Forensic DNA Phenotyping: Improving the Prediction of Eye, Hair, and Skin Color through Quantitative Measurement

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Without a match in the DNA database or a reference profile, current methods in forensic DNA profiling fail to give any leads to further criminal investigations. Forensic DNA Phenotyping bridges that gap in the investigation by providing 'intelligence' through the identification of externally visible characteristics of the unknown individual from their biological sample left at the crime scene. Recent work on eye and hair color prediction using a tool called 'HIrisPlex' has allowed accurate predictions of blue or brown eye color with a precision greater than 95%, and of hair color with a precision of approximately 75% for blond, brown, black and red categories. DNA phenotyping is a new and exciting area of DNA profiling, however there are areas that still require improvement. These include the prediction of intermediate eye colors such as green, or the mechanisms and/or genes involved in age-dependent hair color changes. At this time, categorical skin color prediction is still being developed and will soon be included in the HIrisPlex system, however it is not until the day that pigmentation measurements move toward a quantitative color scale that accuracy will be at a maximum. Our research hopes to target this area specifically. While the predication of categorical measurements is helpful, the term "light brown" is subjective and leads to the possibility of error in interpretation. In order to circumvent this interpretation issue, understanding quantitative color prediction is key. To achieve this, we are in the midst of a database collection of approximately 5000 individuals in which we will perform genome-wide association studies (GWAS) to locate additional eye, hair and skin color genes associated with a quantitative pigment scale phenotype. This database will help create a world-wide representative statistical panel from which quantitative predictive measures can be ascertained. Furthermore, in conjunction with computer programming techniques, it will allow the creation of a user-friendly software program that will enable the prediction of pigmentation-related externally visible characteristics such as eye, hair and skin color. This software has the capacity to be a revolutionary intelligence tool to aid law enforcement investigations by producing a color-print out biological mugshot.