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Research Paper

The visibilities and invisibilities of race entangled with forensic DNA phenotyping technology

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ABSTRACT

Forensic DNA phenotyping (FDP) technology represents a set of techniques that aim to predict physical features of criminal suspects, such as eye, skin and hair colour, and also ethnicity through the inference of biogeographic ancestry from their biological samples. In contrast to other forensic technologies, FDP is not used for identification purposes but valued for its potential intelligence value. Since features predicted by FDP relate to common traits shared by different population groups, critical voices highlight that this technology may (re)create dynamics of collectivisation of suspect populations.

Looking at the criminal justice system, this paper aims to explore the diverse understandings of FDP by professionals working in forensic laboratories and by the members of police forces, alongside the automatic exchange of genetic profiles to fight cross-border crime. Their perceptions are explored according to the perceived potential investigative value and potential threats of FDP. Furthermore, we discuss how racial issues are implicitly and explicitly present in these narratives. Results show that FDP may be ushering in a new assemblage of racial issues along three entangled dimensions: the differentiating power of externally visible characteristics, the comparison between genetic and eyewitness testimonies, and the collectivisation of suspicion.

1. Introduction

The evolution of forensic genetics can be understood within the framework of interconnected waves of technological innovation.[1] The first wave was marked by advances in forensic genetics, with several controversies related to the credibility of DNA evidence[1(p99)]. The second wave of technological innovation was marked by the establishment, expansion and use of forensic DNA databases across the world and the third, sought to go beyond the limitation of the match/no match results provided by DNA databases. Technologies such as forensic DNA phenotyping (FDP) are still emerging as promising forensic tools given their supposed ability to provide new clues in the context of criminal investigations.

Forensic DNA phenotyping represents a set of techniques that aim, from biological samples, to infer probabilistic information about externally visible characteristics of criminal suspects, such as eye, skin and hair colour, and also ethnicity, through the inference of biogeographic ancestry.[2–5] The DNA inference of biogeographic ancestry is based on the analysis of Ancestry Informative Markers, or SNPs to estimate the genetic inheritance that individuals carry from their ancestors in their DNA.[6] This estimation is usually made at the continental level, therefore giving probabilistic information of a person's genetic ancestors as belonging to Afro-American, Southern European, and Northern European region.

The initial development of FDP dates back to the early 2000s with the prediction of some appearance traits being explored for forensic purposes[2(p34)]. Resulting from efforts to provide valuable intelligence to the police, FDP technology is expected to mainly apply in the following scenarios of criminal investigations: when DNA samples collected from crime scenes do not match with the profiles stored in national forensic DNA databases[7,8] and when there are no other investigative leads (the so-called 'cold cases') or eyewitnesses available.[7,9] Additionally, FDP technology is also expected to provide new leads for the identification of missing persons.[1]

The legal landscape governing the uses of forensic DNA phenotyping technology differs widely across Europe. Within a scenario of absent legal regulatory frameworks, FDP techniques are, to date, prohibited in Belgium[10(p9)] and only regulated in The Netherlands and Slovakia[11(p2)]. Although they are not expected to spread massively across criminal justice systems,[4] there are ongoing discussions in Germany that seek to change the law, regulating their use. Despite this ambiguous legal landscape within the European Union, there are high profile criminal investigations in which FDP technology have been applied.[12,13]

As posed by Derksen, "acceptance of the accuracy and objectivity of forensic measurements results from a series of efforts to establish and

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represent 'consensus' in a scientific community" [14(p805)]. Until the time of writing (2019), there is a shared perception within the scientific community of forensic genetics that knowledge about the genetic basis of pigmentation traits,[2] such as the estimation of eye, hair and skin colour,[2,15] and biogeographic ancestry[6] is more advanced than the knowledge of predicting other physical features. Given the complexity in understanding the genetic basis configurations that result in the expression of other physical characteristics - morphology of the human face,[7,9] weight/body structure,[16] hair loss/baldness,[17] age,[2] and the morphology of hair[18] -, further research is being developed. Meanwhile, more recent publications are emerging, presenting results obtained from testing genetic kits and software analysis for FDP technology, revealing the still unsatisfactorily, issues and discrepancies within the predicted results, thus allowing to evaluate its accuracy.[19]

Forensic imaginaries sustaining enthusiasm over third wave innovation technologies have been shaped by diverse expectations around potential benefits of its application in the criminal investigation. FDP technology has been subjected to several debates concerning its ethical, social and legal implications (ELSI)[20(pp2−3)] and also 'anticipatory governance deliberations'[4] before its widespread application.

Contrasting to traditional and routinely use of forensic technologies, FDP is not expected to be used in court, but rather as policing intelligence technology.[4,21] This means that instead of projecting its usefulness as evidence, intelligence resulting from forensic DNA phenotyping technology is framed in the form of investigative information to support criminal investigations.[11,22] By constructing probable knowledge about the suspect's physical characteristics, FDP technology allows the police to establish priorities by interpreting and analysing the results "to inform future actions of control against an identified target"[23(p42)].

The third wave of technological innovation[1] provided, therefore, a shift in technological developments, moving the locus from identification technologies to collectivisation. As David Skinner puts it: "one way in which third wave forensics is novel is in the explicit use of race and ethnicity as investigatory resources"[20(p12)]. Attempting to predict phenotype information from genotypes, forensic DNA phenotyping technology infers information about the racial or ethnic characteristics of suspects.[20,22]

This technology is anchored in processes of collection, organisation and classification of genetic data that resort to distinct taxonomies of population to identify patterns of difference and sameness in DNA.[24] Since it clusters population groups sharing the same, but variable, biological features, FDP has the potential to increase the visibility of racial or ethnic difference, thus working as a technology of collectivisation of suspicion.[20,25,26] Although not exclusive of FDP technology, these processes not only reproduce racial categories within scientific research, ascribing to them new significations,[27] as they also embody biological meaning to the existing social categories of race[20,28(p888)].

The following section explores the intertwined links between concepts of race, ethnicity, population and ancestry in the forensic field and also in biomedicine. Aiming to capture how the use of these concepts have evolved within genetics, this section provides empirically grounded theoretical tools to critically analyse the visibilities and invisibilities of race entangled with forensic DNA phenotyping technology. The methodology used in this study is then explained, followed by the empirical analysis where the (in)visibilities of race in the context of forensic DNA phenotyping technology are explored. Exploring interviewees' expectations on the potential investigative value and threats of FDP technology, results show attempts to neutralise race through different practices, also indicating three entangled dimensions in which racial issues are rendered (in)visible: the differentiating power of externally visible characteristics, the comparison between genetic and eyewitness testimonies', and the processes of collectivisation of suspicion.

2. Framing race and genetics: (in)visibilities of forensic DNA phenotyping

Ethnicity and race convey multiple meanings ascribed to the identification of different cultural, traditional and identity aspects of human life that also relates to the social meanings attributed to descent and belonging.[20,29,30] Race and ethnicity are then slippery terms that throughout human history have gained different, biological, political, social and cultural meanings in different contexts.[31,32] Its absent–presence[32] is explored and made visible in this paper addressing its connections with technological tools to infer visible (racial) traits and biogeographic ancestry for forensic purposes.

Historically linked to controversial debates within the field of biomedicine and genetics,[25,33–35] concepts of race, ethnicity, biology, ancestry and population are once again under the spotlight in the wake of the developments of the third wave of technological innovation.[1]

After the completion of the Human Genome Project, the end of race as a biological category was worldwide disseminated. However, since then, genomic investigation has witnessed an unpredicted shift, as race quickly returned to the surface as the main focus of research.[27,36,37] Several authors devoted their work to study the subsequent moves derived from science's renewed interest in race,[27,36–38] revealing an acknowledgement from many geneticists on the utility of race-based categories for measuring and improve health disparities. Among these, Duanna Fullwiley's work in the pharmacogenetics field has shown how geneticists mobilised, uncritically, socially constructed categories of race in their researches, recognising some genetic validity to its use.[35,39] Although driven to reduce health disparities, Fullwiley's study revealed that when communicating their work and results, geneticists also convey potentially damaging links between genetics and race.[35,38] Thus, in spite of aiming to improve health inequalities, the rationalization of medicine and race presents itself a high risk of increasing inequalities and stigmatisation of minorities.[39] Catherine Bliss also addressed geneticists understandings of race in genomic science but found a new scientific and politically conscious ethos committed to engaging actively with its social implications[27(pp4−7)].

Revealing that the debate on the use of racial categories is a concern also shared within the biomedical field, attempts to avoid the use of race in genomic research are also known.[25,28] Despite the considered effort to reconceptualise the human genome, the slippery nature of race was also revealed in some of these attempts through the form of new racialised "genomic geographies".[25] Although there is within science a shared acknowledgement of race as an ambiguous concept, embedded with different social meanings, research on the human genome continues to use race categories as entry points in different domains.[30]

Within the field of forensic genetics, there is a great concern about how the use of race and ethnicity and biological aspects of suspects are put together[22,29,37] and how the trend of "scientification" of police work[23,40] impacts the criminal justice system.[41,42] Therefore, concerns stressing racial-derived issues on policing and on the use of DNA within the criminal justice system have been the topic of several studies.[31,42,49–52] Skinner,[20,22,29,47] Duster,[37,45,48] M'charek[43,44,49] and Ossorio[46] are between those devoted to addressing racialisation (explicit talk of races and ethnicities)[20(p8)] and social discrimination within the criminal justice system. Within racial concerns, the use of forensic DNA databases has also been critically addressed, underscoring the disproportion of ethnic minority groups within the imprisoned population[43,47,50] and overrepresentation of certain racialised groups.[47,48,51] More recently, the third wave of technological innovation[1] has brought new dimensions to the existing debates between race and genetics.[20,22,43,52,53]

Forensic DNA phenotyping technology translates phenotypic and ancestry genetic markers onto categories of difference that are genetically shared through time by different population groups. Given that predictions based on biogeographic ancestry result from the differentiation of population groups based on continents or population

groups, associations between these and specific categories of race and ethnicity are often made[52] and racialised. Within these processes, DNA emerges as a constitutive element of a larger articulate collective.[53] Meaning, a part of a "heterogeneous network of relations that draw together a variety of humans and things in a fluid configuration"[53(p521)]. More important, this articulate collective 'speaks' and produces different facts depending on how it is performed and translated by different actors in the criminal justice system.[20,43,53]

The use of biogeographic ancestry and ancestry informative markers relies on a system that gathers, organises, classifies and interpret genetic data resorting to continental population categories. Thus it represents a scientific product built upon race,[54] a bio-logistical construction of race[35(p699)]. As posed by Fullwiley: "Ancestry informative markers have emerged as a dispassionate research product that purportedly rises above subjective practices of racializing the phenotypes of others"[35(pp699−700)].

Although the efforts of some FDP scientists emphasising that biogeographical ancestry is not the same as race, arguing that results do not rely on shared physical appearance traits[55(p18)], other scholars underline that social meaning attributed to ancestry and also to externally visible characteristics may legitimise the attribution of ethnic and racial classifications over certain population groups,[46] reinforcing existing stigmatisation, through new forms of racial profiling, thus increasing the vulnerability of specific population groups.[20,22,56] Complementarily, scholars have also addressed how predictions based on externally visible characteristics also incorporate specific ethnic and racial classifications as they result from the assemblage of individuals' data based on the fact that they share particular visible (racial) characteristics or a set of visible traits.[43,53]

Critical voices of FDP highlight not only that racial and ethnic-based classifications lie at the heart of this technology, but also that such classifications can be reinforced as categories of difference through the action of this innovation technology.[20,25,31,43,53] By focusing on difference, racial and ethnic classifications increase the visibility of specific population groups in specific socio-political contexts, translating what M'charek and colleagues called '*phenotypically others*'[31].

Given the current global context of criminalisation of minority population groups, technologies such as forensic DNA phenotyping become attractive political objects of surveillance or, as recently posed by Skinner, instruments of innovation technosecurity.[22] Although some ethical and social issues of FDP technology have already been flagged,[4,11,20,22,57] more empirical work is needed to fully grasp why race predictions are particularly problematic[20(p5)] within this new wave of police intelligence technologies. Aiming to expand current debates this paper explores how race is rendered (in)visible by interviewees when addressing forensic DNA phenotyping technology.

3. Methods

This article is part of a broader project[1] that explores the societal, cultural, ethical, regulatory and political impacts of the use of forensic DNA technologies in the European Union. To grasp the multidimensionality of the object of study, privileging socially constructed perspectives related to the empirical object, this study is anchored in a qualitative methodology that combines the collection and analysis of specific actors views, through interviews, with a systematic comparison between analysis, empiricism and theory.[58] Following the principles of grounded theory,[59] this study values the sociological representativeness of each perspective, and these seem to be generalizable to theoretical statements and not to populations or universes[60(p10)].

Interviews were conducted with professionals involved in international police cooperation who have acted as Prüm National Contact Points or were directly involved in the process of joining the Prüm system, following the protocols and procedures of the European Research Council's ethics regulations. Before the interviews, all interviewees signed a written informed consent form and agreed to be audio recorded. The data on which the analysis is based includes 38 semi-structured interviews conducted in different EU member states with 48 professionals operating in the Prüm system. These include forensic practitioners working in forensic laboratories and police member forces. All interviews were digitally recorded, transcribed verbatim and anonymised. Editing of the quotes was carried out whenever necessary to assure clarity of language while respecting the participants' meaning.[61] To protect the anonymity of the interviewees, the country in which each interviewee was based was identified using a letter. This form of anonymisation will be used in the interview quotes analysed in the following sections.

The interviews covered the following themes: the organisation of the provision of forensic genetics services in the country where the participant was based; views and experiences regarding the transnational exchange of DNA data in the EU; representations of public engagement with forensic genetics; and perceptions concerning DNA technology developments and innovations, such as forensic DNA phenotyping. For this article, interviewees' views are explored only with respect to forensic DNA phenotyping technology.

Relevant quotes pertaining to the participants' perception of the potential investigative value and potential threats posed by forensic DNA phenotyping technology were coded and subjected to multiple readings to develop an in-depth understanding of race' (in)visibilities. These quotes were systematically compared, contrasted, synthesised and coded by theme and thematic category, following the principles of grounded theory[59] and interpreted using a qualitative content analysis approach.[62] This paper details the analysis of replies that were illustrative of each thematic category that emerged from the content analysis.

3.1. Empirical analysis

Inspired by the conceptualisation of race as an absent presence,[32] the (in)visibilities of race are explored from the perspective of professionals who work directly with the automatic exchange of genetic profiles across European countries. Their expectations on the potential investigative value and threats of FDP technology reveal three entangled dimensions in which racial issues are rendered (in)visible: the differentiating power of externally visible characteristics, the comparison between genetic and eyewitness testimonies', and the processes of collectivisation of suspicion.

3.2. Differentiating power of externally visible characteristics

Perceptions of how FDP technology can prove useful and be applied in the context of criminal investigation engage with different rationales and arguments. Contrasting to more traditional uses of forensic tools, where DNA evidence can be used in court, interviewees, especially those of police profile, value FDP technology through a perspective that access its practical operationalisation[63(p133)]. Acknowledging its usefulness when other criminal investigation tools fail, FDP is framed by interviewees by its intelligence.[4,21,64] Thus, by constructing probable knowledge about the suspect's characteristics, FDP allows the police to establish priorities within the investigation:

> If you do the DNA analysis in the database and do not find a match, forensic DNA phenotyping can help the investigation at least to prioritise in some way. (Interview O02-02 – Police officer)

The estimations of physical characteristics and probabilistic information about the biogeographic origin of the suspects' ancestors result from the division and assemblage of individuals' data based on the idea that they share certain genetic categories or a set of visible (racial) traits.[53] By recognising its power to distinguish specific racial

[1] Exchange project (http://exchange.ics.uminho.pt/).

characteristics, *phenotypically* others',[31] interviewees' perceive the investigative value of information derived from FDP as being able to minimise the number of suspects during an investigation. Thus, the first dimension regarding the (in)visibilities of race concerns interviewees' understandings of the power of differentiation of FDP results in criminal investigations. The following quote addresses this issue by referring to results that point to rare characteristics as "good information", allowing to cross-check with other available tools, such as eyewitnesses or recordings of CCTV. Simultaneously this perspective unravels how professionals operating in the criminal justice system perceive the use of racial and ethnic categories as an investigative tool. FDP technology operates using intelligence as a form of investigative information[4(p7)]:

> If you find out [from FDP analysis] that it is a black hair person with blue eyes, which is **rare**, this could be good information and you can then question witnesses again, if somebody with those characteristics was seen, or you can check the CCTVs. (Interview O02-02 – Police officer)

However, as aforementioned, the use of racial and ethnic categories by FDP technology unravel their slippery character as different social meanings are ascribed to them within different socio-political contexts. Results of biogeographic ancestry and of externally visible characteristics resonate and are confused with socially shared notions of race, ethnicity, belonging, nationality.[20,29,30] Forensic scientists, as the following interviewee, have made efforts arguing for the separation between concepts of biogeographical ancestry and race, claiming that results of biogeographic ancestry do not rely, neither translate unequivocally, on shared physical appearance traits[55(p18)]:

> You can [visually] look in a way it does not say anything about where you live or where you come from, but it says something about how do you look like. (Interview U02 – Forensic scientist)

From the perspective of the following interviewee, who works in a police unit, externally visible characteristics are considered to be more relevant to criminal investigations than information about the biogeographic origin of the suspects. Therefore, the use of racial categories externally visible characteristics is a valued element in criminal investigations allowing greater visual differentiation of individuals:

> If I am looking for someone and I have a DNA from the scene it would help me more, as a police officer, to know things like facial or bodily characteristics. For example, the suspect has black hair, brown eyes, things that may help narrow down my search to an extent. But whether he is from Asian descent 500 years ago, I do not think it would much help my case. (Interview W01 - Police officer)

This is not an isolated perspective. Depending on the context and on population-specific characteristics of the interviewee's specific country, potential uses of biogeographical ancestry prediction are differently perceived.[65] Interviewees' perceptions on the relevance of specific ancestry information are balanced according to the population characteristics and the history of their particular country. The following interviewee exposes this contextual weighting by claiming for the heterogeneity of the population in his national context. By suggesting that in his national context information derived by FDP technology cannot become 'visible', meaning racialised, this also indicates that population heterogeneity is perceived as a limitation to the use of such techniques:

> I think my country is going to be a challenge for this kind of projects because our history is so rich with invasions from different countries that our gene pool is quite diverse. (Interview B01 – Forensic scientist)

Closely involved in the production of knowledge, forensic scientists tend to be more cautious and to expose their uncertainties concerning technological innovations [66(p12)]. Given the reduced possibility of the results obtained to differ from the majority of the population, the following interviewee argues that genetic homogeneity can also be an obstacle to the successful use of these forensic tools. By understanding the usefulness of FDP inferences by its ability to pinpoint to a particular group of suspects, interviewees convene the idea of the investigative value of FDP with the racialisation of the predicted features:

> The predictions they can make right now with the phenotyping probabilities are not that useful for countries where there is a sort of uniform common phenotype. So, even if they give you the percentage of blue eyes or green eyes, that's pretty much the vast majority of the population … (Interview E01-01 – Forensic scientist)

Results of forensic DNA phenotyping are perceived by interviewees as being more useful for criminal investigations if they disclose information about '*phenotypically* others'[31] - rare phenotypic characteristics within a specific socio-political context. This assumes to be more problematic as its most attributed utility relies on situations which the results allow the distinction between minority groups and the rest of the population.[30,44,67] Thus, by increasing the visibility of these population groups estimations made by FDP technology become racialised.

Some of the third wave of innovation technologies rupture with the imaginary of truth and objectivity[68] that until now have defined the use of DNA in the criminal justice system. Forensic DNA phenotyping technology requires some reflection concerning its use as intelligence[4] by the police, given its role in evaluating and interpreting the complex probabilistic results obtained. Since the attribution of a racial and ethnic group is based on the visualisation of specific externally visible characteristics, resulting from socially constructed notions about that particular group, it is urgent, in the light of these emergent technologies, to develop a deeper understanding and recognition of the associations that circulate between race and ethnicity.[53,69]

3.3. Comparison between genetic and eyewitness testimonies

Directly comparing them to eyewitness testimonies, the results of FDP technology have been termed by supporters as a 'biological witness'.[2,7] From this perspective, DNA evidence is portrayed as being more objective, precise and reliable than eyewitness descriptions,[15,70] which are comparatively understood to be unreliable and permeable to racial bias.[20,22] Supporters of FDP technology also argue for the reliability objectivity, accuracy and statistical support of its results, using this rhetoric and discursive mechanism to neutralise racial concerns surrounding FDP technology. The developments of FDP technologies exposed the fragilities of current ethical boundaries of DNA for forensic purposes. However, high expectations in FDP have been reflecting efforts to build up new ethical boundaries.[11] The direct comparison between genetic and eyewitness testimonies' is mobilised by interviewees to rebuild such boundaries in forensic science, making a case for the non-problematic character of predicting racial characteristics.[2,8] Nevertheless, I argue that the results of FDP techniques are racialised in the same way as eyewitness testimonies can be, especially by those who read them and must assess its utility in the context of criminal investigations:

> I do not think it is very robust, but do I not I see it as being very different from bystanders saying the suspect is somebody with red hair. So the police start looking for somebody with red hair. As long as it is used as an intelligence tool then that is not much different for me. (Interview R01 – Forensic scientist)

Embedded in this articulated comparison between eyewitness and genetic testimonies, FDP technology potential is presented as being an intelligence tool to be used in the context of the investigative phase of criminal investigations. This rationale, as the following quotes shows, frames FDP as something that might guide criminal investigations by pointing to specific racial characteristics that are assumed to correspond to the description of the suspect to have committed that crime. By stressing its potential values, information on its potential risks are

practically non-existent:

> I think it is like a description of the suspect. So you could potentially say: "We are looking for a suspect with grey hair, or blonde hair, blue eyes". It could help yes. And if you can then narrow down, "OK, his ethnicity is probably Scandinavian or Asian" … It helps you narrow down the pool of probable suspects. (Interview Y01-02 – Forensic scientist)

> You use this tool instead of an eyewitness. That is all. Just instead [of eyewitness]. As the eyewitness can say: "OK, I saw a guy with red hair and blue eyes …" Only in this way will it be used. (Interview S03 – Forensic scientist)

Through the comparison with eyewitness's testimonies, the following interviewee seeks to neutralise concerns about the reliability of FDP technology's results by arguing the lower margin of error of a traditionally used resource in the criminal justice system[4,15]:

> [Forensic DNA phenotyping] is even better than eyewitnesses, because the truthfulness of the eyewitness is only 50%. (Interview S03 – Forensic scientist)

FDP technology is presented and highlighted as a useful intelligence tool. While stressing its intelligence value, interviewees also unravel their forensic imaginaries, in which new genetic tools are perceived as being able to solve practical obstacles that police come across in the course of criminal investigations[3(p7)]. These imaginaries are also part of the equation to understand how some police members seize upon the potential uses of FDP technology. As the following interviewee enthusiastically explains, the informative nature of FDP results frames its perception as highly prized in the context of criminal investigations. However, the burdens of legitimising the use of racial-based predictions in forensic science must be considered as it increases the danger of linking race and genetics[35,38] and potentially increases police forces' dependence on racial identifiers[52]:

> This technology is perfect because, if I am not mistaken, it gives you the ancestry information, for example, if you have blue eyes or dark eyes, the colour of the skin. I think it is what everyone should look forward to. (Interview X01 – Police officer)

3.4. Collectivisation of suspicion

As pointed by Skinner, "race has an enduring power as a means of describing and stigmatising collectivities"[20(p6)]. By clustering population groups sharing the same, but variable, biological features, FDP relies on a complex network that configures suspicion to individuals even in the absence of other forms of suspicion. As it relies on fluid patterns of genetic difference and sameness,[24] FDP might increase the visibility of racial or ethnic difference[20(p6)], thus working as a technology of collectivisation of suspicion.[20,25,26]

Just as with the benefits, the perceived risks of FDP technology are also not homogeneously understood in all population contexts. As the following interviewee highlights, forensic DNA phenotyping may present some risks in countries where racism is more prevalent. Critical perspectives of FDP have also stressed how these techniques might increase the creation of new forms of racial profiling, reproducing discrimination and criminalisation of groups already vulnerable and affected by the actions of the criminal justice systems[53]:

> For countries with very large international populations [forensic DNA phenotyping], this might actually mean something. But I would hesitate with the implementation, especially in countries where institutional racism is still a very big issue because once you have this sort of phenotypical possibility, it opens up a different kind of racial profiling, which is definitely an issue. (Interview E02 – Police officer)

In both techniques - biogeographic ancestry and externally visible characteristics - there is an absent presence of race[32] resulting not only from the ambiguity of the categories used to classify the suspect populations[43] but also from the performative processes on which the definition of race is built. Although seeking to neutralise and externalise the concept of race,[32] forensic scientists narratives reveal both, its eminently social and political character, and the difficulties of decoupling from intrinsically associated concepts such as race, ethnicity, physical characteristics and ancestry[22]:

> Now [with forensic DNA phenotyping] we can try to establish additional information on the person, like the colour of eyes, hair, **race**, range of age … So this technology is growing, It's not a cheap technology, but it is a powerful one. (Interview G05 – Forensic scientist)

As FDP technology resorts to different configurations of genetic difference and sameness[24] there are concerns that, while producing different kinds of populations and population differences[25(p19)], results may exceed certain ethical limits

> From a scientific point of I would like to have a lot of information obtained from samples, such as the age of the person, or some specific characteristics that will provide some clues for the investigators. It would be interesting but it also implies some risks, because it would be much easier to make some non-ethical discrimination. (Interview J01 – Forensic scientist)

Thus, also within the forensic geneticists' community, a fear emerges that, by resorting to biological categories of race, forensic DNA phenotyping may establish new positionings that rely on old readings of criminal bodies.[37,71] By reporting on the alleged existence of a 'crime gene', the following interviewee acknowledges the need to set up boundaries and limits, that must not be exceeded:

> There are studies which say that there is like this crime gene that makes people more prone … But we cannot just say: "It is written in his genes to commit a crime". No, it also depends on the environment. I really like to use DNA profiling for everything and even the idea of using the physical characteristics of the person but I think we should not go further than that. (Interview Y01-01 – Forensic scientist)

4. Conclusion

Aiming to expand current debates this paper explored expectations of professionals working directly with the automatic exchange of genetic profiles across borders. The absent–presence[32] of race was explored and turned visible in this paper by addressing its connections with technological tools to infer visible (racial) traits and biogeographic ancestry for forensic purposes. The attributed potential investigative value and threats ascribed to FDP technology revealed three entangled dimensions in which racial issues are rendered (in)visible: the differentiating power of externally visible characteristics, the comparison between genetic and eyewitness testimonies', and the processes of collectivisation of suspicion.[20,25,26]

The differentiating power of FDP technology renders race and ethnicity visible through the racialisation of specific physical appearance traits. Interviewees highlight the potential investigative use of FDP when results of collected samples differ from the physical appearance traits shared by the majority of the population in a specific context. This also means that, regardless of the context, while some groups can remain invisible, others, '*phenotypically* othered',[31] will arise more frequently as targets of police surveillance.

By comparing results of FDP with accounts of eyewitness testimonies, materials have revealed a shared acceptance among interviewees on how FDP technology portrays race and ethnicity as descriptive categories within criminal investigations. This comparison

acts, on one hand as a rhetoric and discursive mechanism used to neutralise racial concerns and, on the other hand, is also mobilised to build up new ethical boundaries in forensic science in which the inference of racial characteristics are perceived as not problematic from an ethical point of view.[11] Lastly, issues concerning the robustness of FDP technology also arise within this analogies with eyewitness testimonies, framed as being less reliable, although with a long history in the criminal justice system.

Coupled with discussions on the visibility of racial differences of FDP results, have also shown a greater preponderance of imaginaries of scientific objectivity within forensic scientists' in contrast to the perspectives of the members of police forces. Perceptions that investments in DNA technologies bring objectivity to police work[23] raise questions related to how trends of "scientification" of police work[23,40] focusing on race will impact the criminal justice system.[41,42]

Despite recognising the potential investigative value of FDP, interviews also showed awareness of the potential risks associated with the collectivisation of suspicion.[20,25,26] In particular, by acknowledging that results of these innovative tools potentially increase visibility towards specific population groups, both within the investigation and in society. This awareness can be understood as a materialisation of race, insofar as it recognises the consequences this technology may produce, exacerbating the stigmatisation of already racialised and disadvantaged groups within society and also the criminal justice system.

Declaration of interest

None.

I declare no conflicting interests

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