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A Law Enforcement Intelligence Framework for use in Predictive DNA Phenotyping

Nathan Scudder a,c *, James Robertson a, Sally F. Kelty b, Simon J. Walsh c, Dennis McNevin a,d
a National Centre for Forensic Studies, Faculty of Science and Technology, University of Canberra
b Centre for Applied Psychology, Faculty of Health, University of Canberra
c Australian Federal Police
d Centre for Forensic Science, University of Technology Sydney

Abstract. Analysis of information about physical characteristics, biogeographical ancestry or common genetic ancestors from crime scene DNA is a technique aimed at informing an intelligence process, rather than obtaining evidence for a criminal trial. This intelligence supports tactical or operational decision-making. Like other forms of intelligence there is a risk for it to be misconstrued or for its investigative value to be misunderstood. The potential for intelligence derived from DNA to divert investigative resources or result in unnecessary intrusions into individual privacy can be mitigated by applying an appropriate intelligence doctrine. Establishing an appropriate framework could reduce the need for government regulation of these emerging capabilities in the context of law enforcement use.

Keywords: forensic DNA phenotyping, forensic genetic genealogy, forensic intelligence, intelligence doctrine

1. Introduction

Forensic DNA capabilities have now progressed to a point where it is possible to exploit a sample from a crime scene to provide information to input to the intelligence process. Such leads include predicting the physical characteristics of a donor, the donor’s biogeographical ancestry or, by overlaying genealogy records, identifying common genetic ancestors. Such an approach, termed forensic DNA phenotyping or forensic genetic genealogy, is intended to provide information as part of a broader forensic and criminal intelligence assessment, with any DNA-based leads later verified by comparing an identified suspect’s DNA with the crime scene sample through STR-based DNA analysis. In this way, such a lead could be viewed as more reliable than eyewitness evidence, where erroneous identifications have sometimes proceeded all the way to the witness box.[1]

This, however, ignores the fact that convictions have occurred despite exculpatory DNA evidence.[2] Flawed intelligence, more generally, can result in other investigative leads going cold due to the potential pivot effect on an investigation as a whole and misdirection of investigative resources. Intelligence can also influence community suspicions about likely suspects and form the basis of judicial decisions to warrant further searches or undertake more intrusive inquiries.[3]

Forensic DNA phenotyping and forensic genetic genealogy can be used to exclude as well as implicate. Even an exclusion must be approached with caution, however, given the complexities of gene expression and ancestry profile interpretation.[4] The latter is heavily influenced by the availability of representative reference genotypes, the choice of genetic markers and the quality of prediction algorithms. Genealogy has the added limitation of data quality and, at times, a reliance on proprietary algorithms.

Intelligence can be defined as ‘the collection, processing, integration, evaluation, analysis and interpretation of available information concerning…areas of actual or potential operation’.[5] This definition underscores the intelligence cycle, and its application to forensic intelligence.[6] The intelligence cycle begins with developing an intelligence plan and a collection method, an approach that considers the purpose of the intelligence collection and the proposed sources of intelligence, including their inherent limitations. In the context of the proposed application of forensic DNA phenotyping and forensic genetic genealogy, this approach involves assessing how the predictive power of DNA can assist in answering an investigative question or contribute to a broader intelligence assessment.

2. Material & Methods

Once genetic information has been obtained from a crime scene sample, analysis and production, in the context of other forensic information, can inform a forensic intelligence product. At a conceptual level, this involves a process of moving from premise to inference and then applying words of estimative probability to assess the likelihood of those inferences.[7, 8]. Table 1 shows a simple example of applying this forensic DNA phenotyping to an item of clothing believed to have been dropped by a suspect.

<table>
<thead>
<tr>
<th>Premise: a witness saw the suspect wearing a red scarf.</th>
<th>Premise: DNA from an item of clothing probably came from the person who last wore that clothing.</th>
<th>Premise: a particular sequence is almost certainly associated with the donor having blue eyes.</th>
</tr>
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<tbody>
<tr>
<td>Premise: a red scarf was found a short distance from the crime scene.</td>
<td>Premise: DNA was found on the scarf.</td>
<td>Premise: DNA from the scarf contained that sequence.</td>
</tr>
<tr>
<td>Inference #1: it is probable the scarf was last worn by the suspect.</td>
<td>Inference #2: it is probable that the DNA from the scarf came from the person who last wore it.</td>
<td>Inference #3: it is almost certain the donor of the DNA obtained from the scarf has blue eyes.</td>
</tr>
</tbody>
</table>

Table 1: Illustrative example of moving from premise to inference, in an application of forensic DNA phenotyping
3. Results

Flawed intelligence can occur if an analyst or investigator adopts the third inference (in Table 1) as an investigative lead: it is almost certain that the suspect has blue eyes, without considering the posterior odds of the first two inferences, which must lower our confidence in this statement. If, for the purposes of illustrating this point, we quantify these statements of estimative certainty using a model first published by former CIA officer, Sherman Kent, this statement would more accurately be reflected as: it is between 35 and 75 per cent likely that the suspect has blue eyes.[8]

Law enforcement has established processes for dealing with uncertainties associated with intelligence, particularly where investigative leads come from anonymous tip-offs or other potentially unreliable sources. However, particularly in a scientific context, it can be argued that investigators are dependent on analysts providing the necessary context to enable an informed decision about the intelligence value. The use of DNA for intelligence purposes should follow a process of verification or triangulation. That is, overlaying different intelligence – ideally from multiple intelligence sources – to deliver a more reliable overall intelligence product. The investigative value of the intelligence product may increase in the above case if, for example, a human source had separately identified a possible suspect who was known to frequently wear a red scarf.

3.1 Regulatory considerations

Can the use of an intelligence framework mitigate the risks of misuse of DNA as an intelligence source, and the potential for it to lead to intrusions into personal privacy? Australian forensic procedures legislation does not provide any form of comprehensive regulation of forensic DNA phenotyping or forensic genetic genealogy.[9, 10]

A new regulatory regime could govern the use of such information for intelligence and investigative purposes. While such a regime could set broad parameters, legislation is arguably an extremely poor lever for managing law enforcement use of technology. Any prescriptive legislation regulating the use of these capabilities could quickly become outdated as new DNA and data matching capabilities are developed. Lessons could also be drawn from other sources of intelligence and evidence: for example, the Telecommunications (Interception and Access) Act 1979 governing law enforcement access to telecommunications metadata and content in Australia. Use of a best-practice intelligence framework would provide a more agile structure to ensure predictive DNA capabilities are applied consistently with governance around the broader police use of criminal intelligence. Ensuring forensic DNA phenotyping and forensic genetic genealogy serve as an intelligence source within a broader forensic intelligence model, and an integrated intelligence assessment, will help avoid many of these risks and sensitivities while still delivering operational benefits.

4. Conclusion

Forensic DNA phenotyping and forensic genetic genealogy are valid inputs into the intelligence process and can utilize the same intelligence cycle as other sources of forensic intelligence. These capabilities would therefore benefit from being incorporated into the same intelligence framework for collection, analysis and use. This includes guidelines as to the appropriate reporting of DNA intelligence to investigators. Cautious and careful use of this DNA intelligence may reduce calls for legislation to codify the circumstances under which this technique may be used for crime scene samples.

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7. Conflict of interest

Conflict of interest: none.

8. References


* Corresponding author: Nathan.Scudder@canberra.edu.au