Law enforcement use of DNA technologies

Law enforcement use of probabilistic genotyping, forensic DNA phenotyping, and forensic investigative genetic genealogy technologies

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Submission from Dennis McNevin

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Acknowledgements

- I acknowledge the Gadigal people of the Eora Nation upon whose ancestral lands I work
- The opinions presented are mine and do not necessarily reflect those of any organisations with which I have been associated

Dennis McNevin

- Professor of forensic genetics in the Centre for Forensic Science at the University of Technology Sydney (Australia)
- Director of the Genetic Ancestry Lab (University of Canberra / University of Technology Sydney) which has provided inference of biogeographical ancestry (BGA) and externally visible characteristics (EVCs) derived from DNA for law enforcement in Australia
- Seconded to the Australian Federal Police National DNA Program for Unidentified and Missing Persons (2021-2023) which uses BGA inference, phenotyping and forensic investigative genetic genealogy (FIGG) techniques

Probabilistic genotyping (PG)

- As far as I'm aware, there are no interlaboratory comparisons of PG results amongst forensic laboratories in Australia
- At least one laboratory has participated in the Forensic Assurance "Forensic biology with probabilistic genotyping software" proficiency test[1] but the results were not made publicly available
- Arguments against interlaboratory comparisons have been made, based on "human factors, laboratory policy, and elements outside the province of the software"[2] and "conflating too many variables"[3]

[1] Forensic Assurance (2022) Forensic biology with probabilistic genotyping software, https://forensicassurance.com/product/probabilistic-genotyping-software-dna-mixture-analysis-sample-set/

[2] Gill *et al* (2021) A review of probabilistic genotyping systems: EuroForMix, DNAStatistX and STRmix™, Genes, https://doi.org/10.3390/genes12101559

[3] Buckleton et al (2019) Response to: Commentary on: Bright et al. (2018) Internal validation of STRmixTM – a multi laboratory response to PCAST, Forensic Science International: Genetics, 34: 11–24, https://doi.org/10.1016/j.fsigen.2019.102198

Probabilistic genotyping (PG)

- There is a means by which PG results can be compared amongst laboratories that accounts for interlaboratory differences by applying PG to a dilution series of a DNA mixture to determine where the LR plateaus[4,5]
- The mixture consists of a combination of equal volume and equal concentration aliquots of pristine, high abundance DNA
- Only include loci in common when calculating the LR
- Use the same population allele frequencies and sub-population correction (θ)

[4] McNevin et al (2019) Commentary on: Bright et al.(2018) Internal validation of STRmix™–a multi laboratory response to PCAST, Forensic Science International: Genetics, 34: 11–24, https://doi.org/10.1016/j.fsigen.2019.03.016

[5] McNevin et al (2021) Proposed framework for comparison of continuous probabilistic genotyping systems amongst different laboratories, Forensic Sciences 1 (1), 33-45, https://doi.org/10.3390/forensicsci1010006

Forensic DNA phenotyping (FDP)

- Distinction between inference of externally visible characteristics (EVCs), which is FDP, and inference of biogeographical ancestry (BGA) which is not
- There is a legislative vacuum regarding FDP and BGA in Australia – they are not explicitly allowed or disallowed
- The Genetic Ancestry Lab provided a FDP and BGA service to law enforcement in Australia[6]
- The Australian Federal Police National DNA Program for Unidentified and Missing Persons employs FDP and BGA[7]

[6] McNevin (2020) Forensic inference of biogeographical ancestry from genotype: The Genetic Ancestry Lab, Wiley Interdisciplinary Reviews: Forensic Science 2 (2), e1356, https://doi.org/10.1002/wfs2.1356

[7] National DNA Program for Unidentified and Missing Persons, https://www.missingpersons.gov.au/support/national-dna-program-unidentified-and-missing-persons

Forensic DNA phenotyping (FDP)

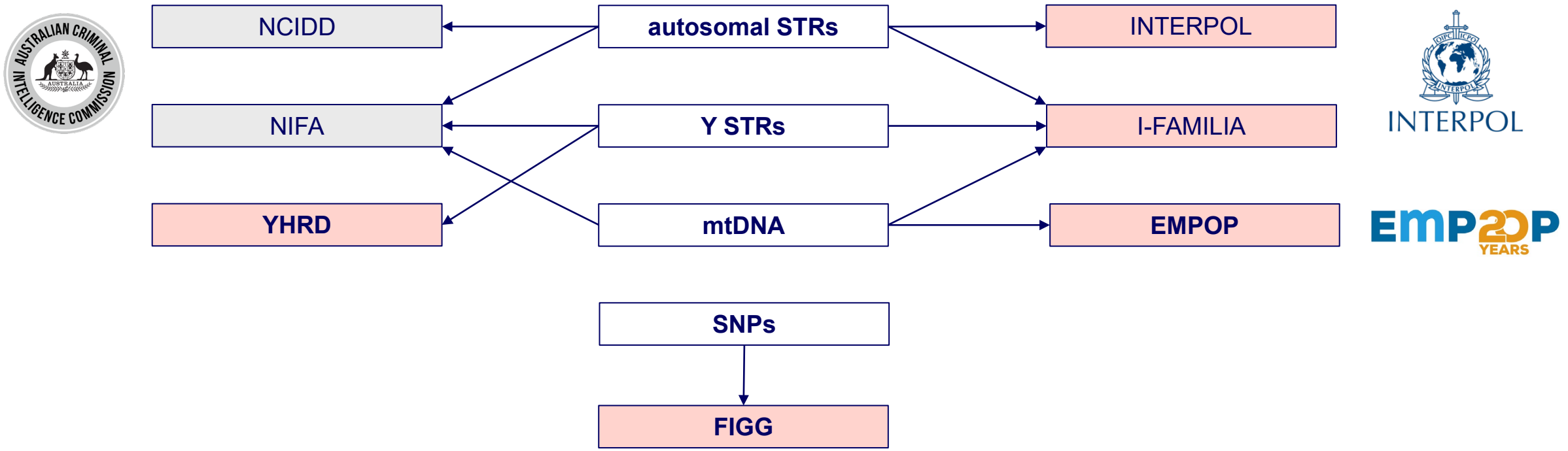
- BGAs are limited to major continental ancestral populations: African, European, South Asian, East Asian, Oceanian, American
- EVCs are limited to pigmentation traits (eye colour, hair colour)
- Privacy impact assessments (PIAs) are generally conducted before implementing FDP and BGA[8]
- FDP and BGA are only employed if short tandem repeat (STR) direct matching and partial matching (familial searching) fail to confirm an identity
- In my opinion, FDP and BGA should be retained in house for investigative purposes and not released to the public in the form of a photofit

[8] Scudder et al (2018) Forensic DNA phenotyping: Developing a model privacy impact assessment, Forensic Science International: Genetics 34, 222-230, https://doi.org/10.1016/j.fsigen.2018.03.005

Forensic investigative genetic genealogy (FIGG)

- There is a legislative vacuum regarding FIGG in Australia – it is not explicitly allowed or disallowed
- Emphasis is on privacy legislation, in particular the Australian Privacy Principles outlined in the Commonwealth Privacy Act 1988
- Privacy impact assessments (PIAs) are generally conducted before implementing FIGG

Forensic investigative genetic genealogy (FIGG)



Forensic investigative genetic genealogy (FIGG)

+ Family participation
+ DNA testing information
+ Forensic Investigative Genetic Genealogy information
+ Frequently asked questions
+ Fact sheets
+ Partnerships
+ Media
+ Contact

https://www.missingpersons.gov.au/support/national-dna-program-unidentified-and-missing-persons

Key points

- There are opportunities for interlaboratory comparisons of PG results within Australia and elsewhere
- BGA is not a phenotype and should not be described as FDP
- FDP and BGA inference provide useful investigative leads but any public descriptions should be very carefully considered
- Because of the legislative vacuum in Australia regarding FDP, BGA inference and FIGG, governance tends to default to privacy legislation
- Use of PIAs is encouraged
- Sequential unmasking of genetic information is a useful guiding principle
- Public education is important