B61 Using Likelihood Ratios for Source Attribution of Glock® Model 21 Fired Cartridge Cases

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After attending this presentation, attendees will understand how likelihood ratios are used to interpret impression evidence of pistol cartridge cases.

This presentation will impact the forensic science community by guiding future researchers and firearm examiners to analyze firearm data from the Integrated Ballistic Identification System® (IBIS) (Ultra Electronics Forensic Technology© (UEFT). Using statistical analysis, the examiner will be able to infer source determinations in a more logical manner.

The purpose of this study was to determine the effectiveness of using likelihood ratios to evaluate the accuracy of source attribution using IBIS® scores. This was achieved by evaluating the error rates of the method when using Bayesian networks to assess the correctness of the attribution using the IBIS® scores for the firing pin and breech face comparisons.

Firearm examiners are prone to criticisms due to the purported lack of consistency when making source determinations.[1] For example, examiners with different educational backgrounds and experiences may draw different conclusions from the examination of the same samples. In particular, vague terminology may contribute to incorrect conclusions of same source attributions. To decrease potential error of terminological inconsistencies, standards should be implemented and universally utilized by firearm examiners.[2] Additionally, erroneous source determinations may be decreased by eliminating unnecessary, outside information pertaining to the case.[3]

Researchers commonly use pristine, consecutively manufactured firearms (or parts thereof) to evaluate methodologies. Although this approach reduces variability, pristine conditions may also diminish the generalization of results to real-world conditions.[4]

This research hypothesized that this method will: (1) provide a statistical basis for the interpretation of firearms evidence; and, (2) increase reliability and validity of determining source attributions.

The IBIS® system was used in this research to provide scores of known cartridge cases against a database of both known and unknown cartridge cases. This system measures each case and generates breech face and firing pin scores based on the comparison of a pair of cartridge cases. IBIS® consists of two fully automated comparison systems known as BULLETPROOF®, which compares projectiles, and BRASSCATCHER®, which compares cartridge cases.[5]

This research used a quantitative correlational study design to examine impression evidence on cartridge cases fired by various Glock™ pistols. Twelve Glock™ .45ACP firearms were used for this study. Each gun fired 30 cartridges (reloads: Magtech® Ammunition large pistol primers and Accurate® #2 powder). The firearms were from a local law enforcement agency. Although the firearms are used, the exact number of shots fired through each is unknown.

The firearms were fired at an outdoor shooting range and all cartridge cases were collected from each test fire. The casings were then entered into IBIS® using standard protocols and the candidate matches were organized into Microsoft® Excel®. RStudio® and R® were used to process the data and Netica™ was used to generate a Bayesian network. The Bayesian networks contain the conditional probability tables and density distributions required to interpret new data. Such networks intrinsically incorporate likelihood ratios in the odds form of Bayes' Theorem.

The firing pin score, firing pin rank, breech face score, and breech face rank generated by the IBIS® system were used together with the model, caliber, and firearm identifier of the sample and database firearms to build the network.

References:

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Firing Pin, IBIS®, Glock® Pistol