Approaching ethical, legal and social issues of emerging forensic DNA phenotyping (FDP) technologies comprehensively: Reply to 'Forensic DNA phenotyping: Predicting human appearance from crime scene material for investigative purposes' by Manfred Kayser

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Published in:
Forensic Science International. Genetics

DOI:
10.1016/j.fsigen.2016.01.010

This letter to the editor appeared online in Forensic Science International: Genetics on January 19, 2016. See http://www.fsigenetics.com/article/S1872-4973%2816%2930010-2/abstract

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Dear editor,

In a recent special issue of the journal on new trends in forensic genetics, Manfred Kayser contributed a review of developments, opportunities and challenges of forensic DNA phenotyping (FDP). In his article he argues that FDP technologies—such as determining eye, hair and skin color—should be considered as akin to a "biological witness" with the potential of providing more accurate information than traditional eye witnesses [1].

We share with Manfred Kayser the goal of supporting the scientific progress of forensic genetics. We are, however, less convinced by the assumption that the power to improve the safety of our society lies simply (or even primarily) in technology [2]. Technologies are—as decades of research in Science and Technology Studies have shown—never merely material vehicles of progress. Instead they are a multi-faceted conglomerate of scientific and societal practices [3]. In other words, technology is always technology-in-practice [4]. This is exactly the reason why the ethical evaluation of technological innovation, when done well, is such a difficult trade: a merely principle-driven ethics—although it may be easiest to do—never grasps and addresses the messiness of how technologies are understood and used in the real world. It is in this light that we are concerned about Kayser's call to expedite FDP research, when coupled with his narrow treatment of both personal safety and individual rights. Such a reductionist understanding cannot capture the richness of ethical discussions about notions such as individual freedom, autonomy, and solidarity [5-7]. Rather, it foregrounds technology without giving due consideration to wider ethical, legal and social dimensions as well as issues around the practical implementation of FDP technologies.

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In this letter, we add some of these missing dimensions to the proposals made by Kayser, embedding our response to his paper into a wider discourse of forensic genetics studies, and addressing the wider community of forensic geneticists, practitioners and policy makers. We demonstrate that ethics, at its very core, is a deliberation about what kind of society we want, what we value, and what we consider proportionate interference of powerful (e.g. state) actors within the personal sphere of less powerful ones (i.e. most citizens), that is informed by an understanding of practices, and the social processes that render issues ethical [8]. It also entails an exploration of how different notions of 'ethical conduct' may collide, and how we can navigate a path out of imagined technological fixes for complex cultural phenomena like crime and safety.

Applied technologies, applied ethics

The use of FDP technologies raises, as Kayser [1] states, several ethical issues. When he asserts that externally visible characteristics (EVCs) "in principle cannot be considered private data" (p. 45) because by definition they are visible to everybody, he overlooks that exploring the impact on privacy in connection with FDP entails more than merely considering whether externally visible traits are sensitive information. Privacy risks are configured differently in the case of a one-off examination of externally visible traits (e.g. by looking at somebody, or taking a picture, or examining her DNA to be able to make probabilistic inferences regarding her traits) versus the digital storage of this information, which renders the information *usable and losable* for different purposes and by different actors. While in Western societies the one-off disclosure of somebody's (likely) eye or skin color may indeed not seem particularly problematic to most people, allowing law enforcement actors to retain and use this information in the future raises a range of issues that need to be discussed in light of other principles that compete with the public interest in the solution of crimes. These include ethical principles such as autonomy, justice, dignity, confidentiality, and solidarity; legal principles such as due process and proportionality; and democratic values such as equality, transparency, and pluralism. In addition, considerations of privacy must include what technologies do and how they are deployed. Technologies such as EVCs or disease-linked traits raise questions not only about their technical reliability but also about the features of the system in which they are being used, including:

- The nature of the data that FDP technologies are capable of producing;
- Sources of biological material and data used for FDP in (i) research and (ii) investigations;
- The context in which original material and data had been sourced;
- The way data are recorded;
- Access to and use of FDP information in an investigation;
- The value of FDP information to an investigation;
- Storage of FDP material and data during and after an investigation;
- Systematic searching of such data in current and future investigations;
- Potential use of such data as a form of proof in judicial adjudication.

These examples show that ethical deliberations can and need to be applied in order to grasp the practicalities of using FDP technologies in the criminal justice system. To address these questions is to contribute to a sustainable development of forensic genetic technology use without a narrow recourse to existing regulation or legislation or lack thereof (see Kayser's fallacy about the lack of regulation for eye witnessing, and how this could be transposed to FDP technologies).

Discrimination of suspect populations

Kayser's failure to distinguish between privacy issues related to examining somebody's externally visible traits, and the retention and further use of this information, is only one problem arising from his 'thin' view of ethics that overlooks practicalities of use. Another one is that FDP technologies "do not aim to provide data capable of probabilistically identifying unique individuals. Instead, they provide typological information about common but variable personal properties of relatedness to others, features of visual appearance, or aspects of biogeographic ancestry" [9]. In other words, FDP technologies work with data from groups of people sharing a particular visible trait, or a range of commonly (read: culturally) associated visible traits, and provide group-based data in return [10]. For a criminal investigation this means that similar-looking people are grouped together in a "suspect population" [11, 12]. Once included in a suspect population, these citizens need to be excluded in order to narrow down the number of the potential perpetrators of a crime. An approach to achieving the exclusion of individuals from a suspect population using FDP technologies is via DNA mass screening [13, 14]. However, mass screens ('dragnets') have been associated with various legal problems. The truly "voluntary" nature of each person's contribution, and the degree to which that consent is informed about intended and future uses of the contributed DNA, have seriously been questioned. That an individual is asked to prove his or her innocence by participation in a DNA dragnet thus raises considerable ethical and legal concerns: For example, this stands in opposition to the legal doctrine of the presumption of innocence, and the presumption of non-interference from law enforcement actors in the absence of individualized suspicion. Allowing suspicion-less seizure of persons and then demanding proof of that person's innocence inverts our structural arrangement of power between law enforcement and the individual; the notion of volunteering is problematic because deciding not to participate in a DNA dragnet renders the "genetic suspect" more suspicious [15]. These legal principles—presumption of innocence, onus of proof, freedom from arbitrary or suspicionless search and seizure—are cornerstones of our democratic states of law, and have very practical effects on the way that technologies need to be applied in the criminal justice context. This type of "genetic policing" [16] brings together issues of informational self-determination and bodily integrity of entire groups of people [12], and expectations about how these are managed in practice. Mass screens themselves are a very specific way of deploying FDP, and the use of EVCs can easily render minority groups into suspect populations since the predominant group living in a particular area or country is often too large to investigate [10]. This effect of operational use must be further contextualized by limitations to effective and objective use of information by law enforcement agencies and individuals and the likely role of cultural bias, for example in policing practices and media stereotyping of the genetic suspect [17-19]. It is in such a context that Zieger and Utz [20] argue that outcomes regarding EVCs should be kept confidential from the wider public to "avoid stigmatization of

whole subpopulations" (p. 14). In addition, cultural sensitivity training of law enforcement officers is needed for the unintended consequences of the use of EVC in criminal investigation to be minimized. We will not be able to fully avoid them, if only because the difference between traditional STR profiling technologies and emerging FDP technologies are unlikely to be fully understood by professionals working in the criminal justice system. This could lead to the erroneous assumption that FDP and STR technologies have equal informational power.

In the eye of the beholder

Another issue with Kayser's argumentation is his contention that FDP operates as a "biological witness," in principle delivering similar information to eye witnessing about a suspect's appearance, and this comparison leads him to query why specific laws and regulations would be needed for the use of FDP technologies as "biological witnesses" (p. 45). In fact, there are two aspects to this comparison—informational and evidentiary—that require further consideration. The first is that while FDP technologies provide de-contextualized statistical information about a person's most likely appearance, eye witness accounts often provide important context about the events of a crime. And two, whereas eye witnessing has reportedly been of some significance in the criminal justice system for some time [21], FDP technologies' consistent and relevant contributions to investigating crimes has yet to be evidenced properly (for exceptions, see [22, 23]).

Two worlds colliding

As Kayser points out, DNA phenotyping is a field of interest to both biomedical and forensic genetics, especially for disease-linked externally visible traits. Using knowledge about susceptibility for, or presence of, certain diseases is indeed a highly contentious area of debate. The practicalities and implications of using material and data garnered in biomedicine to apply in the context of forensic science poses challenges that are linked to the very practice—rationales, procedures, values and norms—of each domain. Forensic genetics utilizes biomedical material and data in two distinct ways: for research in technology development, and in investigations by operationalizing technologies. Here we offer two reflections on these two ways of using biomedical data.

Research and validation of markers for FDP technologies has sometimes utilized biological material collected for biomedical purposes. A major challenge here pertains to the ethical practice of research around the donation of biological material: Did donors who volunteered DNA for biomedical research also consent to its use in the development of FDP technologies for forensic uses? Research and development of biomedical applications in a healthcare or disease context and of forensic applications in a criminal justice context have very different aims and are subject to different ethical regimes of law, science, and practice [24, 25]. In any case, should such data be made available to research, then there tends to be an obligation to publish findings as one way of reciprocating the solidarity and trust connected to the donation of such data. Somewhat relatedly, there is the question of using DNA from

convicted criminals for research purposes [13], and whether research based on such data must also be published.

For the operationalization of FDP technologies, Kayser (p. 45) contends that a "murderer who otherwise cannot be caught and thus continues murdering, overwrites ethical concern on patient discrimination." In cases where disease information may be considered interesting for criminal investigations, that information is only of use if it can be compared to a wide pool of suspects. In other words, investigative authorities would have to gain access to medical records of many citizens/patients, and then trawl through those records to identify a pool of potential suspects. Such trawling breaches patient confidentiality and trust, two aspects that are central to the idea and work of biomedical science and healthcare. For an example of the consequences of such a cavalier approach, take a case in Texas, USA: When a newspaper revealed that standard newborn blood samples were handed over to a military laboratory for forensic research, rather than used in medical research as claimed, political backlash was swift and ultimately culminated in a federal law shoring up informed consent [26]. Downstream consequences of this kind must factor into any measure of the proposed benefit of FDP. We need to remind ourselves that while the purpose is to find the "murderer", during the investigation we are dealing with a suspect whose rights also constitute the building blocks of our democratic societies. Second, this use of medical information runs the serious risk of being unethical. The biomedical domain has a specific role in society, i.e. contributing to societal goals for healthcare, including the provision of treatment, and building on the certainty that the patient-healthcare professional relationship relies on principles of transparency and confidentiality [27].

Concluding thoughts

The anticipated capacities of FDP technologies as described by Manfred Kayser are impressive, and their potential application in forensic work may be useful in providing additional information in investigations. Nevertheless, whilst their value to actual case work has hardly been assessed in scholarly publications, and as predictability from genotype to phenotype, and routine reproducibility of analysis outcomes continue to be subject to improvement, the technologies reviewed by Kayser remain anticipatory. Their value for, uptake by, and uses in the criminal justice system are uncertain. Legal actors have justified compulsory DNA collection programs resting heavily on the distinction between the use of DNA to discern "meaningless" identifier traits versus those associated with some personal characteristic. Although Kayser may be right to call into question the *scientific* basis for distinguishing between "coding" and "noncoding" uses, the ethical and legal distinction bears much greater scrutiny: what we have described as "thick ethics" above. Therefore, FDP technologies such as EVCs and AIMs merit extensive democratic deliberation before they are widely utilized in criminal investigations.

Our ethical toolbox needs to be expanded beyond principle-focused deliberations and take into account the practical deployment of technologies in order to usefully address how technologies should be applied in society. This means we cannot stop at referencing existing law. Rather, if a technology is intended for use in society, forensic scientists and professionals, social scientists and ethicists, as well as

commissioners and potential users need to work together to engage with its social contingencies [10]. Ethical issues are not a burden but an opportunity for engagement, for technology enhancement and for negotiating (social) legitimacy. As one of our peers wrote about another controversial technology—stem cell research: engaging with ethical, legal and social issues of life sciences helps in developing science and technologies that do 'good' [28], and in order to do so we need a good set of deliberative tools including ethical principles and empirical data on technology use.

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