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Forensic Science (Biology Concentration)

The Use of Color Contrast to Detect Biological Sex Differences in a Small Population of Fingerprints.

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My SURF project this summer was a complicated, yet important study. My study was a blind, affirmation study to prove the overall theory that color contrast is sensitive enough to develop an equation to identify the amount of time a fingerprint has been deposited at a crime scene. My study was an affirmation study because my mentor, Professor Fossoul, did this same study on his own fingerprints. My project was conducted on fingerprints from 10 different individuals (five males and five females). This was key because we wanted to see if this process could still produce the same results on a larger scale. The hypothesis that I tested this summer was that; color contrast is sensitive enough to reveal quantitative differences in male and female fingerprint images when exposed to different experimental variables such as substrate and powder developer. This hypothesis was never revised throughout my whole study. My methodologies were mostly on my laptop using photoshop, image J, and Microsoft excel. I started with a small population of ten donors (five males and five females) deposited three fingerprints (index, middle, and ring fingers) of the non-dominant hand under eight different experimental conditions as shown:

	Fingerprint type							
Condition 1	**Latent**				**Patent (inked prints)**			
Condition 2	**Black Powder**		**White Powder**		**Flat**		**Rolled**	
Condition 3	**Tile**	**Glass**	**Tile**	**Glass**	**Gen 1***	**Gen 2****	**Gen 1***	**Gen 2****
# of prints	30 (x3)	30 (x3)	30 (x3)	30 (x3)	30 (x3)	30 (x3)	30 (x3)	30 (x3)

*Generation 1: finger was inked and printed on paper substrate

**Generation 2: finger was not inked again and was re-printed on paper substrate

Before the collection of any quantitate color data, every image was standardized to a “standard white” color. A total of 720 fingerprint images (240 per 3 trial runs) were edited using imaging software. The portion of the image selected to represent the “standard white” was the white portion of the 1 cm scale placed above the deposited fingerprint. The (grayscale) color contrast scale consists of a range of color values between 0-255 as depicted in a histogram. On this scale, a value of 0 represents pure black pixels and the number 255 pure white pixels. Then, the target

"standard white" for all images was arbitrarily set to 205 since most of the images' "standard whites", prior to any editing, were closest to this number. The image was re-sized to 1:1 scale and cropped to a 1cm X 1cm. To assure data accuracy across the eight different images of a single finger, each representing a different experimental condition, the area selected for each image was identical. The data collected included variables such as the mean value of the color pixels, amplitude (range) of color pixels, and the visual quality rated subjectively by the examiner. The fingerprints were visually rated on a scale from 0-4 as follows:

Quality Grading	Description of Grading
0	No print present
1	Print present but no visual indication that it is a fingerprint
2	General classification pattern present but no clear minutiae can be identified
3	Minutiae can be identified – suitable for identification
4	Very clear ridge edges, high contrast with background – suitable for identification

Statistical analysis included testing the repeatability throughout the three trial runs, detecting any differences between male and female donors and between the different experimental conditions.

My results were successful in my study. They showed the same results that my professor's previous study also produced. Preliminary results show no differences in the mean color values and amplitude (range of colors) between male and female fingerprints of the same experimental conditions. The data throughout the three trial runs have shown to be consistent and confirmed the robustness of the technique. Differences in the mean and amplitude between Generation 1 and Generation 2 of inked fingerprints for flat and rolled depositions have also been detected. Latent fingerprints visualized with black powder appear to mirror those developed with white powder on opposite sides of the grayscale color histogram. My plans for the future are to now submit an abstract to the American Academy of Forensic Science to present a poster in February at the national convention in California.

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