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Evaluation of the Occurrence and Associative Value of NonIdentifiable Fingermarks on Unfired Ammunition in Handguns for Evidence Supporting Proof of Criminal Possession, Use and Intent

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Table of Contents

A. Project Summary

Major Goals, Objectives, Research Questions and Applicability

The overall goal of this project was to answer the question of how often non-identifiable fingermarks occur on naturally loaded handgun ammunition and what range of associative values can be expected. This is a potential new source of evidence, as current forensic science practices set these fingermarks aside, leaving them unexamined. The project was successful, with highly significant findings showing that non-identifiable fingermarks with strong associative value are found frequently on loaded handgun ammunition. Utilization of this new source of evidence will require adjustment of long-standing forensic examination practices and balancing the level of effort required with the utility of the resulting associations. To do this one important follow-on step is replacing the labor-intensive research laboratory methods applied in this project with more efficient technologies available in forensic laboratories.

Context for this Research

Among the most serious and pervasive criminal offenses in our society are the possession of handguns by convicted felons and their use in the commission of crime. Evidence of who loaded a recovered handgun is important for the proof of criminal possession, use, or intent.

Laboratory methods, including the analysis of loaded ammunition for fingerprints and DNA, can provide this evidence. However, both methods have limitations. DNA analyses are time consuming, costly and often confounded by mixtures or degradation. Likewise, identifiable fingerprints are very rarely found on the small slippery surfaces of ammunition. Non-identifiable finger marks (NIFMs) offer an intriguing possibility to address these limitations.

Prior research [1,2] has found that NIFMs occur frequently on evidence and at crime scenes and that most have high associative value. This suggests that NIFMs on handgun ammunition could provide important evidence. However, it was unknown how often, and with what level of associative value, NIFMs occur on loaded handgun ammunition. Small, highly curved metal surfaces and rapid handling decrease the likelihood that useful prints will be left. Does sufficient fingerprint detail for high associative value commonly remain on loaded ammunition? Does this vary by caliber and handgun type?

The answers are important. If NIFMs of high associative value occur commonly on loaded ammunition, this could be a major additional source of evidence. Current practices could be routinely setting aside associative evidence that is directly relevant to the investigation and prosecution of violent crime. Alternatively, the added information could be very limited or rarely occurring, failing to justify additional laboratory, investigative or prosecutorial attention.

Project Description

In this project ammunition from naturally loaded handguns has been recovered and processed for latent fingerprints. The occurrence of identifiable fingerprints and NIFMs have been documented, and the expected associative values of NIFMs were determined based on a well-defined, currently available, calibrated approach. Frequencies were measured for the overall recovery of NIFMs, and their distribution of expected associative values, for revolvers and semi-automatic pistols covering a range of common calibers.

The results of this project have answered the question of how often NIFMs occur on naturally loaded ammunition and what associative value can be expected. These findings allow an informed assessment of the potential utility of the approach and help set priority for development and validation of methods to exploit the use of NIFMs on ammunition. The NIFM dataset that has been developed is a lasting resource available for further examination as measurement and interpretive methods are refined.

Research Design, Methods, Analytical and Data Analysis Techniques

The research design addressed four specific project objectives:

- Collection of unfired ammunition from a reasonably representative set of handguns
- Laboratory processing of the rounds of ammunition, recovering those fingermarks having four or more fingerprint ridge characteristics (minutiae)
- Measuring the expected associative values (selectivity) for these fingermarks
- Categorizing and analyzing the rates of occurrence and associative value of NIFMs by handgun type (semi-automatic vs revolver) and size of ammunition (caliber classes)

The differences in available surface area and curvature among different calibers of ammunition are known to affect the recovery of latent prints. To achieve a reasonably representative set of ammunition, collections were made from loaded semi-automatic and revolver handguns covering a range of caliber classes from .22 through .45. Ammunition was collected directly from firearms that were loaded previously by their owners, without any specific guidance or requirements for preparation of ammunition, washing of hands, or loading technique.

Fingermarks were visualized on ammunition using two well-established methods cyanoacrylate fuming (CA, superglue), followed by fluorescent dye staining (using the dye BY-40). Candidate NIFMs were photographed. These candidates were marks showing friction ridge detail with the potential for 4 or more ridge characteristics (minutiae) in a clear relationship to one another. Photography of the cylindrical ammunition surfaces required multiple exposures around the circumference (up to 15 for the complete cartridge surface).[3] These individual images were cropped and stitched together (analogous to panoramic photography) as illustrated in Figure 1.

Images of candidate NIFMs were examined by a highly experienced certified latent print examiner and accepted where 4 or more minutiae were present and in a clear relationship to one another in the context of the ridge flow. Minutiae were documented by annotation of the images, as shown in Figure 2. Fingermarks were also graded as either Of Value for Identification (meeting traditional requirements for a fingerprint identification) or No Value (a non-identifiable fingermark, NIFM).

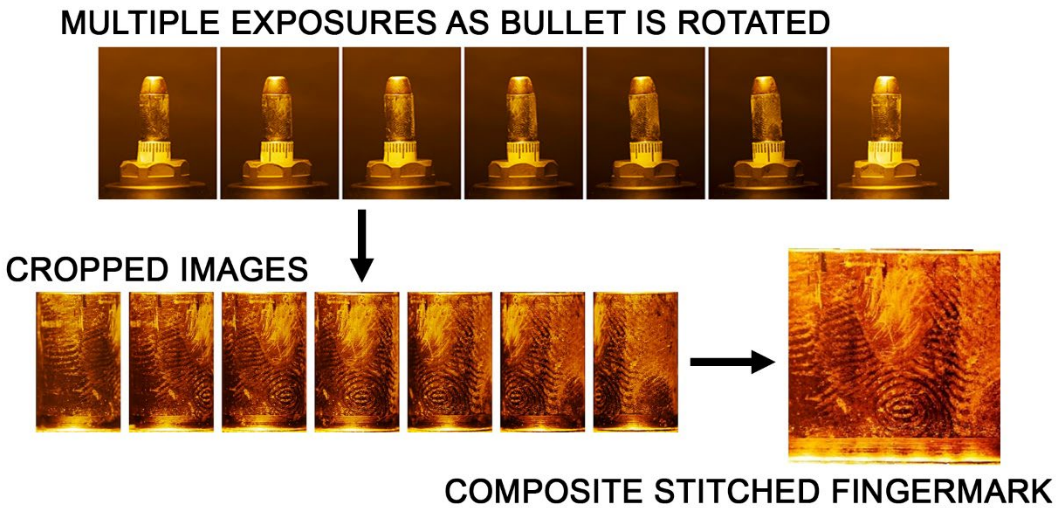


Figure 1. Illustration of the steps to produce the image of a candidate NIFM. This fingermark was developed by cyanoacrylate fuming on a naturally loaded round of .32 ACP ammunition. The original photographs (top row) are taken in sequence, rotating the specimen 24 degrees between exposures. These images are cropped, resulting in those to the lower left, which are then stitched together using Photoshop's Photomerge™ function to produce the final NIFM image (lower right).

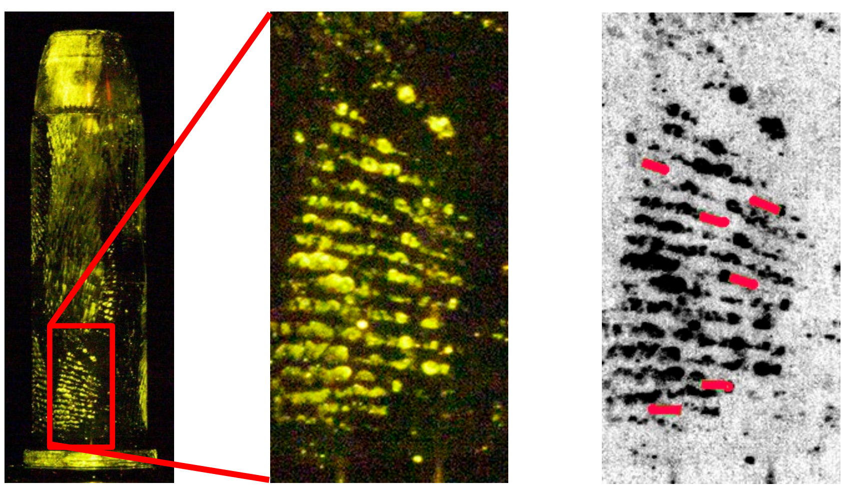


Figure 2. Round of ammunition (left) and candidate NIFM (center). To the right is the corresponding annotated (marked) NIFM after image processing to enhance contrast and expert analysis to determine the number and position of ridge of the minutiae (ridge characteristics). This NIFM showed 6 minutiae.

The associative values of the fingermarks were determined based on their numbers of annotated minutiae, using a well-established method [1] that compares random non-matching scores from a large fingerprint database with a range of scores obtained from the true source. The result is an “Expected Score-Based Likelihood Ratio” or ESLR, derived from the modeling of within-variability (true source) and between-variability (different sources) of scores resulting when an automated fingerprint identification system (AFIS) measures the similarity between two fingermarks. The ESLR provides a measure of strength of association. For example, an ESLR of 1000 shows the same strength of association as a feature that would occur randomly at a rate of one time in a thousand.

B. Participants and Other Collaborating Organizations

This project was awarded to Stoney Forensic, Inc., a small business incorporated in Virginia. Stoney Forensic is an R&D company focused on forensic science research, with specific expertise in fingerprint identification, applied statistical analysis in forensic science and the identification, analysis and interpretation of particulate trace evidence. Stoney Forensic has developed and applied specialized forensic and particle analysis processes to address problems that cannot be solved using traditional methods. Prior research completed for the National Institute of Justice has NIJ has resulted in 16 major peer-reviewed publications and more than 45 presentations at national and regional professional meetings.

ESLR measurements of associative value, developed with prior National Institute of Justice support, were conducted at the University of Lausanne (UNIL), Switzerland. The School of Criminal Justice at the UNIL has a longstanding international reputation of excellence for research and education in forensic science, criminology and criminal law.

Key personnel on this project were Dr. David Stoney, Dr. Christophe Champod, Marco De Donno, Pat Wertheim, Dr. Maria Cuellar and Paul Stoney. Dr. Stoney, Chief Scientist of Stoney Forensic, Inc., led the research effort as Principal Investigator with Dr. Christophe Champod, Professor of Forensic Science at the University of Lausanne (UNIL), Switzerland, as Co-

Investigator. Both have Ph.D. dissertations focused on the associative value of fingerprint ridge details. Marco De Donno has specific expertise using the UNIL research AFIS system for ESLR measurements. Dr. Maria Cuellar, Assistant Professor of Criminology; Statistics & Data Science; and Biostatistics at the University of Pennsylvania and member of the Center for Statistics and Applications in Forensic Evidence (CSAFE) oversaw the data analysis. Pat Wertheim, a certified latent print examiner with extensive domestic and international expertise, performed the latent fingermark examination, annotation and assessments of utility for identification. Paul Stoney managed the scientific program and provided systems analysis expertise. Members of this research team worked closely developing and applying the measurement methods that were used on this project.[1]

Also directly contributing to the project were three consulting subject matter experts: Dr. Alex Biederman, Associate Professor of Forensic Science at the University of Lausanne, Switzerland (evidential reasoning, decision making, and quantitative methods used for data analysis), Michael Grubb, former Crime Laboratory Director/Manager of the Washington State Patrol Crime Laboratory (Seattle), the San Diego Police Department and the San Diego County Sheriff's Department (crime laboratory management) and Judge Ron Reinstein, former Arizona Superior Court Judge and consultant for the Arizona Supreme Court (jurisprudence, criminal law and public policy).

C. Outcomes

Activities and Accomplishments

1263 rounds of ammunition were collected from 164 handguns. Table 1 shows the distribution of these by type of handgun (semi-automatic vs revolver) and caliber class. The four caliber classes used were 22 (.22LR); 32 (.32 ACP); 38 (including .38 Special, .357 Magnum, .380 ACP and 9mm); and .45 (including .45 ACP, .45 Colt, .44 Magnum and .40 S&W).

Table 1. Rounds of Ammunition Collected

Caliber Class	Revolver	Semi-Automatic	Totals by Caliber Class
22	225	198	**423**
32	0[3]	105	**105**
38[1]	107	348	**455**
45[2]	102	178	**280**
Totals by Handgun Type	**434**	**829**	**1263**

[1] Including .38 Special, .357 Magnum, .380 ACP and 9mm ammunition
[2] Including .45 ACP, .45 Colt, .44 Magnum and .40 S&W ammunition
[3] .32 caliber revolvers are very rare and none are represented

Each of the collected rounds of ammunition was processed by cyanoacrylate fuming (CA, superglue). Those rounds not showing a NIFM meeting the project's acceptance criteria (4 or more ridge minutiae in a clear relationship to one another) were also processed by fluorescent dye staining (BY-40). Images of candidate NIFMs were prepared as shown in Figure 1. Expert examination and annotation were completed for each of the images, and those showing 4+ minutiae were entered into UNIL's PiAnoS annotation system to determine their associative value as shown by measurement of the ESLR.

Results and Findings

Examination of the 1263 rounds of ammunition resulted in 479 fingermarks with 4 or more minutiae on 345 rounds of ammunition. Sixty-four of the 479 fingermarks (13.4%) were graded as identifiable (meeting traditional requirements for a fingerprint identification). The distribution of these 479 fingermarks by handgun type and caliber class is shown in Table 2. Overall, 27.3% of the collected rounds showed one or more 4+ minutiae fingermarks (with an average of 1.39 marks per round when present). The different ammunition classifications ranged from a low of 20.4% of collected rounds (22 revolvers) to a high of 44.9% (38 revolvers).

Table 3 shows that identifiable fingermarks were found on only 4.7% of the collected rounds. Without consideration of NIFMs, the examinations left 95.3% of the rounds of ammunition without associative fingermark evidence. With the inclusion of the 415 NIFMs, the number of rounds of ammunition with associative evidence increased by 286 to a total of 345. Useful fingermarks with high associative value are found on nearly 6 times as many rounds of ammunition.

The numbers of annotated minutiae for the 479 fingermarks are given in Table 4 showing the distribution among handgun type and caliber class. Differences among these categories are charted in Figure 6, which shows the numbers of NIFMs found exceeding a given number of minutiae, per 100 rounds of ammunition examined.

Table 2. Distribution of 480 Fingermarks by Handgun Type and Caliber Class

NIFMS (4+ minutiae) + IDs BY CATEGORY									
	Semi-Automatic				Revolver				Total
IDs & NIFMs 4+	.45	.38	.32	.22	.45	.38	.32	.22	
Number of Marks	50	101	60	51	86	79	0	52	479
On X Rounds	41	82	44	43	41	48	0	46	345
% Rounds	23.0%	23.6%	41.9%	21.7%	40.2%	44.9%	n/a	20.4%	27.3%
Ave Per Round	1.22	1.23	1.36	1.19	2.10	1.65	n/a	1.13	1.39

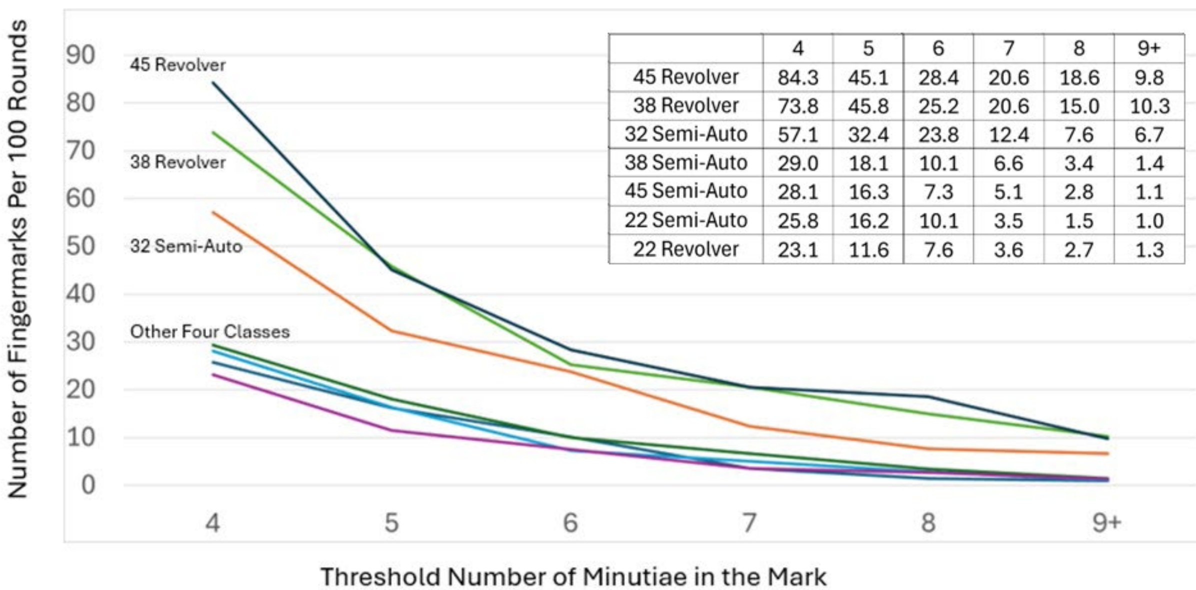
Table 3. Distribution of the 64 Identifiable Fingermarks by Handgun Type and Caliber Class

IDs BY CATEGORY									
	Semi-Automatic				Revolver				Total
IDs	.45	.38	.32	.22	.45	.38	.32	.22	
Number of Marks	5	13	7	2	17	14	0	6	64
On X Rounds	5	12	7	2	14	14	0	5	59
% Rounds	2.8%	3.4%	6.7%	1.0%	13.7%	13.1%	n/a	2.2%	4.7%
Ave Per Round	1.00	1.08	1.00	1.00	1.21	1.00	n/a	1.20	1.08

Table 4. Numbers of Annotated Minutiae by Handgun Type and Caliber Class

			Number of Minutiae											
Handgun Type	Caliber Class	Rounds Tested	4	5	6	7	8	9	10	11	12	13	14+	Totals
Semi-Auto	22	198	19	12	13	4	1	1	0	1	0	0	0	**51**
Semi-Auto	32	105	26	9	12	5	1	3	1	1	0	2	0	**60**
Semi-Auto	38	348	38	28	12	11	7	3	0	1	0	0	1	**101**
Semi-Auto	45	178	21	16	4	4	3	2	0	0	0	0	0	**50**
Revolver	22	225	26	9	9	2	3	1	0	1	0	0	1	**52**
Revolver	38	107	30	22	5	6	5	2	5	2	1	0	1	**79**
Revolver	45	102	40	17	8	2	9	3	1	1	1	2	2	**86**
Totals		**1263**	**200**	**113**	**63**	**34**	**29**	**15**	**7**	**7**	**2**	**4**	**5**	

Figure 6. Number of Fingermarks Per 100 Rounds Showing a Given Number of Minutiae or More



For example, following the orange line in Figure 6 (corresponding to the third row on the inset table) shows that for 32 semi-automatic handgun ammunition in our project, examination of 100 rounds of ammunition resulted in 57.1 rounds with 4 or more minutiae, including 32.4 with 5 or more minutiae, 23.8 with six or more minutiae, 12.4 with 7 or more, 7.5 with 8 or more and 6.7 with 9 or more. The 45 and 38 revolver classes show much greater numbers of fingermarks, but very importantly, all ammunition classes showed more than 20 fingermarks with 4 or more minutiae per

100 rounds examined, with approximately half of these showing 6 or more minutiae. The associative values expected from these fingermarks are very high.

Expected associative values (as measured by ESLRs) are closely associated with the numbers of minutiae. Figure 7 shows this relationship. There is a regular increase in Log_{10} ESLR with the number of minutiae (although wide ranges are seen in the values for any given number of minutiae, and the values for different minutia numbers overlap considerably). Table 5 translates the mean values of the Log_{10} ESLRs shown in Figure 7 to the ESLR values themselves. For example, the 4-minutia value indicates an association with equivalent strength to an event that occurs randomly once in 1900 times, the 5-minutia value indicates that for an event occurring randomly once in 20,000 times, and so forth, with the 9+ minutia value indicating that for an event occurring once in 1.3 billion times.

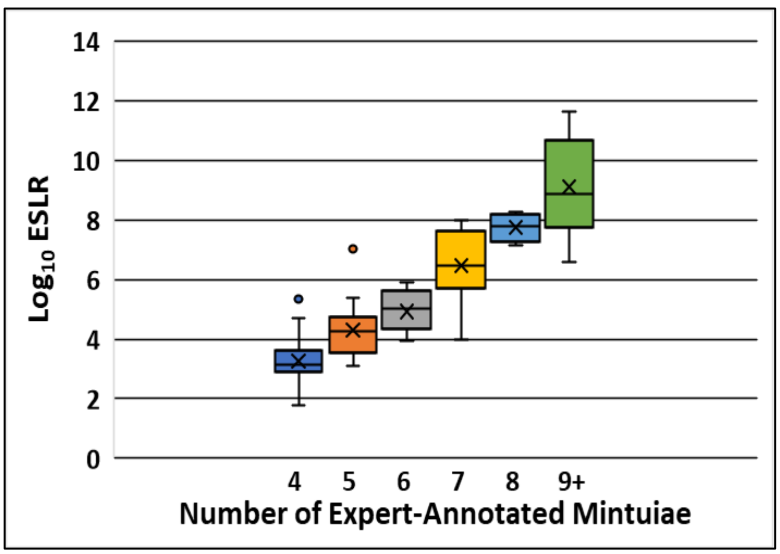


Figure 7. Box and Whisker Plot of Log_{10} ESLR values for fingermarks from this study dataset categorized by the number of expert-annotated minutiae. Mean values for each minutia number are indicated by the “X”. The shaded boxes show the range covered by half of the values, the “whiskers” extending outside of the boxes show the range expected based on commonly accepted statistical criteria, and the dots show individual values that are outside this range and considered “outliers.”

Table 5. Associative Values indicated by the ESLR.

Number of Minutiae	Mean of Log_{10} ESLR	Approximate ESLR
4	3.27	1,900
5	4.30	20,000
6	4.92	84,000
7	6.46	2,900,000
8	7.75	57,000,000
9+	9.10	1,300,000,000

Based on these criteria, and following the European Guidelines for Reporting,[4] 48% of the 415 NIFMs recovered from the ammunition in this study would be rated as providing strong support for association, another 42% rated as providing very strong support, and the remaining 10% as providing extremely strong support.

These findings clearly demonstrate the common occurrence of NIFMs of high associative value on loaded handgun ammunition. Although differences among handgun types and caliber classes occur, NIFMs providing strong support for association were found regularly (more than 20 per hundred rounds examined) for each of the handgun type and caliber classes. Revolver ammunition in the 45 and 38 caliber classes showed NIFMs occurring roughly four times more abundantly.

Occurrence and Significance of Fingermarks Recovered in this Project

Table 6 summarizes the project findings for each of the handgun types and caliber classes. The table to the left shows percentages of *ammunition rounds* with marks that would occur more rarely than once in the number for the given column. For example, in the first row of the table, 21.7% of the rounds of ammunition from semi-automatic handguns in the 22 caliber class showed associative values rarer than an occurrence of one in 1900; 14.6% showed values rarer than 1 in 20,000; and so forth, to the last column where 1% showed values rarer than 1 in 1.3 billion. The information in this table allows an estimate of how common marks of a given associative value are expected on individual rounds of loaded handgun ammunition.

In casework, the number of rounds of ammunition in any loaded handgun will vary, and each round provides an opportunity for recovery fingermarks leading to evidence associating the handgun to an individual. The table to the right in Table 6 shows percentages of *handgun loads* with marks that would occur more rarely than once in the number for the given column. For example, in the first row of that table, 66.7% of the semi-automatic handguns in the 22 caliber class showed fingermarks on *at least one of their loaded rounds of ammunition* showing associative values rarer than an occurrence of one in 1900; 46.7% showed values rarer than 1 in 20,000; and so forth, to the last column where 9.5% showed values rarer than 1 in 1.3 billion. The information in this table allows an estimate of how common marks of a given associative value are expected on loads of ammunition in a single handgun.

Table 6. Associative Values of Fingermarks in this Study*

		Percentage of Rounds with Marks Rarer Than 1 in					
Handgun Type	Caliber Class	1,900	20,000	84,000	2.9 Million	57 Million	1.3 Billion
Semi-Auto	22	21.7	14.6	9.6	3.5	1.5	1.0
Semi-Auto	32	41.9	29.5	22.9	11.4	7.6	6.7
Semi-Auto	38	23.6	14.7	8.9	6.6	3.4	1.4
Semi-Auto	45	23.0	14.0	6.7	5.1	2.8	1.1
Revolver	22	20.4	11.1	7.1	3.1	2.2	0.9
Revolver	38	44.9	29.9	20.6	17.8	13.1	8.4
Revolver	45	40.2	29.4	21.6	16.7	14.7	9.8
All Categories		27.3	17.7	11.6	7.4	4.9	2.9

		Percentage of Loads with Marks Rarer Than 1 in					
Handgun Type	Caliber Class	1,900	20,000	84,000	2.9 Million	57 Million	1.3 Billion
Semi-Auto	22	66.7	47.6	42.9	23.8	14.3	9.5
Semi-Auto	32	68.8	56.3	50.0	37.5	31.3	25.0
Semi-Auto	38	57.5	45.0	37.5	35.0	22.5	12.5
Semi-Auto	45	60.0	55.0	35.0	30.0	15.0	10.0
Revolver	22	72.4	48.3	34.5	17.2	10.3	6.9
Revolver	38	76.2	61.9	42.9	33.3	28.6	19.0
Revolver	45	64.7	58.8	47.1	47.1	41.2	29.4
All Categories		65.9	51.8	40.2	31.1	22.0	14.6

*Associative values are presented as randomly occurring events that would result in equivalent ESLR values. A more complete explanation of this approach is provided in [1].

Limitations

Limitations Arising from the Scope and Choice of Research Parameters

The choice of methods and approach used in this project were suitable to meet the research goal of finding how often NIFMs occur on naturally loaded ammunition and what range of associative values can be expected. The project collected ammunition from a reasonably representative set of handguns, applied well-established methods to detect and photograph the fingermarks, evaluated these using a highly experienced fingerprint expert, measured associative values of marks using a well-characterized, peer-reviewed method and compared the values among different classes of handguns.

During ammunition loading and collection, several factors known to affect the leaving of fingermarks were intentionally left uncontrolled in this research (with the purpose of providing a reasonably representative set of conditions, rather than controlling them). These factors included

- the loader's susceptibility to leave fingermarks (which is known to vary among individuals)
- the cleanliness of the loader's hands
- the presence or absence of corrosion or loose surface debris on the ammunition
- the technique used for loading of the handgun (such as the use of speed loaders for revolvers, or magazine loaders for semi-automatic pistols)

These factors could be the subject of additional investigation which would provide insight into how significantly they influence the chances that a useful fingermark would be left on loaded ammunition. However, the contribution of such insights may be limited as the factors are usually unknown in actual casework.

Alternative, or more narrow classifications of handgun and ammunition types could have resulted in additional distinctions and revealed heterogeneity in the findings. For example, the composition of cartridge casings (e.g. brass vs. nickel-plated), and overall differences in available surface area on rounds of ammunition (due to differences of length as well as diameter) were not investigated. This additional work could be of value to help with policy decisions if these become dependent on specific types of handguns, ammunition sizes and ammunition compositions.

This project used two very well established and widely applied methods for fingermark visualization (cyanoacrylate, or CA fuming, followed by fluorescent dye staining). These methods were applied sequentially and if one or more NIFMs were found after CA fuming, the second method was not applied. Adding fluorescent dye staining for all rounds of ammunition, or the inclusion of other, more specialized methods would increase the chances that more or better-quality fingermarks would be found.

The project used a single, highly experienced fingerprint expert to evaluate candidate NIFMs and annotate their minutiae. These activities are known to be expert-dependent, and the results could be influenced if a different expert were to perform these evaluations. This project did not include re-investigation of this well-known source of variation.

The associative value of the NIFMs was measured using ESLRs (expected score-based likelihood ratios). This is one well-established, calibrated method to measure the associative value of a fingermark. However, there is no consensus or standardization regarding the use of this method, and the use of an alternative measurement method could change the results. To allow for this possibility, and preserve this project's contribution, the entire dataset of NIFMs (original and annotated) is being maintained and is available for further evaluation as measurement methods evolve. That said, as the variations among alternative measurement methods are small relative to the data results of this project, it is unlikely that using another method would materially alter the overall findings of this project.

Challenges for Transition to Practice and Implementation

The development and vetting of measurement methods to determine the associative value of comparisons of NIFMs to known fingermarks of an individual is one important challenge for transition to practice, but these methods will not be long in coming.[5] Of parallel importance is the need for a paradigm change that recognizes the associative value and utility of NIFMs.[6]

One major challenge is the presence of the long-standing forensic workflow practice that includes an all-or-nothing triage step that recognizes identifiable fingermarks as useful and dismisses any potential value for marks that fail to meet this threshold. Utilization of NIFMs as a new source of evidence would require adjustment of these long-standing forensic examination practices and balancing the level of effort required with the utility of the resulting associations. Among the forensic science community, there is uncertainty regarding what new levels of effort would be required, what alternative procedures would need to be developed, and what benefits would result.[2] The present project contributes to the body of work that shows an extremely high potential benefit: useful fingermarks with high associative value on nearly 6 times as many rounds of ammunition. However, an important limiting factor that remains is the uncertainty of the increased cost (in terms of Level of Effort) which would be needed to recover and utilize this new form of evidence. This project used labor-intensive research laboratory methods for two of the necessary steps: photographic documentation (including manual multiple exposures and related image processing for individual rounds of ammunition) and annotation of minutiae (employing visual expert evaluation of each candidate NIFM). Accordingly, an important follow-on step is replacing the more labor-intensive research laboratory methods with efficient technologies currently available in forensic laboratories and measuring the required level of effort to utilize this important new form of evidence.

References

1. Stoney, D.A., M. De Donno, C. Champod, P.A.Wertheim, and P.L. Stoney, Occurrence and associative value of non-identifiable fingermarks. *Forensic Sci Int* **309**:110219, 2020.

2. Stoney, D.A. and P.L. Stoney, Utility of non-identifiable fingermarks. *Forensic Sci Int* **319**:110630, 2021.

3. Porter, G., R. Ebeyan, C. Crumlish, and A. Renshaw, A novel method for the photographic recovery of fingermark impressions from ammunition cases using digital imaging. *J Forensic Sci* **60**(2):418-421, 2015.

4. European Network of Forensic Science Networks, ENFSI guideline for evaluative reporting in forensic science, https://enfsi.eu/wp-content/uploads/2016/09/m1_guideline.pdf

5. Simon A Cole, Sharon Kelley, Brett Gardner, Kori Khan, Maddisen Neuman, Justin L. Sola, Introduction, *Law, Probability and Risk*, Volume 23, Issue 1, 2024, mgae006, https://doi.org/10.1093/lpr/mgae006

6.David Stoney, Paul Stoney, How the work being done on statistical fingerprint models provides the basis for a much broader and greater impact affecting many areas within the criminal justice system, *Law, Probability and Risk*, Volume 23, Issue 1, 2024, mgae008, https://doi.org/10.1093/lpr/mgae008

D. Products, Datasets and Dissemination Activity

(Presentation) Stoney, D.A. and Stoney, P.L., “Occurrence and Associative Value of Non-Identifiable Fingermarks on Ammunition in Handguns,” International Association for Identification 2022 Educational Conference, August 4, 2022, Omaha, Nebraska.

(Podcast) Stoney, David and Dutton, Greg, “Building More Reliable Forensic Sciences (Part One),” Justice Today podcast, NCJ Number: 306260, March 1, 2023. Available at https://nij.ojp.gov/library/publications/problematic-forensic-evidence-part-1, Accessed 12-17-24.

(Peer Reviewed Journal Article) Stoney, D.A. and Stoney, P.L. “How the Work Being Done on Statistical Fingerprint Models Provides the Basis for a Much Broader and Greater Impact Affecting Many Areas Within the Criminal Justice System,” *Law Probability and Risk* Volume 23, Issue 1, 2024; https://doi.org/10.1093/lpr/mgae008

(Data Sets Generated)

Non-Identifiable Fingermark Dataset (415)

Annotated Non-Identifiable Fingermark Dataset (415)

Archived at: Stoney, David (2024), “Non-Identifiable Fingermarks from Unfired Ammunition in Handguns”, Mendeley Data.

(Upcoming Presentation) Stoney, D.A. and Stoney, P.L., “Evaluation of the Occurrence and Associative Value of NonIdentifiable Fingermarks on Unfired Ammunition in Handguns for Evidence Supporting Proof of Criminal Possession, Use and Intent,” 2025 National Institute of Justice Forensic Science Research and Development Symposium, February 18, 2024, Baltimore, MD.