather rare. Mostly, there is a concrete reason for a person to decide taking a screening: she may have developed a symptom of an as yet undiagnosed disease or disorder, or she may be part of a family that suffers from a hereditary disorder and wonder whether she should trade uncertainty for certainty. The setting in which the issue of deciding about knowing or not knowing arises is relevant. In the ‘medical’ setting, the person is not in an absolute state of ignorance; there is a certain knowledge that something is wrong or that she possibly has a deleterious gene.75

In a forensic setting, on the other hand, information about genetic predispositions comes out of the blue. Information may come to light when a profile of the DNA source is made public, which may, for instance, refer to an abnormal behavioral trait. Moreover, information about the results of a DNA analysis may be included in the criminal file as composed by the police and prosecution authorities. In that way, the subject will get acquainted with this DNA information through the file, and hence read information about his DNA, including medical data, that he may not have known before and would not want to know about. Forensic phenotyping may therefore breach a basic principle in medical law, which is often referred to as the ‘right not to know’.

This principle holds that people should have self-determination in gaining information about their medical situation. The right not to know is fairly uniformly recognized as an important principle. For instance, the Universal Declaration on the Human Genome and Human Rights of 11 November 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.’

Similarly, the European Convention on Human Rights and Biomedicine states in art. 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.’

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

‘if 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.

76 Article 7:449 of Dutch Civil Code (Burgerlijk Wetboek) (our translation).
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 of criminal investigation may outweigh it in this case.

4.1.2. The approach of legislatures

The attention paid to the right not to know in relation to medical information is very clear in the approach of the Dutch law to restrict phenotyping to externally perceptible characteristics. The source of the DNA can reasonably be assumed to know about these features already, so his right not to know is not at stake. For the time being, only race and gender of the DNA source may be derived under Dutch law, but in future, other traits may be designated by the government. These exclude disease-related traits. The only case in which medical information may be derived is when a disease or disorder relates to externally perceptible traits, such as albinism. However, the Dutch government has severely restricted itself in this respect: where it is not certain whether the source of the DNA knows of a disease-related trait (is it only a propensity, or has it perhaps not manifested itself yet?), the DNA may not be investigated with respect to this trait. So, in case of uncertainty, the right not to know prevails over the interests of criminal investigation. This raises the question under what conditions it is certain that the DNA source has knowledge of a trait. The government has sought to clarify this by stating that the traits must be visible from birth.\footnote{Kamerstukken I [Parliamentary Documents First Chamber] 2002/03, 28 072, nr. 13b, p. 4.} So, a disease or hereditary disorder relating to externally perceptible traits that may manifest themselves at a later stage than at birth may not be investigated. Clearly, the Dutch approach is very cautious when it comes to medical information, and this, in effect, 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 US states with phenotyping prohibitions, the latter of which all explicitly prohibit obtaining information about ‘predisposition for disease’.\footnote{See supra, sections 3.4 and 3.5 and n. 41 and surrounding text. In the same vein, Australian Law Reform Commission 2003, supra n. 94.} 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 ‘absolutification’ of the right not to know is understandable but excessive. Although there clearly are just concerns over deriving information about propensities for diseases, this need not imply that all kinds of disease-related information should be discarded outright. For instance, a less conservative stance than the Dutch ‘birth approach’ might be considered. The threshold could have been placed at a later age, for instance, by allowing the analysis of disease-related traits that are usually manifest at puberty rather than at birth. More importantly, however, the right not to know is not absolute in medical law,\footnote{See supra, section 4.1.1.} so why should it be absolute in criminal law, where equally important interests lie in the other half of the scales? Rather than an outright prohibition of all medical information, a more nuanced approach might be considered which sometimes attaches more weight to the law-enforcement interest; we go into this below (section 4.2.2).

4.1.3. Intermediate conclusion

Governments feel strongly about forensic phenotyping for disease-related traits in light of the right not to know. They seem, in fact, to consider this right absolute in the criminal-law context, an approach that we feel is overcautious. In fact, the distinction between medical information and other information ‘hidden’ in the DNA is understandable but somewhat misleading. The issue should be viewed in a wider perspective: to what extent should forensic phenotyping be allowed when it comes to deriving data from DNA 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 broader problem.

4.2. Potentially unknown information and the right not to know

4.2.1. Vulnerable information

propensity heritability. Of course, there are no genes simply ‘coding for’ these traits, but from twin studies, it is clear that genes are a significant factor in explaining the incidence of these traits; that is, certain complex and yet unknown combinations of genotypes create a higher chance than other genotypes for the person, in interaction with environmental factors, to develop this trait.

If in the future, more insight is gained into specific genotypes relating to such traits, it should be discussed to what extent forensic phenotyping should be allowed to determine these propensities. After all, an investigation could be significantly brought further if there is, say, a likelihood that person carrying the DNA is homosexual or a zealot, or whether he smokes or stutters or has perfect pitch. Some even imagine that phenotyping can be used for ‘mental profiling,’ i.e., to ‘get into the mind of a criminal’ which is relevant, for instance, in cases of serial killers; genotypically-derived information about propensities for impulsivity, aggression, or nocturnality, to name a few candidates, could add to such a mental profile.

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; 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 would find out through forensic phenotyping about a genetic propensity for homosexuality, he might get a serious identity crisis. Moreover, were his wife to get acquainted with this genotype, for instance, because it was published in the newspaper as part of the suspect’s profile, she might be confirmed in suspicions she already harbored, perhaps subconsciously, and request a divorce. Given the sensitivities with which homosexuality is still surrounded in most societies, these issues cannot be thought of lightly.

Apart from information about propensities, DNA also contains information about the person’s ancestry. Forensic phenotyping may lay bare this information, which the source may not have been aware of. For instance, it might be the case that someone who looks Caucasian has some genotypes left from a Chinese ancestor three or four generations back. He need not look Chinese at all, and so does not necessarily know of this Chinese connection. Or a Moroccan Arab may turn out to have had a Sephardic Jewish ancestor some generations back. This would not usually, we feel, seriously impact this person’s life, but the psychological impact of new knowledge of ‘racial roots’ might sometimes lead to a person questioning his sense of identity. This is not, however, realistic or serious enough to warrant limiting forensic phenotyping by analyzing geographic background.

Another case in point of where forensic phenotyping might lead is when it would find, for example, one recessive gene related to red hair; since this does not determine the person’s hair color, it is of no use for the criminal investigation. However, should the perpetrator be found by other means, 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, if 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 then-time boyfriend when she studied in England, our Italian might justifiably get doubts about who his real father is.

Such cases are unlikely to happen and do not pose a serious objection to forensic phenotyping. However, there is one application of forensic phenotyping in which the parental problem seems more realistic. Surnames analysis is a promising line of forensic phenotyping. Suppose that crime-scene DNA suggests a certain likelihood that the DNA source listens to the name of Bulstrode and the investigation is hence targeted at the group of Bulstrodes. This does not lead the police anywhere, but the perpetrator – a man called Harleth – is caught in flagrante delicto of a second crime, and his DNA profile is found to match the profile of the first crime sample. He is now also accused of this first crime and gets acquainted with the investigation in that case. The fact that Harleth may thereby discover that his Y chromosome likely belongs to an ancestral line of Bulstrodes 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 called Bulstrode, he will have a very clear indication that his real father is someone else than he has always thought. We admit that 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. It is realistic to expect that, if ‘surname phenotyping’ were to be performed on a larger scale, a number of suspects will be confronted with potential adultery in their ancestry, which in some – though presumably not many – cases will directly lead to a suspicion that they have a different father, because the uncommon surname is recognized by the person as belonging to someone his mother knew.

To sum up the problem, forensic phenotyping risks laying bare to a DNA source information that he did not know before. This information may relate to propensities for certain traits (other than diseases), which for some traits, such as homosexuality, can be burdensome information and sometimes 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, which in some cases could lead to a person getting doubts about who his real father is. This can also be a psychological burden 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.’ 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 for their sense of identity and the way they live their lives. 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 based on direct 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 (great-etc.) great-parent than he may have supposed. This differs from a regular parenthood test, where the result is an answer to the specific question whether someone is really the child of someone; here, on the contrary, we are concerned with indirect inferences about parentage 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.

The right not to know should not be respected in an absolute way. It should not preclude analysis of each and every characteristic that the DNA source need not be aware of. 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 right of suspects not to know.

4.2.3. A trade-off

The weight of the right not to know is not equal in every situation. Finding out about a Chinese ancestor three generations back is not on the same footing as finding out a propensity for a genetic disease. Finding out a disease for which a treatment or cure exists is not on the same footing as finding out a disease that is incurable. But also, a propensity for (perhaps an incurable form of) early baldness is not as threatening as a propensity for (perhaps a curable form of) cancer. Finding out

87 See also Ruth Chadwick, ‘The philosophy of the right to know and the right not to know’, in: R. Chadwick, M. Levitt & D. Shickle (eds.), The Right to Know and the Right not to Know. Aldershot etc.: Avebury 1997, pp. 13-22, which, although formulating the right (not) to know broadly at p. 13 (‘The right to know what? Presumably information about an individual’s genetic constitution’), gives examples only in the medical sphere.

88 See supra, section 4.1.1.
about a propensity for left-handedness is not the same as finding out about a propensity for homosexuality. 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 at all be allowed for forensic purposes? 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 trade-off can be made.

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 – say, a propensity for left-handedness – has value for criminal investigation, the law-enforcement interest can easily outweigh the right not to know. In other words, a trait-by-trait approach is to be preferred.

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 potentially large impact on people’s lives. However, not all medical information should be disallowed. 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; if the DNA source is subsequently 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 is a cure for this disorder, then the knowledge would not be very burdensome, and there seems no reason not to let the law-enforcement interest outweigh the right not to know in this case. 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.

Another important category to discuss is propensities for medical disorders or behaviors that may be associated with crime, such as alcoholism or drug abuse. For example, one form of alcoholism (‘type II alcoholism’) – starting when 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’. If the genotypes were discovered 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 be (already) 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 too sensitive, too uncertain to manifest themselves, or too little useful in criminal profiling, to allow them in forensic phenotyping.

Apart from most medical traits, also 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 prevails over the need for forensic phenotyping, helpful as it might be in a criminal investigation to know that a DNA source may be homosexual. After all, homosexuality is – even for considerable parts of society in traditionally liberal countries like the Netherlands – a sensitive issue, 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

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

90 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).

91 See Clark & Grunstein, supra n. 5, at p. 211 and surrounding text.
The right not to know is now at issue for external looks and there is a clear relevance for using these traits in criminal investigation. Of course, external traits are influenceable: 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. They can equally well be used in profiles based on phenotyping, provided the police is aware of the changeability of certain looks and does not overestimate the particular feature.

There are more traits, however, that may be quite useful in criminal investigation and where the right not to know is less relevant, and we think 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 for indirect information, notably geographic origin, which the Netherlands and the UK also allow already: there may be a very few cases in which knowledge of geographic or ethnic background is new to a suspect and potentially burdensome, such as a Jewish connection for an Arab, but these are extremely rare and moreover are unlikely to have a lasting disruptive impact on the person’s sense of identity.

The difficult issue is how to deal with the middle category of traits that do not obviously belong to the excludable or includable categories. This concerns traits that help criminal investigation, but that have potentially substantial – but not devastating – consequences for the DNA source to find out about. Since there must be added value for investigation, we should restrict ourselves to traits with a relatively high likelihood of manifesting itself, say 75% or more (i.e., 75% or more of persons with this genotype actually develop the phenotype). Rather than try to devise criteria for legislatures to pick and choose among traits in this middle category, it may be helpful to try and think of ways to allow forensic phenotyping while respecting the right not to know at the same time. If this is possible, then the entire middle category might be accepted for forensic phenotyping, and only traits where the risk of knowledge is too great (the first category outlined above) 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. First, it should be assessed whether there are any forensic uses for deriving characteristics that cannot be disclosed to the DNA source. At first sight, this is not the case if the phenotyping has the goal of adding information to a criminal profile that is to be published in order to ask the public to assist in identifying and tracing down the unknown suspect. Results would then not only be known by the unknown suspect, but also by relatives for whom the information may be relevant as well. However, it is not necessary to include in the profile the source of the information: a TV program might announce that a red-haired Caucasian male is sought, who is nervous and a smoker, without revealing that the assumed hair color, nervousness, and smoking are based on DNA analysis rather than on eye-witnesses or other traditional clues. Apart from published profiles, information may also be used only internally by the police as intelligence. Another example may be the derivation of the propensity for a mild disease. If it has manifested itself, doctors could help since they may know the suspect and thus be helpful in narrowing down the circle of potential suspects. The right not to know has now become immaterial since the suspect already ‘knows’. If the disease has not manifested itself, it is a dead-end for identification purposes.

Second, all of these applications still raise questions when the DNA source is eventually identified and apprehended as a suspect. Should the fact of the forensic phenotyping and the results be made known to him? The principle of internal transparency of criminal proceedings – related to the notion of ‘equality of arms’: the defense should have access to the same information as the prosecution – opposes non-disclosure. Is it acceptable 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? That would respect the right not to know but possibly infringe the principle of equality of arms. Since 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, presumably not because they are clumsier, but because a correlate of left-handedness creates an as yet unknown – cause for accident-proneness. See OMIM, supra n. 19, http://www.ncbi.nlm.nih.gov/entrez/dispomim.cgi? id=138900 (‘Relative handskill’), referring to D.F. Halpern & S. Coren, ‘Handedness and life span’, New Eng. J. Med. 324 (1991), p. 598. It is therefore possible that genotypes related to externally visible features like hair color or stature 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.

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93 Cf., infra, section 4.6.

94 See infra, notes 102-103 and surrounding text.
hardly an issue of the test results containing 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 no serious breach of equality of arms. Another objection, however, is that the suspect may well be able to add two and two together by combining the fact of phenotyping with other information from the criminal file, for instance, the profile broadcast to the public or the visit to doctors, and thereby at least partly infer the test results. Formally respecting the right not to know may then amount to a breach in practice. Still, all considered, the chain of events leading to the DNA source unwillingly gaining knowledge in this way that he did not have before seems to us rather unlikely. It is therefore an option worth considering to allow forensic phenotyping for the middle category, and to mention only the fact of phenotyping and the traits researched in the criminal file, leaving it to the suspect to decide whether or not to request the results. If this approach is not chosen, legislatures should make a trade-off 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. This is, on the one hand, comparable to the other type of indirect phenotyping, namely on 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 surname phenotyping might therefore somewhat more often lead to suspects questioning their parentage if they find they have another ‘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 investigation 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 argumentation, it may be concluded that the right not to know precludes forensic phenotyping of many but not all disease-related propensities as well 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 such 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 investigation 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 with third parties makes the person potentially vulnerable, as seen from a ‘knowledgeis power’ perspective. That raises the question whether the DNA sources’ informational privacy is being implicated by such investigations.

Data protection principles and rules can be found in international conventions, such as art. 8 of the European Convention on Human Rights and Fundamental Freedoms (ECHR) and art. 17 International Covenant on Civil and Political Rights. The major convention codifying principles of data protection is Convention 108 of the Council of Europe, concluded in 1981. In the EU, data protection is further regulated by Directive 95/46/EC. In the United States, data protection is not generically regulated, but is spread across sector-specific laws; there is no federal data-protection legislation in the US for the police and judicial sector, however. In fact, the EU Directive does not apply to areas of criminal law either. The question whether phenotypical information derived from DNA in a forensic setting constitutes personal data as defined in this directive need thus in theory not be discussed.

95 Convention for the Protection of Individuals with regard to Automatic Processing of Personal Data, CETS No. 108, Strasbourg, 28 January 1981.
However, there is a 1992 recommendation of the Committee of Ministers of the Council of Europe about 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.’ It opens up broad application of DNA within the field of criminal law: ‘Recourse to DNA analysis should be permissible in all appropriate cases, independent of the degree of seriousness of the offence.’

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, which would effectively establish similar data protection rules for criminal law, for instance, through goal-binding and proportionality requirements. This follows an increasing call for harmonizing data-protection rules in the area of criminal law. 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.

Is the DNA source’s informational privacy 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. 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.

However, as soon as the phenotyping information has become personal data because the suspect is known (which will usually mean that a DNA test confirms that his DNA matches the crime-scene DNA), the information derived should be immediately destroyed. After all, the information was created with identification in mind, and as soon as the information has fulfilled its identificatory purpose, the use limitation principle, codified in the data-protection rules, implies that the information be destroyed. There are, however, two reasons why this is not the way to proceed. First, the criminal investigatory process is subject to internal transparency. This does not only follow from art. 6 para. 1 ECHR but also from art. 8 ECHR. A defendant charged with a criminal offence 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.

However, the fact of forensic phenotyping, and perhaps some of the resulting information, may still be relevant for the criminal case, because it gives insight in the procedure the police used to trace down the unknown suspect. Errors made or exceeding use of powers during the criminal investigation may trigger a court to conclude a violation of the right to a fair trial, in extreme cases leading to exclusion of evidence.

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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.’ So, applying the WP’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 as’ 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 knows 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, and that if the source is identifiable earlier, the data already qualify as personal data at that stage.

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97 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, see: https://wcd.coe.int/com.intranet.InstraServlet?Command=com.intranet.CmdBlobGet&DocId=601408&SecMode=1&Admin=0&InstranetImage=43351(last visited March 2006).
99 See ibid., pp. 2-3, under ‘General Context’.
100 See art. 2 & 3 Convention No. 108, supra n. 95.
101 Art. 5 sub e Convention No. 108, supra n. 95. Compare also art. 8 Recommendation No. R(92) 1, supra n. 97, and art. 4(1)(e) Proposal for a Framework Decision, supra n. 98. Instead of being destroyed, the data could also be anonymized, for instance for use in statistical research.
102 See European Court of Human Rights (ECtHR) 16 December 1992, A 247-B (Edwards), at §36. The Court considers that it is a requirement of fairness under Article 6 para. 1 ECHR, that the prosecution authorities disclose to the defense all material evidence for or against the accused.
103 See ECtHR 26 March 1987, A 116 (Leander).
104 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.

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This suggests that phenotyping information should be included in the criminal file.

A second reason, perhaps, to retain the data is art. 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.

Assuming for these reasons that the phenotyping information is not destroyed, then the data-protection and privacy implications have to be faced. In the context of art. 8 ECHR, 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. According to long-standing case-law, the "law" need not be statutory law: it may also be case-law if the resulting privacy infringement is sufficiently precise and clear. This requirement is not a problem for the Dutch law, given that there is a statutory law on forensic phenotyping, with specific mention of characteristics by Order in Council. The use of phenotyping in the UK, however, has more trouble passing this prong: it is questionable whether phenotyping for hair color or ethnic background is sufficiently foreseeable for citizens without an explicit legislative framework. Second, the infringement must serve a specific purpose named in art. 8 para. 2; in casu, the prevention of crime is an adequate specific purpose.

Third, and most importantly, the infringement needs to be "necessary in a democratic society". Here, a proportionality test must 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 phenotyping without looking at specific traits to be analyzed. As we indicated in the discussion of the right not to know, there is a category of trivial or non-sensitive characteristics – including externally visible traits and relatively neutral traits like propensity for left-handedness or voice type – which is not privacy-sensitive and hence, would easily pass the proportionality test (provided, as always, that there is a 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, for instance in a report, this information could be used by employers in job decisions, not only concerning the suspect but also concerning his next of kin. 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, and a surname may surface that was not known to the police or to the DNA source and his family either.

Privacy-threatening though 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 will only be so in very few cases, notably where the DNA source is found with great likelihood to have a different parentage than was always thought. This is not the case with ethnic origin phenotyping, but may happen occasionally with surname phenotyping. 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

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105 However, see ECtHR 12 May 2000 (Khan), where an infringement of art. 8 ECHR did not lead to a violation of art. 6 ECHR and exclusion of evidence.
106 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’, Privacy & Informatie 2006/2, No. 68.
107 Supra, section 4.2.
109 See supra, section 4.2.1.
thus placing the father in an awkward position. All considered, however, the advantages for criminal investigation in general for allowing this kind of phenotyping seem to us 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 phenotypical information derived therefrom may be stored or used for other purposes, for instance, by storing them in forensic DNA databases. Since the forensic phenotyping only aims at creating leads to find a suspect, it has served its purpose 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 can 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. Is this relevant for forensic phenotyping? The question may seem pointless, since art. 8 ECHR protects both informational privacy and physical integrity in one swoop. However, there is one crucial difference. The protection of physical integrity is available right 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. That would, perhaps, warrant more limitations than the above-mentioned data protection test, since also 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, since phenotyping uses material found at a crime scene and hence, the bodily integrity of the suspect is not violated by the police. Should 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 investigation powers have a chilling effect on this right, for instance, if body scanners induce people to refrain from nipple piercings. In the same vein, 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 can not 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.’ Often, a concern over privacy is voiced related to disease-related information. 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 to 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 well be motivated, as long as they really enhance law enforcement, and provided the analysis is restricted to intelligence-led phenotyping and not used for other purposes.

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110 This is part of the protection of ‘private life’ as mentioned in art. 8 ECHR and codified as a constitutional right in, for instance, the Netherlands (art. 11 Dutch Constitution).
113 See, e.g., Australian Law Reform Commission 2003, supra n. 34, pp. 1028-1029; Williams, Johnson & Martin 2004, supra n. 12, p. 113.
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 above-quoted statement of the UK Forensic Science Service: ‘British Afro-Caribbeans for example, display a greater number of differences and so are more easily discriminated’114 is meant as scientifically neutral, but inadvertently raises the issue of discrimination and stigmatization. If crime-scene DNA is likely to belong to an Afro-Caribbean, prejudices against Afro-Caribbeans in relation to crime might come into play. This is all the more so, 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 an Afro-Caribbean, 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 the case, 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. Particularly if the same ethnic origin were to be found in a number of consecutive, non-related crimes in a relatively short period, and if this were, for instance, widely published in the newspapers, people might be led to think: “Aha, it’s a phenotypical Moroccan again? Must be something in the 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.115 Mrs. Jones might be tempted to think: “My neighbor Charlie is an Afro-Caribbean – would he have something to do with this rape?” and avoid contact with 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, for instance, in a newspaper or television report describing people arrested for a crime, is a well-known problem, and media have chosen their policies with respect to this. 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 transport.116 In the United States, including ethnic background in a suspect’s description based on witnesses does not as such violate the Equal Protection Clause.117

Does forensic phenotyping make this any different? The fact that an inference of ethnic background is based on DNA research may give it an extra dimension. First, if ethnic information is derived from DNA, the public may interpret that racial differences (which are essentially a sociocultural construct) are a ‘hard’ biological given. This might deepen the social divide between ethnic groups, and the adverse effects of DNA-based stigmatization could thus 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, since people might be tempted to think that certain ethnic groups are definitely more criminal than others – “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, an Asian with a propensity for phlegmatism, or an African with a low IQ, to name just a few prejudices that are happy candidates for reinforcement by DNA-rooted information. Of course, the opposite could also occur, if a gentle Sicilian or intelligent African were

114 Forensic Science Service (2004), supra n. 67.
116 For the Netherlands such rules can be found in the Aanwijzing opsporingsberichtgeving [Instruction on Investigation Publications], Staatscourant 16 November 2004, nr. 221, p. 9.
117 See Elkins (2003), supra n. 37, at p. 289 and references listed there.
sought, but prejudices are more likely to be reinforced by corroborating information than to be diminished by negating information.

In short, phenotypical information derived from DNA as such is nothing new, and may be comparable to information provided by, for example, witnesses. Discrimination is no serious risk in that respect. However, it 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, also in the area of DNA forensics, than it will be in, for instance, Europe. 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 on the risk of discrimination or stigmatization. Nevertheless, also in Europe, this risk should be faced, given the current debate on immigration and integration in many European countries, and also because of Europe’s own racial sensitivity if sufficient characteristics of Jews could be derived from DNA.

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 of groups having this trait, 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, XYY syndrome – men with an extra Y chromosome – was thought to be related to a propensity for crime and aggression; if in a number of cases, forensically 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 somewhat of a risk for other phenotypical information than racial background. 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.

There is only a need for involving the public if the group of people carrying the trait is too

118 Elkins, id. at p. 305, concludes: ‘[a]lthough DNA-based physical profiling might raise a constitutional equal protection problem, it can pass constitutional muster because no group is singled out for special treatment and no one is penalized because of hostility toward a particular trait or race.’
119 Cf., Oscar H. Gandy, Jr. & Lemi Baruh, ‘Racial Profiling: They said it was against the law!’, University of Ottawa Law & Technology Journal (forthcoming).
120 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,’ and that ‘[g]enomically-derived information gathered from offender profiles may also stigmatize the offender’s family or ethnic group by revealing genetic markers distinct to that family or ethnic group’, without indication how this power may affect the subjects. See Hibbert (1999), supra n. 37, at pp. 791 and 794.
121 The risk of discrimination is not mentioned as a concern in the 2002 report by the UK Human Genetics Commission, supra n. 37, or in Williams, Johnson & Martin 2004, supra n. 12. 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 n. 115, but discrimination was no longer mentioned in its more extensive 2003 report, pp. 1026-1030, supra n. 34, which was based on public consultation.
122 The main point of discussion was a terminological distinction between ‘race’ and ‘section of the population’. See Kamerstukken II [Parliamentary Documents Second Chamber] 2001/02, 28 072, nr. 5, p. 7.
123 Some markers on the Y chromosome are known to be specific to certain Jewish lineages, as mentioned in Lee & Tifornia (2003), supra n. 112, at p. 309. M.G. Thomas et al., ‘Origins of Old Testament priests’, Nature 394, pp. 138-140 (1998) found a marker common to 10% of the general Jewish population and absent in non-Jews.
124 Supposing these were allowed in phenotyping, for instance, if the right not to know and privacy were not at issue; cf., supra sections 4.2 and 4.3.
126 Of course, ‘dragnet’ investigations where a group is asked to co-operate voluntarily (or ‘voluntarily’) in DNA profiling carry their
large for other investigation methods, and in that case, the risk of individual stigmatization is proportionately smaller.

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 racist police force. They could exclusively or with priority investigate those crimes where DNA traces are found of members belonging to a 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. This might ultimately help convince investigators with discriminatory tendencies to overcome their prejudices.

Results will not always be so clear-cut as to say that with a 99% likelihood a DNA source has this or that racial background. If the results of DNA research suggest a 60% probability of the DNA source being African and a 40% probability of being Caucasian or other 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. In other words, forensic phenotyping for ethnic background might strengthen the tendency visible in several criminal investigations of a ‘tunnel vision’: concentrating too much on a single lead and disregarding relevant clues that oppose this lead. This is not only bad and ineffective investigation practice, but it might also lead to discrimination of minorities more likely to be the object of a tunnel vision.

However, this does not necessarily imply that deriving ethnic origin should not take place, since this is not a phenotyping-specific issue. The problem might be better addressed by educating police officers and by strengthening control mechanisms into 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 is 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 concern 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.

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 to preclude forensic phenotyping on ethnic origin at all (although opinions on this might differ between, for instance, 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 especially relevant if the use of such information would hardly ever be justified from a stigmatization perspective; this may be the case with information that 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 will not contribute to the criminal investigation. Therefore, a specific, case-by-case approach is preferable, in which phenotyping for

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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.


128 Cf., Staley (2005), supra n. 37, p. 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.’

129 See art. 3 Dutch Police Files Act (Besluit Politieregisters).
ethnic origin or other traits is allowed in general, but where in specific cases, the decision is made to take precautionary measures or not to use phenotyping at all. 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 words it in view of the ‘danger that this type of information is used selectively to reinforce existing prejudices: for example, about race or skin colour’: ‘[i]t 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.’\(^{130}\) Existing guidelines on police reporting could therefore be extended with, for instance, 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.

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

That leaves only the problem of reinforced discrimination by the police, if 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, and such knowledge could 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 interventions related to crime detection and crime prevention – or perhaps even for other non-criminal purposes, such as testing by insurance companies or employers. Let us briefly review other purposes to which phenotyping might be put.

4.5.1. Down the hill of phenotyping

First, and for many the most horrifying prospect, the discovery of aggression-related genes may induce forced (or quasi-voluntary) medication, and the knowledge of pedophilia alleles to forced chemical (or ‘voluntary’) castration, raising the specter of eugenics. Many countries have in the past forced sterilization upon people considered ‘inferior’ or unfit to have offspring. In the 1960s and 1970s, in the US, babies were screened for the XYY syndrome (then considered to be related to a propensity for crime) and followed into adulthood.\(^{131}\) The fact that research into the XYY syndrome was partly funded by law enforcement 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 is, in fact, not an issue particularly relevant to DNA testing: there are numerous other – and better – sources for determining (actual or potential) schizophrenia, which 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’: it can also be scientifically interesting to research possible correlations between, for instance, 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

\(^{130}\) Staley (2005), supra n. 37, p. 34.


\(^{132}\) Reilly (1989), supra n. 125, p. 46.
lead to stigmatization of nervous or smoking people. 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, for instance, in determining ethnic background, and perhaps 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 would have occurred by chance. 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 – first or recidivist – 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 cause or even to be used as circumstantial evidence. We consider these unlikely steps to make down the ‘slippery slope’, given the fact that, first, ‘crime-related genes’ can only suggest propensities and never certainties for aggressiveness or pedophilia, and second, a propensity for aggression does not mean that someone is violent in a particular case. 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 would also be interested in, for example, genes related to stubbornness, unsociability, or forgetfulness. However, as McEwen rightly points out, ‘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,’ 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 more risk for 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, notably medical diagnosis or therapy, or forensic DNA profiling as long as only non-coding DNA is used that carries no genetic information.

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 phenotyping to trace an unknown suspect. For this purpose, we have discussed potential other uses of phenotypical information as these 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 particularly enhanced by phenotyping but can be equally – or better – facilitated by other means. It is true that forensic

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134 Cf., supra, section 4.4.2.
135 E.g., in the United Kingdom, a mother was convicted when two children died from crib death; the conviction was later overturned, see http://www.sallyclark.org.uk/. 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.
136 [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 (1989), supra n. 125, p. 48.
137 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.
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 using 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 ‘criminal propensities’. The doom scenario of forced medication or chemical castration is fed 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 hardly added value in determining a likelihood that the unknown suspect of a murder has an aggressive nature, or that a suspect of a rape of a 10-year-old boy 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 indeed.

In short, the ‘slippery slope’ is insufficient reason to forbid forensic phenotyping to trace unknown suspects. It is an option worth considering, to remain on the safe side, 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 this investigation measure is allowed to some extent, several practical issues will have to be addressed. Actually, a normative decision also depends in part on practical issues. 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 relevant in the case of phenotyping, 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 – for example, 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 soon become near 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 –, which calls for many features to be included. 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%, so that 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? And what if there are 15 such men fitting the profile? Then, probable cause can in any case not be assumed, since the suspicion is not individualized enough, but the circle of ‘suspects’ is sufficiently narrow to allow a dragnet investigation. It may be a different story, however, when 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

Forensic DNA phenotyping opens up, in theory, an interesting new investigation method for cases in which no clues avail to indicate a suspect. Information derived from crime-scene DNA may be used to compose a description or profile of the unknown suspect, and in that way, the circle of possible suspects might be narrowed down sufficiently to allow other investigation methods to join in, ranging from traditional detective work to a dragnet investigation\(^{139}\) of all those who fit the profile.

Forensic DNA phenotyping is currently explicitly regulated only in the Netherlands, where race and gender – and, in future, other externally visible characteristics – may be derived from crime-scene DNA, and in Belgium, Germany and a few states in the US, where it is by and large forbidden. Most legislations 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 a case in point where it 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 this article, we have surveyed regulatory issues relevant to forensic phenotyping. There are serious issues indeed, but their importance should not be overestimated. The argumentation in some of the literature and the cautious approach of some legislatures seem overcautious, when the real thrust of forensic phenotyping is considered. It is useful here to distinguish between the two types of 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 very sensitive other 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 stepping down the slippery slope towards forced treatment while these traits hardly have added value for tracing unknown suspects.

There is a middle category, however, of traits that are somewhat – but not too – sensitive and that can have real added value for criminal investigation to trace unknown suspects, that merits debate. Arguably, the right not to know plays some role here, although it must certainly not be made absolute; data protection and privacy and the risk of stigmatization may also warrant limits to deriving information about these traits. However, this does not mean that these traits should be excluded outright. Rather, a trait-by-trait approach – on some level of abstraction – is called for, in which the legislator takes various factors into account: 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).

To give an indication of where such a trait-by-trait approach could lead, if relevant genotypes should be discovered: medical disorders that are apparent from puberty onwards, or earlier, such as Down’s syndrome, albinism, birthmarks, and dwarfism, could be allowed, as well as relatively insubstantial disorders such as early male baldness. Propensities for disorders with high heritability and clear added value for criminal investigation might also fall in this category, such as teenage-onset (‘type II’) alcoholism or bulimia nervosa, although these will be more contentious. Other behavioral characteristics with high heritability could be acceptable as well, even if they are somewhat sensitive, such as a propensity for religiosity. Ultimately, whether or not to allow phenotyping for such traits is a political decision, in which all relevant factors and the – real but not to be overestimated – infringement of fundamental rights should be taken into account.

Indirect phenotyping is compatible with the fundamental rights we discussed and hence should be allowed as well. Determining geographic background and surnames are promising lines of phenotyping that can significantly help criminal investigation to 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

\(^{139}\) We do not discuss in this article the pros and cons of dragnet investigations as such, which merits separate study. Cf., supra n. 126.
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 purposes 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 in view of 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. 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 himself. 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 hardly anywhere has a substantial debate taken place with the public, in the media, or in parliament. It is wise to discuss this new investigation matter over the next couple of years, in order to be prepared when science comes up with certain correlations between genotypes and phenotypes. Sooner or later, a forensic expert or a parliamentarian will fasten upon this finding and propose that it be used in forensic practice. A timely societal debate in the upcoming years can prevent rash and ill-considered legislation. We hope this article is useful for triggering and structuring such a debate.

140 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.
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