Supplemental Appendix III

As described earlier, the appropriate mated sample is that which results in a distribution of similarity statistic values which is similar to the distribution of similarity statistic values observed in actual casework or biased towards lower similarity statistic values thus ensuring that the empirical distributions represent the full range of plausible similarity statistic values that could reasonably be observed in casework when impressions are subject to various distortions during deposition. This supplemental appendix provides greater detail regarding the determination.

A casework dataset of 605 latent and reference impressions were collected from casework during the course of routine operations by fingerprint experts in a federal crime laboratory in the United States and reported as "positive associations". The impressions were collected from a wide variety of cases, substrates, and assigned fingerprint experts. The corresponding features (ranging between 7 and 15) were manually annotated by the assigned fingerprint expert during the initial case examination. The selected features were then annotated in the proper format at a later time by the same fingerprint expert for purposes of this evaluation. The distribution of similarity statistic values from this casework sample were compared to the empirical distribution of similarity statistic values described earlier from mated sources in which extreme distortions were deliberately produced during deposition on a livescan device. To ensure the casework sample had sufficient similarity statistic values for each quantity of features to compare against the mated sample, the distribution of similarity statistic values was calculated by randomly selecting one combination of *n* features out of *m* available. Figure SAIII-1a illustrates a comparison of the cumulative frequency distributions of similarity statistic values between both samples for each quantity of features. Figure SAIII-1b illustrates the P-P plots of the two empirical cumulative frequency distributions for each quantity of features. Figure SAIII-1c illustrates a comparison of the two empirical density distributions for each quantity of features.

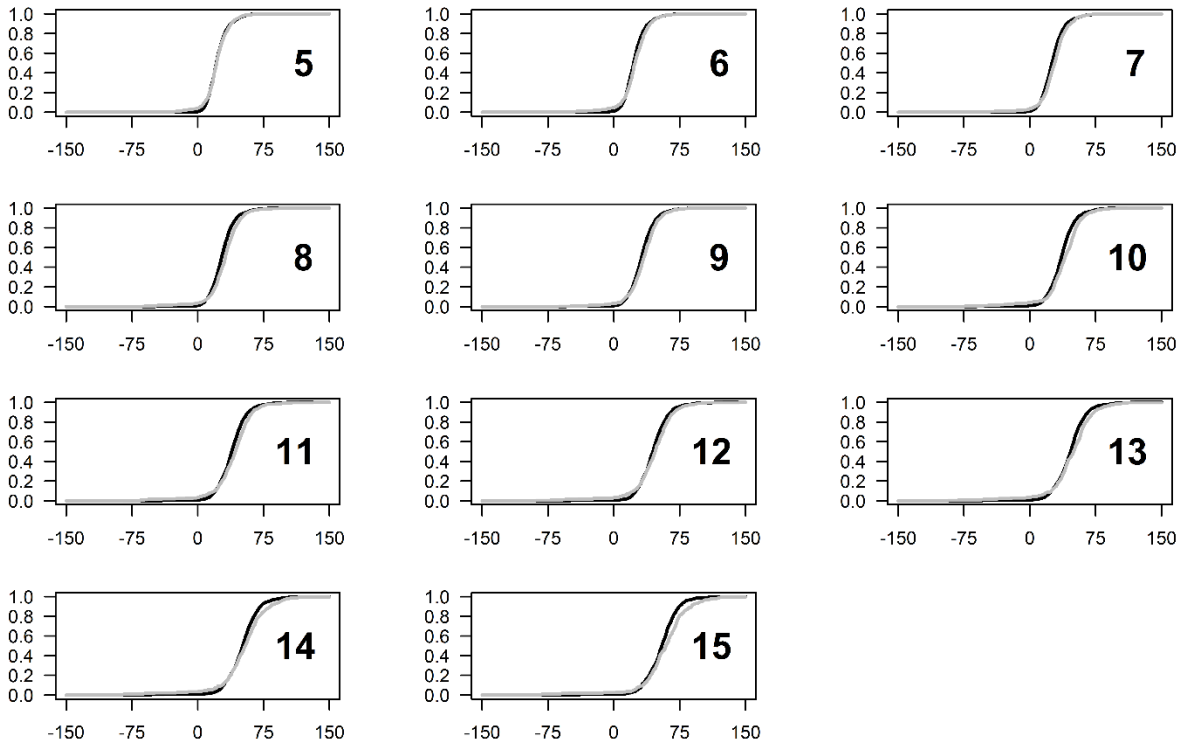

Figure SAIII-1a. Empirical cumulative frequency distributions of the similarity statistic values from the casework sample (believed to be mated) and the mated sample (manually distorted – known to be mated) for each quantity of features (ranging from 5 to 15). The grey line represents results from the casework sample. The black line represents results from the mated sample. The X-axis represents the global similarity statistic values.

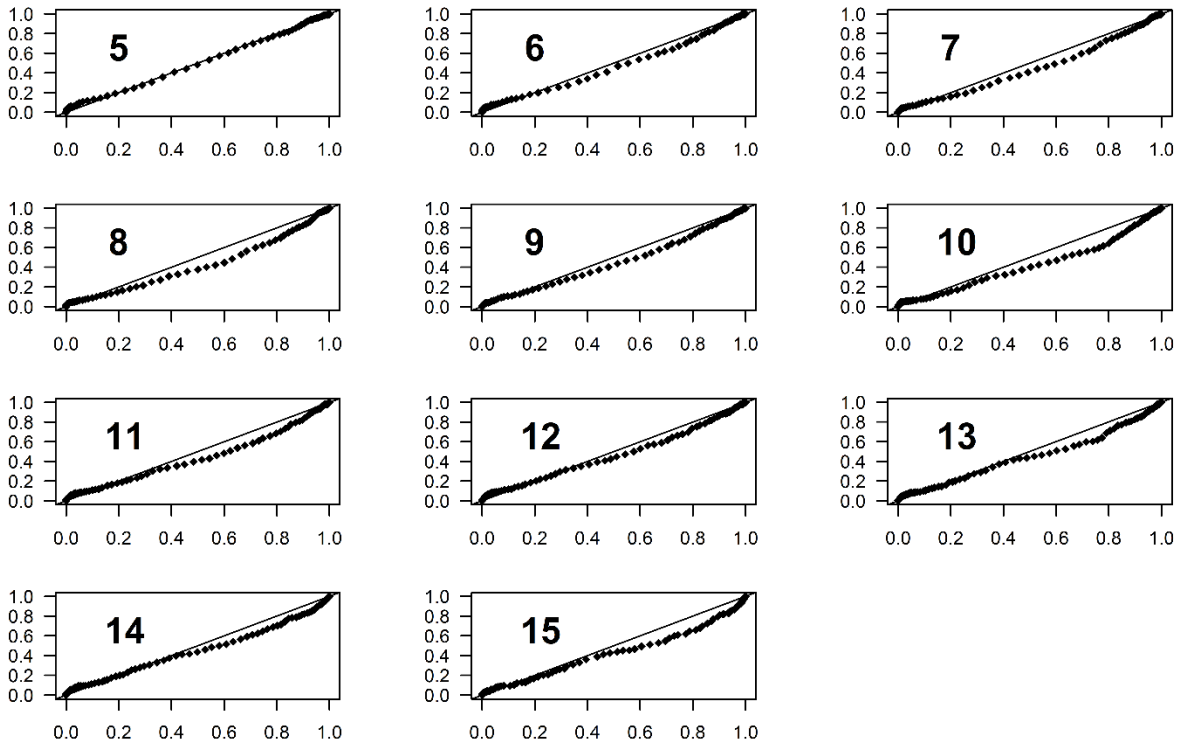

Figure SAIII-1b. P-P plots of the empirical cumulative frequency distributions of the similarity statistic values from the casework sample (believed to be mated) (vertical axis) and the empirical cumulative frequency distributions of the similarity statistic values from the mated sample (manually distorted – known to be mated) (horizontal axis) for each quantity of features (ranging from 5 to 15). The black dots represent the P-P plot. The grey line represents a slope of 1 (perfect correspondence).

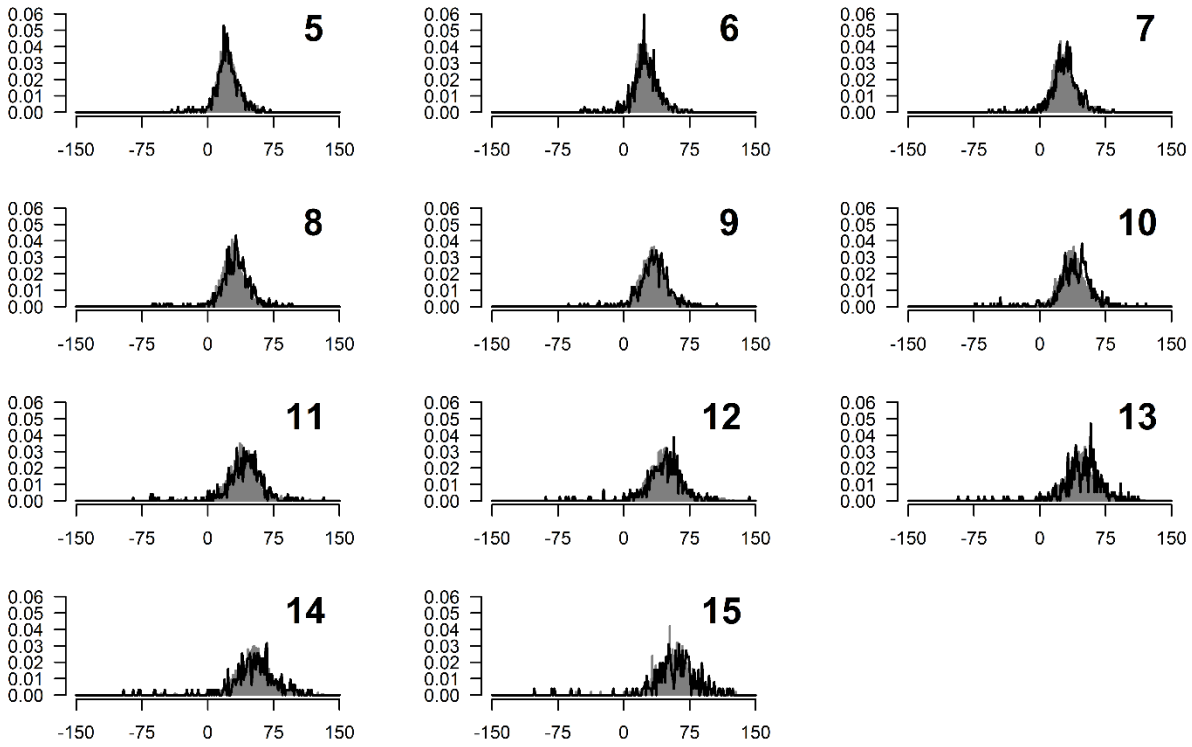

Figure SAIII-1c. Empirical density distributions of the similarity statistic values from the casework sample (believed to be mated) and the mated sample (manually distorted – known to be mated) for each quantity of features (ranging from 5 to 15). The black line represents the results from the casework sample. The grey histogram represents the results from the mated sample. The X-axis represents the global similarity statistic values.

A two sample Kolmogorov-Smirnov (K-S) test was performed comparing the two distributions for each quantity of features. Table SAIII-1 provides the K-S test statistics as well as the resulting *p*-value under the null hypothesis that the two samples originated from the same distribution.

Feature Quantity	***n* sample 1** (casework)	***n* sample 2** (manually distorted)	**K-S test statistic**	***p (null)***
5	605	1,996	0.046	$p > 0.05$
6	605	1,996	0.083	$p < 0.01$
7	605	1,996	0.112	$p < 0.01$
8	601	1,996	0.155	$p < 0.01$
9	585	1,996	0.101	$p < 0.01$
10	549	1,996	0.167	$p < 0.01$
11	499	1,996	0.124	$p < 0.01$
12	438	1,996	0.092	$p < 0.01$
13	382	1,996	0.139	$p < 0.01$
14	316	1,996	0.104	$p < 0.01$
15	258	499	0.153	$p < 0.01$

Table SAIII-1. Summary of the Kolmogorov-Smirnov test results between the empirical cumulative frequency distributions of the similarity statistic values from the casework sample (believed to be mated) and the mated sample (manually distorted – known to be mated) for each quantity of features (ranging from 5 to 15). Statistical significance is based on a p-value decision threshold of 0.01.

From the K-S test, the null hypothesis is rejected for each quantity of features except 5. Although the null hypothesis is largely rejected by the K-S test, the distributions are not substantially different from one another in terms of appearance. More importantly, however, the means of the similarity statistic values from the mated samples (manually distorted – known to be mated) are consistently lower, to a marginal degree, than the casework samples (believed to be mated) thereby satisfying the criteria set forth above. Based on these data, the mated sample (manually distorted – known to be mated) is proposed as a plausible mated source distribution.