Contemporary overview: the maturity of forensic DNA phenotyping

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Abstract

The rapid developments of sciences and technologies, during the 19-20 centuries, germinate the new branch of scientific discipline - merging the applications ofvarious branches of sciences, mainly biology,with the legal applications -called forensic science. The emergence of forensic sciencehas the revolutionary impacts on the criminal justice systemas the system, itself, has torebalance the equation due to the new strong player comes into play. At present, the DNA technology, in particular DNA fingerprinting, is no longer a scientific jargon for the criminal justice system. Instead, the usage of DNA fingerprint technology becomes a general norm for criminal investigation due to its high, possibly highest so far, power of discrimination which allows the method of criminal suspect deduction becomes at ease. As time goes by, the DNA fingerprinting technology seems to become bygone and soon to be substituted or, at best, co-existed by more advance DNA technology. Forensic DNA phenotyping, the DNA technology that is able to create the human facial reconstruction from DNA materials retrieved from the crime scenes, could be the future fashion in forensic culture. At current stage, the forensic DNA phenotyping technology, however, does not reach the maturity of its development yet. Although forensic DNA phenotyping does have better merits, its accuracy is still unparallel to perfection.

Key words: Forensic DNA phenotyping, DNA fingerprinting, Facial reconstruction

Summary

Using the natural components (e.g. protein) and characteristics of deoxyribonucleic acid (DNA), the scientific technique of DNA coding becomes possible and yields the consistent results. Since the sequences of DNA are unique in each individual, exception for the identical twin, the use of DNA coding opens the new page to forensic investigation for person identification. In the forensic work, DNA fingerprintingis "a laboratory technique used to establish a link between biological evidence and a suspect in a criminal investigation" (GeneEd, n.d., para 1). Because the DNA fingerprinting in forensic work played an important role in the legal application, many authorities raised concerns about its possibility of abuses and demanded to have the standard protocol for DNA fingerprinting usages in the terms of its reliability, validity, and confidentiality (National research council, et al., 1992). As time goes by, the criminal justice system adapts itself to be more familiar with the contemporary forensic applications.

Change never stops. With dedication and laborious works, scientists and researchers usually insert more new inventions into the human society where the curiosity and urge for new excitement seem to have no end. In the forensic field, researchers look at the DNA fingerprinting technology as a challenge and have an impulse to find something compatible and/or, perhaps, even more advance. Recently, forensic DNA phenotyping technology is at the developing period and later, if possible, become a better substitution for DNA fingerprinting. Forensic DNA phenotyping, defined by Kayser (2015: 33), "refers to the prediction of appearance traits of unknow sample donors, or unknown deceased (missing) persons directly from biological materials found at the scene." Put simple, forensic DNA phenotyping can predict the human appearance from forensic samples.

According to Kayser (2015), the distinctive advantages of forensic DNA phenotyping are substantial.First, it can be used when the police investigation has no known suspect.There is no need to match the DNA of the suspect against DNA from the crime scene. Second, the potential applications of forensic DNA phenotyping go beyond the courtrooms. It could be, for example, beneficial for anthropology researches and studies (Walsh, Chaitanya, Clarisse, Wirken, Draus-Barini, Kovatsi, et al., 2014). The Kayser's research (2015) confirmed that the forensic DNA phenotyping can predict the human pigmentation with high accuracy.

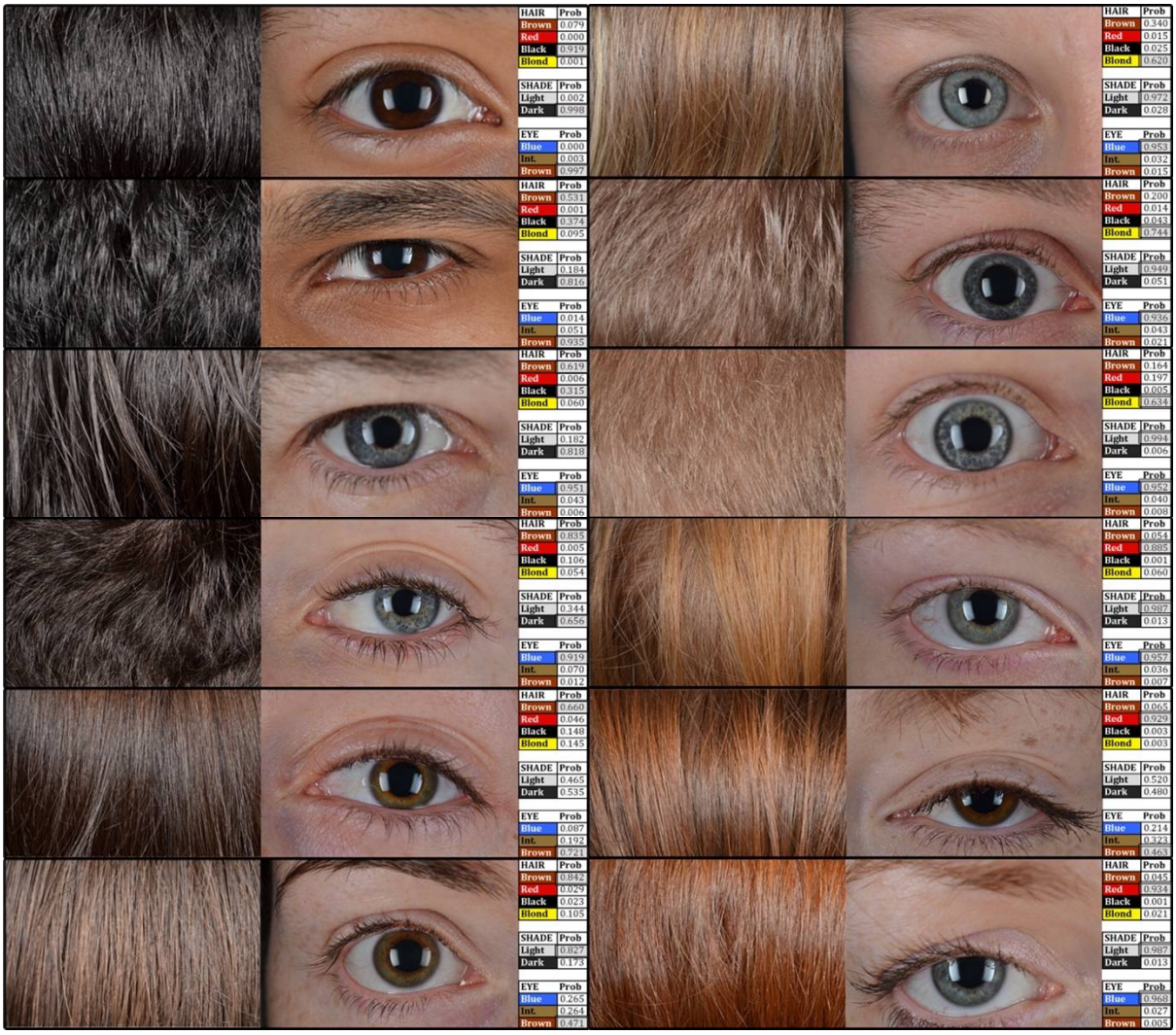

Figure 1. Individual examples of HIrisPlex-based eye and hair color DNA prediction. Probability outcomes are provided for eye and hair color categories as obtained from complete HIrisPlex SNP profiles (Walsh, Chaitanya, Clarisse, Wirken, Barini, Kovatsi, et al., 2013)using the enhanced IrisPlex eye color and the enhance HIrisPlex hair color prediction models (Walsh, Chaitanya, Clarisse, Wirken, Barini, Kovatsi, et al., 2014) for 12 individuals chosen with varying eye and hair colors. Eye and hair photographs are provided to allow visual phenotype inspection and comparison with DNA predicted conclusions. Those probabilities that led to the eye and hair color conclusions are highlighted in grey based on the highest probability rule for eye color and by using the HIrisiPlex hair color prediction guide described elsewhere (cited in Kayser, 2015, 40).

Besides the prediction of human pigmentation which yielded high accuracy, the other forms of human appearance prediction from DNA have rather low credibility.The study of Van Laan (2017) pinpointed an insightful fact about the forensic DNA phenotyping that it could be at the pinnacle for the prediction of externally visible characteristics (EVCs) but it is still far from being peerless. MacLean (2013)'s research illustrated that the prediction

accuracy rates for commonly tested EVCs for gender was 100 percent; race and skin coloring for Caucasian was 90 percent, Asian 88 percent, and African 71 percent; Iris color (brown and blue) was 76 – 99 percent; hair color (blonde, brown, and red) was 90 percent; and adult height was 65 percent. Additionally, the study of Zbiec-Piekarska, et. Al. (2015) employed the forensic DNA phenotyping for the age prediction (within five years using methylations status approach) and the results put the figure of 86.7 percent for the accuracy rate for age group 2 – 19 years and of 50 percent for the age group 60 – 75.

Although forensic DNA phenotyping holds great promising, there are still a plenty of empty spaces to be fulfilled. In the opinion of Van Laan (2017), the use of DNA fingerprinting might remain due to its convenience, high credibility, and gradually lowering cost. However, it has to bear in mind that the forensic evidence does not, and could not, provide all the answers for the criminal justice system.

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