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# Socio-technical disagreements as ethical fora. Parabon NanoLab's forensic DNA Snapshot™ service at the intersection of discourses around robust science, technology validation, and commerce.

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**Abstract**

DNA profiling and databasing technologies have become integral to criminal justice practices in many countries, and their reliability is now rarely challenged. However, a new set of forensic genetics technologies has emerged, one of which is Forensic DNA Phenotyping (FDP). FDP aims to infer a person's visible traits from DNA, and to predict biogeographical ancestry, in order to provide intelligence for difficult investigations. Debates around FDP have been largely academic and legal, but in some countries they have become of public interest. Here, many scientists and practitioners tend to avoid publically articulating disagreement about the limitations of such technologies. This paper attends to a rare public disagreement about technoscientific practices in the wider forensic genetics community about a commercial forensic service called SnapshotTM which utilises FDP. Its analysis of scientists' ethical reasoning about the development and use of this set of technologies contributes to understanding the political economy of forensic genetics, at the intersection of scientific ethics, forensic practice, and commercial resources that make visible and enable further scientific research in the field. More widely, this paper proposes that attending to public ethical debates such as this offers much-needed insight into the various intersecting stakes that co-constitute emerging technologies.

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**Introduction**

In January 2017, the Virginia-based research-company and commercial provider of DNA analyses Parabon NanoLabs announced that, using an emerging DNA analysis method, it had contributed to the successful detection of a double homicide in Rockingham County, North Carolina (Gannon, 2017; Parabon NanoLabs, 2017; PR Newswire, 2017). Two years earlier, the company had been approached by the Sheriff's Office in order to provide intelligence in the ongoing French Homicides investigation which had remained unsolved since 2012. While blood drops had been found at the crime scene, their DNA profile could not be attributed via comparison with police DNA database entries, and the DNA profiles of more than 50 people with access to the house of the murder victims. The company was asked to conduct DNA phenotyping instead, in order to develop an approximation of the potential perpetrator's appearance. The analysis (Figure 1) encouraged investigators to renew their efforts using standard DNA profiling in the husband's family of the murder victims' daughter. Eventually, a match between the blood in the house and the brother-in-law of the victims' daughter was established.

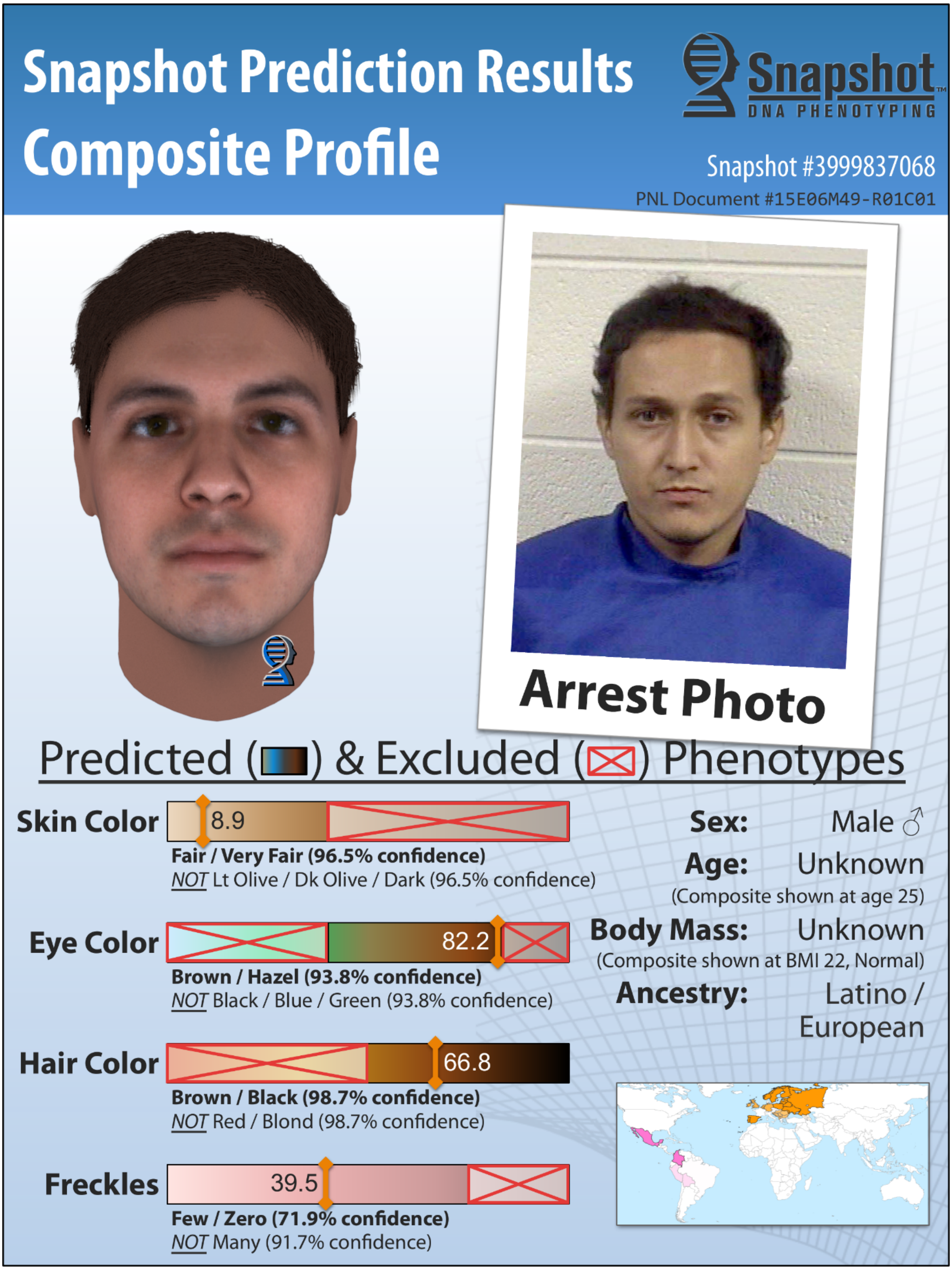


***Figure 1*** Snapshot Prediction Results in French Homicides (Source: Parabon NanoLabs 2017)

In this, and an astounding number of other USA-based cases, this emerging technology—the inference of a person's visible traits from DNA—has been portrayed as a fully operational application in the public domain, delivering public goods. Parabon NanoLabs (from here: Parabon) was approached to provide support in the French Homicides investigation shortly after announcing its forensic DNA phenotyping Snapshot™ service to much media attention in January 2015, suggesting then that it can be usefully applied in law enforcement. The company had previously described its research thus: "Using data mining and modeling, we can look at a genotype alongside single nucleotide polymorphisms (SNPs), which are highly correlated with our physical characteristics, and do things like compose virtual mug shots. It has a lot of potential forensics applications" (Duke University News, 2013). Parabon suggested that its novel technique combines existing arrays of DNA markers, developed by some of the leading European and USA-based forensic genetic phenotyping research teams, with a proprietary data-mining analysis software to offer law enforcement agencies an appealing product. Its main features are a predictive facial composite image and a short list of traits, including skin, eye and hair colour, freckle frequency, and so-called 'biogeographical ancestry', on a sliding scale presenting the most likely and least likely inferences. These interpretations are presented together with a world map indicating possible geographic regions of the donor's genetic ancestry (see Figure 1; however, it is not possible to infer hairstyle from DNA).

Parabon's Snapshot™ service presents forensic DNA phenotyping (from here: FDP) as a tool for establishing social order by predicting from DNA the appearance of a person, including facial features and morphology. By drawing on genetic and forensic imaginaries that comprise notions of genetic essentialism and exceptionalism (Williams, 2010), the company's service invokes the association of left-behind traces with criminal activity and the identifiability of suspects using DNA. When the availability of this commercial forensic service was announced publicly, Snapshot™ was met with considerable response by criminal justice stakeholders and scientific practitioners researching and working in the field of FDP, in particular in reference to the use of prediction composite profiles of unknown persons based on DNA trace analysis. This paper explores scientists' responses as an 'ethical moment' (Heeney, 2017), contextualising this instance within a discourse of contrasting technology identities of FDP. The analysis of ethical considerations made by stakeholders opens up understandings of an emerging technology to wider engagement about its potential societal articulation. Therefore, above and beyond the formalised processes scientific practitioners tend to be enlisted in to engage with ethics (Smith-Doerr and Vardi, 2015), this paper aims to reclaim disagreement between scientific practitioners about scientific basis and societal application of emerging biotechnology as constructive for considering what may constitute ethical technology governance practices. The analysis focuses primarily on scientific ethics, but its embedding in the societal application of technology marks it as a debate around socio-technical ethics. As such, the paper proposes that attending to public ethical debates offers much-needed insight into the various intersecting stakes that co-constitute emerging technologies.

**The story unfolds**

When Parabon took Snapshot™ to the US market in January 2015, they did so to considerable interest from law enforcement and from the media. While the company probably expected to hear some sceptical voices, and see critics raise civil liberties and human rights concerns, they clearly did not prepare for the significant critique they were to face from the scientific community.

Press responses were primarily intrigued by Parabon's new forensic service, and featured an element of scepticism as to how advanced the underlying technology really is and whether its contribution can considerably and reliably improve the way that unknown suspects are identified (e.g. Cookson, 2015; Diep, 2015; Pollack, 2015). The New York Times conducted what they described as "an informal test" of the technology (Murphy, 2015), asking Mark Shriver to use the predictive software tool that was developed by him, Peter Claes and their team (cf. Claes *et al*, 2014; Claes, Hill and Shriver 2014). Advised by Shriver himself, the test was based on peer recognition in the editorial office and turned out to be fairly unsuccessful in facilitating facial reconstruction and recognition in peers, partially, as reported, due to the lack of analysing contextual factors of age and body morphology, such as weight. This failed experiment was contextualised by Parabon reporting that it had already been working together with USA law enforcement in providing so-called ‘Snapshot prediction composite profiles’ of unknown suspects based on DNA trace analysis in several investigations, including in the cases of the ‘Serial Creeper’ in Florida (Rosen, 2015) and a 24-year old murder investigation in Massachusetts (Masters, 2016). Parabon is not the only commercial actor who has started to stake their claim in the field of forensic DNA phenotyping and facial reconstruction from DNA. The forensic service provider Identitas has been working with Toronto police on solving cold cases by providing FDP services using their Forensic Chip since 2014 (Stroud, 2014), and the forensic science company Illumina recently released a next generation sequencing platform which combines standard short tandem repeat (STR) markers with SNP and other alternative markers that can deliver novel analyses, including FDP, alongside established DNA profiling (cf. Børsting and Morling, 2015). Other firms such as ThermoFisher are also working on platforms that include an array of phenotyping and ancestry markers. However, so far Parabon seems to be the only one of these to integrate facial reconstruction in their prediction composite profiles.

The response to Snapshot™ by scientists was critical, featuring concern about the confident portrayal of the technology as being able to reconstruct faces from DNA (e.g. Pollack, 2015), and discomfort about the lack of information on how Parabon’s analysis software works (author’s personal communication with forensic biostatisticians and software developers). Only some welcomed Parabon’s initiative (cf. Parabon Nanolabs, 2015). There is tangible concern among parts of the scientific community that commercial forensic service providers may make overly optimistic promises about the capacities of their services on which they cannot deliver, or that the way they use technologies may even cause adverse impacts on public perception of the use of such technologies. Leading FDP developer Manfred Kayser, for example, is quoted as saying that trait expressions can change over time, or can be masked (Cookson, 2015), relativizing the contribution of FDP to the persuasively looking reporting of the Snapshot™ profile. Some in the forensic genetics community have expressed concern about the forensic service's potential impact on the scientific credibility of FDP and the research community overall. When the lack of peer-reviewed papers on the scientific basis of the service was addressed, Parabon seemingly reluctantly responded that Snapshot™ composite faces are generated using technology that is based on the peer-reviewed research conducted by leading scientists such as Mark Shriver and Peter Claes. This reluctance to mark the contribution of scientists in the community to the underlying science in the forensic services may have been caused by concerns around impacts on intellectual property rights through Parabon's exploitation of scientific knowledge. Another way of understanding this reluctance may be the lack of extensive knowledge or data about relevant genotype-phenotype relationships in the variation of faces (e.g. Claes, Hill and Shriver, 2014; Hallgrimsson *et al*, 2014). Shriver and others have challenged the notion that the number of currently established genetic markers would be sufficient to reliably reconstruct a facial image from DNA for investigative purposes. Interestingly, the company seems to hold the role of 'leader in DNA phenotyping' (Augenstein, 2016) in the imaginary of key security agencies such as the USA Department of Defense.

One likely reason for this primarily critical response from leading FDP scientists is that Snapshot™ entered into a rich and ongoing, and in parts public debate around the ethics of using advanced DNA analyses for security purposes, suggesting that scientists are aware that scientific engagement with technology has an integral societal dimension.

## Contextualising Snapshot™

Policy makers, law enforcement agencies, and forensic practitioners have shown considerable interest in regulating for the introduction of forensic genetic developments such as FDP and Snapshot™ into criminal justice practice. Its scientific champions have argued that technologies and practices currently in routine use by law enforcement and security agencies may be insufficient to deliver security and justice objectives under certain circumstances, such as when none, very limited, or no reliable information about a potential suspect is available. They argue that emerging technologies, and related innovations in practice, may provide the tools to do so: By introducing new ways of using existing technology—e.g. using profiles from DNA databases or dragnets to conduct familial searching—or new technologies such as FDP, both of which have been subject to legal and ethical deliberations in many jurisdictions – e.g. Germany, France, the USA – for some time. And yet, ethical disagreements and uncertainty about the application of new forensic genetics technologies continue, and specialised legal frameworks are not yet in place in most jurisdictions, with the exception of the Netherlands, and a very permissive, validation-based system in the United Kingdom and many states in the USA. However, this paper takes up the call that further deliberations about these technologies, and the changes in practice they may necessitate or facilitate, are indispensable. Simultaneously, FDP emerges as part of a field of practice that has considerable standing with its criminal justice users, and in which science practitioners aim to balance the need to uphold the 'gold standard' of DNA profiling and databasing with the drive for support for novel technologies. When a new technology enters the criminal justice system, questions around its usefulness, value and proportionality in addressing security and justice priorities are raised (cf. Williams and Wienroth, 2017). FDP with its ambition to ascribe appearance and ancestry to an unknown person—as such its (re-)production of the human body and its cultural position in society via genetic reference data of wider population groups—marks the significance of exploring these aspects which are central to negotiating technology application in social contexts. For the criminal justice system, the technology signals a shift in the way that genetic data are used: from evidence to intelligence, and from individuation to attribution, that is from comparing markers for establishing whether a trace may have originated from a specific person, to ascribing certain attributes that are shared by groups of people to an unknown person.

The co-emergence of biotechnologies, legal frameworks, and social order is based, in part, on the ways in which legal institutions and frameworks anticipate and engage with new forms of surveillance based on biotechnology and bioinformation, and how 'this ongoing process redefines the rights and status of the suspect body and the credibility of criminal evidence' (Lynch and McNally, 2009, p. 284). Following Timmermans and Berg's argument that any technology being developed in research is always technology-in-practice (2003), ethical deliberation about the introduction and use of novel technologies needs to be inclusive of the intentions of technology developers and users (Toom *et al*, 2016). Catherine Heeney's idiom of the "ethical moment" (2017) frames such an empirically informed approach to contextualising and analysing snapshots of ethical disagreements, attending to disagreements about what is ethical conduct in technology research and use. The basis for such an approach is the understanding of science as the product of negotiation, an outcome of the settling of controversies (Latour, 1987). Heeney suggests that the "ethical moment" is a deliberative opportunity for scientists to explore scientific and socio-technical conduct, informed but not delineated by existing practices and normative guidelines. Here, understandings about the social place of a specific technology can be produced and tested, e.g. by discussing the credibility of a specific technological claim, and claims regarding the utility of a specific technology. Practically, this suggests value for governance efforts arising from disagreements by considering a technology's potential ways of 'being' in society.

Scientists' disagreements with Snapshot™ are articulated against the backdrop of global societal debates around expanding forensic genetics technologies in criminal justice systems, in which scientific practitioners and scientists seek to retain control over the debate about scientific disagreements, and self-regulatory measures take on a significant role within the forensic genetics community (cf. Wienroth, 2018).

*Forensic DNA phenotyping*

At the heart of Snapshot™ lies the set of technologies called forensic DNA phenotyping, from which arise the claims made by the company to be able to provide comprehensive information about an unknown person, even facial reconstruction. In the late 1990s, the now defunct United Kingdom Forensic Science Service tested phenotypical markers for pigmentation, and commissioned research into the genetic association of facial features (Motluk, 1998), in part encouraged by insights into the genetic basis for red hair colour (Valverde *et al*, 1995). Since then, considerable knowledge about the genetics of trait expression for criminal justice applications has been generated (cf. Chaitanya *et al,* 2018). Social science scholars Koops and Schellekens (2008), Sankar (2012) and Murphy (2013) approach forensic DNA phenotyping as a set of two technologies that use SNP biomarkers to infer visible traits and—together with a range of other markers—aim to predict biogeographical ancestry. While SNPs code, or contribute to coding for certain characteristics, biogeographical ancestry is predicted based on, both, the frequencies of biomarkers that are associated with certain geographic population groups, and some specific coding genes, e.g. for skin pigmentation (Halder *et al*, 2008; Phillips *et al*, 2007; Phillips, 2015). Scientists have been combining both analyses in their work (e.g. Freire-Aradas *et al*, 2014; Walsh *et al*, 2011; Yun *et al*, 2014), suggesting that a distinction between the two technologies will not necessarily be made in investigative practice, rather they will be used in tandem (M'charek *et al*, 2012), especially as new high-throughput sequencing technology that can analyse diverse markers in parallel becomes available (cf. Børsting and Morling, 2015). Snapshot™ uses both technologies simultaneously.

Disagreement about how these technologies work on a scientific basis and how they are used for investigative purposes provides fertile ground for comprehensive discussion of ethical governance, which in part commenced in a brief exchange between geneticists Kayser and Schneider (2009; 2012) and social analysts M'charek, Toom and Prainsack (2012). This exchange, which took place in a leading forensic genetics journal, is in essence a conversation about two different perspectives on FDP which—on that platform—did not mesh into a comprehensive ethical conversation. Since then, a number of attempts have been made for the two communities to engage in a similar format, leading to mixed results (e.g. Buchanan *et al*, 2018, and Caliebe *et al*, 2018; Lipphardt *et al*, 2017, and Schneider, 2017; Staubach *et al*, 2018; Toom *et al*, 2016).

In these and other discussions, different 'technology identities' (cf. Ulucanlar *et al*, 2013) have been produced, giving emphasis to different matters of concern. One describes FDP as a value-adding tool delivering scientific objectivity in an investigation that requires hard-to acquire intelligence, and as such contributes to delivering public goods including security and justice. The other frames FDP as culturally sensitive technology that can only be considered in the context of social practices, values and norms (e.g. Toom *et al,* 2016) in order to avoid social conflicts that may arise from a failure to acknowledge and reflect on the role of social assumptions in genetic knowledge and technology. There are some high profile cases in which FDP information has added to investigations (cf. M'charek, 2008; Phillips *et al*, 2009; Sankar, 2010), and some in which it has been misapplied (Phillips, 2015; Travis, 2009; Tutton *et al*, 2014) or misinterpreted (cf. *Hansard Col 168W* 2005; McCartney, 2006), providing practice context to both technology identities.

*FDP as enhancing*

Phenotyping draws from many population-wide sequencing and genome association projects, aiming to identify commonalities across individuals in population groups. Visible traits of a person are posited by researchers to add value to criminal investigations in cases where current routinely employed DNA profiling and databasing technologies cannot provide sufficient information to enable the identification of an unknown suspect (e.g. Kayser and Schneider, 2009; Ruiz *et al*, 2012; Spichenok *et al*, 2011; Walsh *et al*, 2011). The proposed link between genotype and phenotype, which forms the basis of the negotiated utility of FDP in criminal investigations, at the same time raises new data security and privacy concern (cf. Guillen *et al*, 2000) as well as legal challenges. In 2013, the USA Supreme Court in the case *Maryland vs. King* ruled in favour of compulsory collection of DNA from arrestees, but based on the understanding that non-coding regions of the genome are used (Murphy, 2013). Addressing some of these legal and ethical considerations, proponents argue that FDP facilitates an improvement on less reliable but nonetheless applied investigatory technologies such as eye-witnessing, and they contest privacy concerns on the basis that visible traits are non-private information (e.g. Kayser and de Knijff, 2011, p. 183; Koops and Schellekens, 2008, p. 186). For the case of biogeographical ancestry it has been suggested that its prediction will enhance the accuracy of records held by law enforcement (Phillips, 2015). Another element of this technology identity is its expected use in very serious cases in which criminal justice objectives would trump privacy concerns (e.g. Kayser, 2015), however some potential users have already started viewing FDP as a routine tool. Both views share the expectation that FDP can—proportionally and usefully—contribute to re-establishing social order through the delivery of otherwise perhaps unreliable or unobtainable intelligence in order to reduce the suspect pool in an investigation.

*FDP as culturally sensitive*

A very different technology identity for FDP focuses on its cultural context, articulating concern about the capacity of genetic technologies, which are based on typing populations, to disrupt or aggravate existing issues of social order. Duster (2003) and Skinner (2013) have warned of the 'scientification' of 'eugenics' in policing, and of the 'racialisation' of forensic genetics. These processes describe the production of genetic 'facts' in the criminal justice system that, while their analytical basis is scientifically informed, are translated into investigative practice through the lens of cultural values by law enforcement and justice stakeholders. They, and others, suggest that an association of 'ethnicity' and 'race' with biological aspects may lead to forensic genetics becoming the harbinger of genetic truths that are translated into social identities (topically, see also the debate around David Reich's new book: Kahn *et al*, 2018; Reich 2018a; 2018b). The potential problems that these commentators describe are based on analyses of institutional practices and cultural prejudices in law enforcement which present, for instance, as disproportionate focus on specific minority groups who would then become part of an investigative line of enquiry due to culturally informed biological associations (Chow-White and Duster, 2011; Duster, 2014; Genewatch UK, 2005; M'charek *et al*, 2014; Ossorio and Duster, 2005). This association is seen as of particular concern in linking the utility of FDP to such groups that are in appearance most easily distinguishable from majority populations (M'charek, 2000; 2008). Along this line of argument, the utility of using genetic ancestry prediction in law enforcement is seen as contestable on the basis that communities tend not to define themselves in genetic terms, and that social identity plays a significant role in any self-declared ancestry (cf. Chow-White and Duster, 2011; Skinner, 2013). Operationally, the argument here is that DNA intelligence and evidence always need to be considered in context of other information (Wienroth *et al*, 2014).

**Intersecting tropes: validation, transparency, 'robust' science, and commerce**

Building on the context above, this section attends to four related framings in which scientists' critique of Parabon and its forensic genetics service can be understood. It shows how tropes central to scientific concerns can conflict with commercial considerations, but suggests that simultaneously the commercial dimension to forensic technologies and services is vital for providing resources for forensic genetics research, providing insight into the conundrum of the political economy of forensic genetics between scientific ethics, forensic practice, and resources to continue research.

*Validation*

Scientific validity of the Snapshot™ service lies, perhaps unsurprisingly, at the very heart of the debate. It is closely linked to scientific robustness, and adds a formal level that can generate confidence in the science used in the criminal justice system. The source of information—here specific markers—play a central role as scientific practitioners challenge the claim that existing technologies can deliver sufficient information required to predict facial morphology from DNA. The utility of these sketches is contested based on current scientific research. An academic forensic geneticist who has contributed to investigations using FDP technologies has argued that "even if we find a face that resembles what we are looking for, we don't know if it is the face connected to the DNA" (personal communication with author) because of a lack of understanding about the underlying genetic links. Criticism implies that the markers used by Parabon to reconstruct facial images are either not yet sufficiently matured to provide information relevant to the criminal justice system (e.g. forensic geneticist Lutz Roewer cited in Kastelan, 2017), or that they can only provide very limited information from which the company, perhaps too freely, extrapolates how a face may be reconstructed. Manfred Kayser asserts that the biomarkers Parabon claims to use for Snapshot™ are primarily linked to biogeographic ancestry and sex, information from which "at best one can infer the average face of a female or male European or African" (Weigmann, 2015, quote translated by the author) rather than a precise facial shape of the person whose DNA trace is analysed. This chimes with the asserted lack of sufficient data about relevant genotype-phenotype relationships in the variation of faces by other scientists: Mark Shriver and others have previously challenged the notion that the number of currently established genetic markers would be sufficient to reliably reconstruct a facial image from DNA for investigative purposes (e.g. Claes *et al*, 2014; Hallgrimsson *et al*, 2014) which has been reasserted by forensic scientists more recently (e.g. Sense about Science and EUROFORGEN, 2017, pp. 30-35). Even for relatively well developed prediction models for externally visible traits there is acknowledgement that findings remain incomplete (Caliebe *et al*, 2018).

Furthermore, practitioners have implied that the service may offer too large an interpretative element in the visual representation of the analysis report—an aspect of work that some scientists argue should be left to the criminal justice users of technology (presumably to preserve the imaginary of scientific objectivity of forensic genetic technologies). The underlying assumption here seems to be that while the *investigative* interpretation may err, the *scientific* analysis—if done correctly—remains neutral to the effects of the interpretation, which is an argument of ethical conduct in science that affects both reliability and legitimacy of science.

*Epistemic transparency*

The novelty of Snapshot™ is the proposition of facial reconstruction using DNA-based composite predictions. Parabon has argued that this reconstruction is informed by data mining, presumably of repositories that contain research data on the genetics of facial morphology. Worryingly for scientists, the black-boxing of scientific practices in a package service does not permit users—such as laboratory scientists—to understand the mechanisms through which the analysis takes place. This means, that information which would be used as basis for investigative interpretation and decision-making would have to be taken at face value. It also means that peer-reviewed validation of the mechanisms of this specific service might not be feasible. Drawing from scientists' contentions about Snapshot™, there seems very little understanding about the 'data mining' technique that seems so central to Parabon's argument about the value of their service to law enforcement: Which data sources are mined, how reliable are these sources, and how does the choice of algorithms employed in this data mining process impact on the validity, reliability, and objectivity of the data? Many members of the academic forensic community feel strongly about making analysis software openly available to the wider forensic community, and as such indicate concerns about the proprietary nature of Parabon and others' black-boxed data mining and analysis methods. Previously, many have suggested that analytical tools that inhabit a crucial space in making investigative decisions should be Open Source, to enable users to understand how analysis results are produced and the community to continually improve methodology, reflecting support for wider (peer) scrutiny of software (cf. Balding, 2013; Haned, 2011; Hansson *et al*, 2014). It requires forensic practitioners with the appropriate training to utilise analysis software, and it requires good communication training to enable users to interpret the data and translate it into investigative practice. The discussion around Open Source reflects some of the ethical choices made by parts of the community around reproducibility and transparency in both the laboratory and the investigative context. Arguably, law enforcement agencies may be more interested in the confidence and clarity with which results are presented rather than in tracing the analytical pathway along which these results have been arrived at—presumably as long as this is limited to intelligence, and can lead to using DNA profiling technologies on suspects to produce profiles of evidentiary quality. However, for scientific, practitioner and policy-making stakeholders the considerations of scientific robustness, translating into legitimacy for the technology as well as forensic genetics overall, may be crucial to managing the risk of using emerging and novel technologies in the criminal justice system, and the related aspects of confidence and trust.

*'Robust' science as legitimacy*

In a wider societal setting, social, legal, and moral proportionality and justification present the basis for negotiating legitimacy. At the same time, the concept can also be applied to the scientific discourse in terms of proportionality and justification around what constitutes good practice, the credibility of science, and responsibility towards potential technology users or those affected by their use. Considerations of scientific legitimacy bring together validation and epistemic transparency with scientific responsibility, and is reflected in the forensic genetics community's concern about Snapshot™'s potential impact on the scientific credibility of FDP, forensic genetics as a whole, and the community itself. This is primarily evidenced in the link made by Parabon between FDP, facial modelling software, and the facial reconstruction expressed in the "mug shot" (Duke University News, 2013) of an unknown person:

> "In fact, there is a commercial provider in the USA who asserts that they can already generate virtual facial reconstructions from DNA. Those are, however, ethnic stereotypes, not individualised faces. From my perspective, such claims are a disgrace for robust science." (Peter Schneider in an interview on radio WDR 5, translated from German by the author)

This assertion associates Snapshot™ with cultural rather than scientific tropes, the reference to 'ethnic stereotypes' suggesting a denial of scientific legitimacy. This critique may also aim to distinguish racialized debates from current scientific work in forensic genetics, thereby addressing not just Parabon but also those critical voices that are concerned about the use of genetic material for the purpose of categorising and identifying unknown persons according to population categories such as skin pigmentation or biogeographical ancestry. As such, Snapshot™ is also used to articulate social responsibility of forensic geneticists working in the field. A second example of this moment in the debate is an excerpt from NBC News, citing USA-based forensic geneticist Susan Walsh on Parabon:

> “You can’t just say that you can do something and ask people to trust you,” Walsh says, adding that the research just isn’t there yet to make a lifelike picture of a person’s face. “They’re promising something they can’t give.” (Gannon, 2017)

This promissory element of Snapshot™, while integral to science articulations generally, is criticised by this scientific commentator on the basis of a lack of scientific reliability for the analytical power of the service. By linking reliability to the trust of “crime fighters” (ibid.), the critique here renders it a concern about credibility for the technology, its application, as well as its provider, Parabon.

Further supporting scientists’ argument about lack of scientific credibility of Snapshot™ and Parabon, other scientific practitioners have shown concern about the legitimacy of commercial providers to apply technology without the involvement, and crediting, of the scientific work that has gone into the development of commercial services. When the lack of peer-reviewed papers on the scientific basis of the service was addressed, Parabon seemingly reluctantly responded that Snapshot™ composite faces are generated using technology that is based on the peer-reviewed research conducted by Mark Shriver and Peter Claes. This reluctance to mark the contribution of scientists in the community to the underlying science in the forensic services stands in contrast to good academic practice and may be caused by concerns around impacts on intellectual property rights through Parabon’s exploitation of scientific knowledge, and by scientific limitations to the analytical power of Parabon’s combined approach of DNA analysis, data mining, and computational facial reconstruction.

The case has been deployed by parts of the academic scientific forensic community to articulate boundaries between legitimate phenotyping and scientifically unsound applications, or those considered to be of a social nature and as such not at the heart of a scientific ethic. The commercial provider of Snapshot™ emphasises the service's appeal to criminal justice agents, whereas the articulation of concerns by the academic forensic community can be seen as efforts to draw together rules and norms about scientific conduct, the validity of the underlying science, and the value of robust, that is peer-reviewed and published science. This narrative crystallises around re-anchoring the inference of visible traits and prediction of biogeographical ancestry in the scientific domain, and linking scientific robustness to FDP's role as a valuable tool for societal use—but by re-asserting the scientific primacy over societal and/or commercial interpretations of the underlying science, an issue that, in practice, tends to locate interpretive primacy (the right to define what is legitimate and what is not) of forensic evidence with the legal side in the court room. However, FDP and the Snapshot™ service can produce intelligence, information that is unlikely to make it into any juridical discussion in the court room, and as such offers the opportunity for scientists to re-assert scientific primacy over forensic information in the investigative part of the criminal justice system. The audience that scientific stakeholders primarily aim their arguments at are criminal justice agents as those who would utilise the forensic services, who make decisions about forensic service procurement, and whose experience with the technology would impact on future demand for such services.

*Commercial value and the forensic science community*

While on the surface the emphasis in the debate around Snapshot™ focuses primarily on scientific ethics, the aspect of the forensic market and commercial service provision provides a significant context and reference point. Numerous specialised companies develop forensic equipment and technologies, often in these endeavours working very closely with scientists and forensic practitioners who are both producers and users of such marketable goods. In this commercial landscape, the European forensic genetics community is closely engaged with developers of technologies, but very much less so with providers of forensic services—since they are competitors for access to criminal case work, which generates both scarce financial resources as well as data for further research. Parabon operates primarily as a service provider with Snapshot™, despite its claim of having developed its own service. The company appears to only recently have entered into a collaborative relationship with an academic forensic geneticist (Bruce Budowle, a former FBI forensic practitioner), and then only under pressure to deliver evidence of the viability of Snapshot™ via scientific validation in a peer-reviewed paper. To understand scientists' articulations of reliability in response to Snapshot™, we need to take into account that accounts of legitimacy are also informed by scientific practitioners' preoccupation with their scientific livelihood. This is connected to concerns around ensuring scientific legitimacy of emerging research by ensuring the reliability of scientific findings and technological developments, but also to building and retaining the capacity to continue conducting research. Many of the key researchers in the field deliver forensic services to criminal justice systems themselves, and in part fund their research from such service provision, in fact may source samples and data from such work (regulation in Germany and the Netherlands, e.g., includes the option to use criminal justice data for research purposes).

The Snapshot™ debate helps trace concerns by science practitioners that their efforts to make the case for FDP—for further research as well as for confidence of users in an informed and reliable forensic analysis—may be undermined by misunderstandings. Such misunderstandings are articulated by scientists as unscientific and as leading to misapplications of a technology they have considerable academic investment in. Snapshot™ emerges as a placeholder for the negotiation of FDP and forensic genetics generally in the criminal justice system (see also: Wienroth, 2018) and provides insight into the complex values and relationships that characterise the intersections of forensic science and commerce.

**Concluding remarks**

Ethical deliberations can employ the analysis of practice as a lens through which to enable normative statements about a specific ethical concern. This 'practice turn' has founds its equivalent in the turn towards ethics that can be observed in science policy. Today, many scientists recognise the value of, or the need to, engage with ethical aspects of their work, especially as a way of legitimising the use of new and emerging scientific knowledge and technology in social contexts, e.g. to address societal priorities such as security and justice. One such approach has been discussed in this paper.

The case study provides an insight into scientific practitioners' ethical reasoning about scientific claims-making in the public domain (i.e. outside the scientific domain), about scientific practice, and to a degree also about the operational use of forensic genetics technologies. By relating scientific state-of-art, the validation of technologies for potential use, and public expectations about the capacity of FDP to contribute to investigations, scientific practitioners contest the commercial company Parabon's claim on how to understand and apply these technologies. They articulate their concerns about the impact of accepting Parabon's scientific and operational assertions about Snapshot™ in the criminal justice system, combining such concerns with their accounts of good scientific practice, the need to understand the parameters at the heart of FDP analysis, and the constitution of a community of relevant and legitimate champions in and of the field. There is a competitive edge to these articulations, as scientific practitioners, who compete for funding and conduct their own research, aim to re-establish scientific authority over a commercial product as they ascribe primarily commercial over scientific commitments and emphases to Snapshot™, a service that draws its perceived strength from a scientific basis in forensic genetics. Scientific practitioners assert that commercial service provision should be based on scientific validation first before entering the market, setting academic over commercial rules. Contrasting Parabon's Snapshot™ service with their work, scientists develop a public scientific ethic constituted by argumentation about the need for technology validation before application, accessibility to algorithms and logics of analysis software, and participation as well as collaboration of technology developers and users in and with the wider forensic genetics community. This disagreement is also an instance of scientists aiming to re-assert scientific primacy over legal or juridical concerns in the consideration of forensic genetics technologies that may produce intelligence rather than evidence–while navigating the need to engage with commercial entities in the pursuit of forensic science research. The intersections attended to in this analysis are part of the political economy of forensic science research and use.

For the wider use of this analysis, it stands to reason that the practices of understanding and reflecting on 'ethical moments' of disagreement, and contextualising these, make more visible the interests, values and agents entangled in emerging technologies. Ethical moments can provide a way into deepening the engagement with scientific practitioners about ethical deliberation of the capacities and limitations of a given emerging technology, and its good governance. Identifying and studying 'ethical moments' in scientific practice as a collaborative effort by scientists, social analysts and ethicists can provide a familiar context for practitioners within which ethical reasoning can be worked out, and to translate such moments into deliberative acts outside of that ethical moment, and outside of the protected space into discursive spaces of technology adoption in society.

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