



Université du Québec
à Trois-Rivières

DNA Phenotyping: As good as it seems?



CICC
Centre international de
criminologie comparée

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Introduction

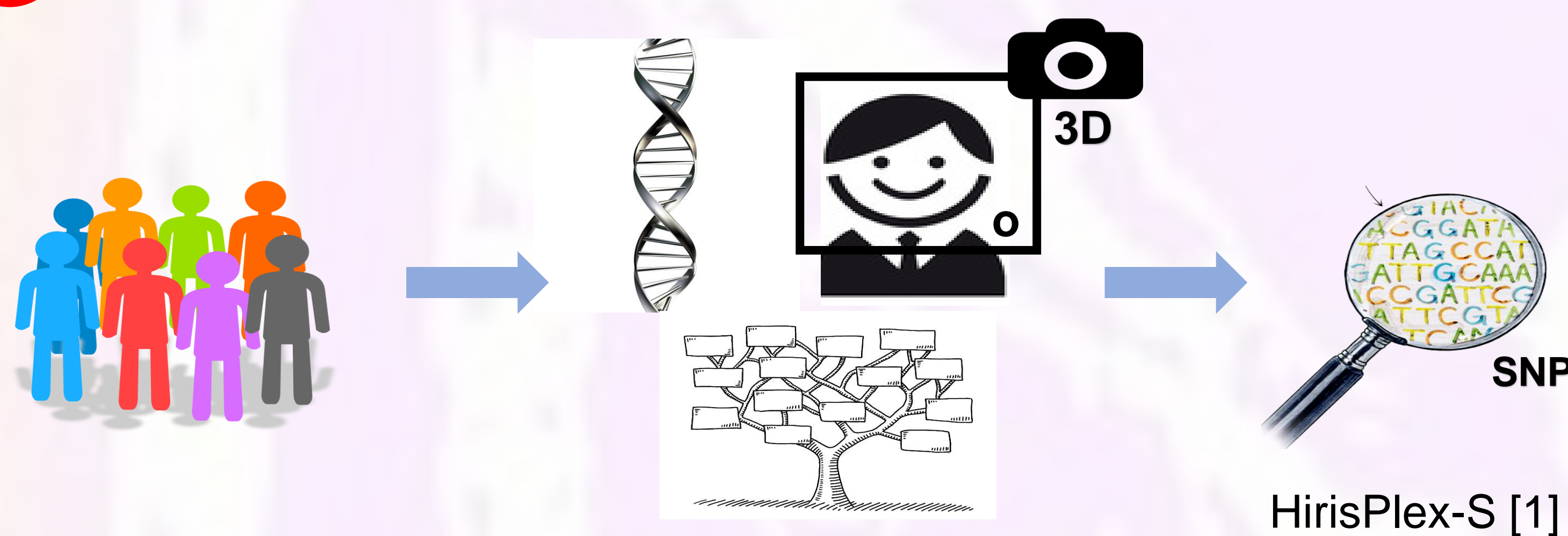
The advent of DNA analysis in forensic science in the mid-1980s revolutionized the practice, allowing the analysis of highly individualizing biological traces from people of interest (e.g. suspects). While DNA analysis is a valuable tool in criminal investigations, it also has its limitations, particularly if the DNA profile found at a crime scene does not match the profile of a known person (suspect, witness, etc.) who can be compared to it. It is then impossible to identify who left the trace. In such case, DNA could provide investigative leads thanks to a new technology called DNA phenotyping, which consists of predicting physical characteristics (e.g. eye color) from DNA alone. By combining several of these characteristics, it would theoretically be possible to create a “genetic sketch” to help identify the individual who left their DNA at the crime scene [1].

However, validation studies in certain populations have shown that the predictions of DNA phenotyping do not always match well with the person’s actual physical appearance. More importantly, obtaining a “genetic sketch” requires the combination of several predictions of different traits with their own uncertainties, questioning the overall reliability of such an approach. The lack of information on the needs and expectations of police officers also questions the true operational utility that this technology can have in criminal investigations [2].

The objectives of this project are 1) to evaluate the reliability and discriminatory power of DNA phenotyping in a large population such as Quebec; 2) to better understand the expectations and knowledge of the police community in order to delineate the conditions necessary for this technology to be truly useful in forensic science. We hypothesize that this technology will be most useful in cases of major crimes, but at the cost of significant optimization specific to each population of interest.

Methods

1 Comparison of predicted and observed physical characteristics



2 Questionnaire for SQ police officers + CST



Results

- 1
 - 139 participants (DNA donation, phenotypic measurements).
 - Analysis of DNA samples underway (eye color, hair and skin).
- 2
 - Preliminary data (n = 133) suggest that:
 - 39% heard of DNA phenotyping (Internet, medias).
 - Interest in using the technology for all crimes with no DNA match (30%), especially major crime (homicides, sexual assaults, violent assaults) (41%), but also property crimes (robbery, breaking and entering/home invasion) (23%).
 - Want as much physical information as possible, particularly pigmentary traits (e.g. eye color), ethnicity, age, height, face, sex, weight and genetic diseases.
 - Knowledge remains limited (benefits, limitations, interpretation of data), even if some are aware that the results can lead to false leads or biases (11%) and that its reliability must be proven in a court of law (12%).
 - Used in at least three cases in Quebec using an American company, including the murder of Catherine Daviau in 2008.

Discussion / Conclusion

- Increasing interest in DNA phenotyping as a new tool to help solve crimes.
- Have as many physical characteristics as possible to obtain the most complete and unique portrait and help solve a case. Medical information, in their eyes, would help them in this sense because it is less general.
- Will benefit from being better informed about the advantages, limitations and how to interpret predictions.
- Quick evaluation needed since it has already been used in Quebec using foreign genetic services (analysis model secret, may not be well adapted).

Next phase : Complete the collection and analysis of the police questionnaires and assess whether this technology is well adapted to the Quebec population. If the technology proves to be sufficiently reliable, guidelines for its effective use will be proposed.

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References

[1] Breslin, K., Wills, B., Ralf, A., Ventayol Garcia, M., Kukla-Bartoszek, M., Pospiech, E., . . . Kayser, M. (2019). HirisPlex-S system for eye, hair, and skin color prediction from DNA: Massively parallel sequencing solutions for two common forensically used platforms. *Forensic Science International: Genetics*, 43. doi:10.1016/j.fsigen.2019.102152

[2] Samuel, G. & Prainsack, B. Forensic DNA phenotyping in Europe: views “on the ground” from those who have a professional stake in the technology. *New Genetics and Society* 38, 119-141, doi:10.1080/14636778.2018.1549984 (2019)