

STATE OF _____)		IN _____ COURT
)	SS:	
COUNTY OF _____)		CAUSE NUMBER:
STATE OF _____)		
)		
vs.)		
)		
X)		

**MOTION TO EXCLUDE GOVERNMENT’S
BLOODSTAIN PATTERN ANALYSIS**

The defendant, by counsel, respectfully requests that this Court issue an Order barring the government from utilizing bloodstain pattern evidence and analysis against him at trial. As grounds therefor, undersigned counsel states as follows:

1. The defendant has a right under the Due Process Clause of the 5th and 14th Amendments to the United States Constitution and _____ of the [State] Constitution to a fundamentally fair trial. A prerequisite of a fundamentally fair trial is the requirement that the government shall be barred from utilizing unreliable forensic evidence.

2. According to the findings of The National Academy of Science Report: *Strengthening Forensic Science in the United States: A Path Forward*, [hereinafter *NAS Report*, Attached as Exhibit A], published on February 18, 2009, the field of bloodstain pattern analysis suffers from some of the worst deficiencies that impair the reliable determination of scientific truth. The report notes that “[t]he uncertainties associated with bloodstain pattern analysis are enormous.” *Id.* at 5-39, and, “...many sources of variability arise with the production of bloodstain patterns, and their interpretation is not nearly as straightforward as the process implies.” *Id.* at 5-38.

“Bloodstain patterns found at scenes can be complex, because although overlapping patterns may appear simple, in many cases their interpretations are difficult or impossible.”¹

3. The NAS Report urges the inadequacy of workshops which “...teach the fundamentals of basic pattern formation and are not a substitute for experience and experimentation which applying knowledge to crime reconstruction.”² The *Report* observes that “[s]uch workshops are more aptly applicable for the investigator who needs to recognize the importance of these patterns so that he or she may enlist the services of a qualified expert.”³

4. The NAS Report stresses the importance of a combination of scientific knowledge, experience and experimental testing of hypotheses. The NAS defines the minimum required for a competent blood pattern analysis is:

1. an appropriate scientific education;
2. knowledge of the terminology employed;
3. an understanding of the limitations of the measurement tools used to make bloodstain pattern measurements (e.g., calculators, software, lasers, protractors);
4. an understanding of applied mathematics and the use of significant figures;
5. an understanding of the physics of fluid transfer;
6. an understanding of the pathology of wounds; and;
7. an understanding of the general patterns blood makes after leaving the human body.⁴

5. The *NAS Report* concludes its discussion of blood pattern analysis with this admonition: “Scientific studies support some aspects of bloodstain pattern analysis....but some experts extrapolate far beyond what can be supported.... many experiments must be conducted to determine what characteristics of a bloodstain pattern are caused by particular actions during a

¹ The Report cites the following in support: H.L. MacDonell.1997. Bloodstain Patterns. Corning NY: Laboratory of Forensic Science; S. James. 1998; *Scientific and Legal Applications of Bloodstain Pattern Interpretation*. Boca Raton, FL: CRC Press; P. Pizzola, S.; Roth and P. DeForest. 1986. Blood drop dynamics-II. *Journal of Forensic Sciences* 31(1) 36-49; R.M. Bardner. 2004. *Practical Crime Scene Processing and Investigation*. Boca Raton, FL: CRC Press; H.C. Lee; T. Palmbach and M.T. Miller. 2005. *Henry Lee’s Crime Scene Handbook*. Burlington, MA: Elsevier Academic Press, pp. 281-298.

² The Report cites the following reference: W.J. Chisum and B.E. Turvey. 2007. *Crime Reconstruction*. Burlington, MA: Elsevier Academic Press.

³ *NAS Report* 5-38.

⁴ *NAS Report*, 5-38.

crime and to inform the interpretation of those causal links and their variabilities. For these same reasons, extra care must be given to the way in which the analyses are presented in court. The uncertainties associated with bloodstain pattern analysis are enormous.” *Id.* at S-39.

6. In the instant case, the government’s bloodstain examiner lacks the minimum criteria that the NAS has deemed a condition precedent to serving as an expert witness on bloodstain pattern analysis. As is clear from the government’s examiner’s report, he seeks to extrapolate far beyond what the data allow, in direct contravention of clear admonitions in the NAS report. Further, the government’s examiner has conducted no experiments to attempt via science rather than subjective speculation to confirm his proposed findings. As the NAS report makes clear, “rigorous and objective hypothesis testing”⁵ are the sine qua non of good science.

WHEREFORE, the defendant prays that the government’s proposed bloodstain pattern analysis expert be precluded from testifying.

Respectfully submitted,

MEMORANDUM OF LAW IN SUPPORT OF DEFENDANT’S
MOTION TO EXCLUDE GOVERNMENT’S
BLOODSTAIN PATTERN ANALYSIS

1. Recognizing the “rising nationwide criticism of forensic evidence, “*Ramirez v. State*, 810 So.2d 836, 853 (Fla. 2001),⁶ and “that significant improvements are needed in forensic

⁵ NAS Report at 5-39.

⁶ A growing number of courts are questioning forensic science’s proclaimed accuracy and reliability. Judge Boyce Martin of the United States Court of Appeals for the Sixth Circuit has called crime labs “unreliable.” *Moore v. Parker*, 425 F.3d 250, 269 (6th Cir. 2005)(Boyce, J., dissenting). United States District Court Judge Jed Rakoff has written: “False positives – that is, inaccurate incriminating test results – are endemic to much of what passes for ‘forensic science.’” *United States v. Bentham*, 414 F.Supp. 2d 472, 473 (S.D.N.Y. 2006). United States District

science,” *NAS Report*, at p. 1, Congress directed the NAS “to conduct a study on forensic science.” *Id.* at S-1; P.L. No. 109-108, 119 Stat. 2290 (2005); H.R. Rep. No. 109-272 at 121 (2005). In the fall of 2006, the NAS established a committee to implement Congress’s charge. The committee included members of the forensic science community, the legal community and a diverse group of scientists. The committee heard expert testimony on several issues relating to the practice of forensic science. Committee members reviewed “numerous published materials, studies, and reports related to the forensic science disciplines, engaged in independent research on the subject, and worked on drafts of the final report.” *Id.* at S-2. The final report, entitled *Strengthening Forensic Science in the United States: A Path Forward*, [hereinafter *NAS Report*] was issued on February 18, 2009.

At the outset of the report, the committee acknowledged that unreliable forensic evidence and exaggerated forensic testimony had contributed to a significant number of wrongful convictions. The committee decried “the potential danger of giving undue weight to evidence and testimony derived from imperfect testing and analysis.” *NAS Report*, at S-3.⁷

The Report went on to observe that the DNA exonerations exposed “serious limitations in some of the forensic science approaches commonly used in the United States.” *Id.* at 1-6. The committee identified and reviewed several requirements of good science that call into question if not entirely undermine – the reliability of several non-DNA forensic identification techniques such as hair identification, serology, and soil analysis. Across the spectrum of forensics, the committee identified issues pertaining to:

Court Judge Nancy Gertner has commented on the noticeable correlation between wrongful convictions and unreliable or invalid forensic science, noting that “recent reexaminations of relatively established forensic testimony have produced striking results.” *United States v. Green*, 405 F.Supp. 2d 104, 109 n.6 (D. Mass. 2005).

⁷ For a more in-depth discussion of forensic science and wrongful convictions, see Brandon L. Garrett & Peter J. Neufeld, *Invalid Forensic Science Testimony and Wrongful Convictions*, 95 Va.L.Rev 1 (2009); Craig M. Cooley & Gabriel S. Oberfield, *Increasing Forensic Evidence’s Reliability and Minimizing Wrongful Convictions: Applying Daubert Isn’t the Only Problem*, 43 Tulsa L.Rev. 285 (2007).

- (1) inadequate or no research regarding base rates, error rates, measurement error rates, and minimizing the risk of bias in forensic testing;
- (2) inadequate or no standards in determining a match, in forensic terminology, report writing and forensic science education;
- (3) the lack of mandatory certification for forensic examiners – and the lack of proficiency testing; and
- (4) inadequate funding.

The following passage captures the essence of the committee’s overall findings:

Too often [forensic science facilities] have inadequate educational programs, and they typically lack mandatory and enforceable standards, founded on rigorous research and testing, certification requirements, and accreditation programs. Additionally, forensic science and forensic pathology research, education and training lack strong ties to our research universities and national science assets. *NAS Report*, at S-10.

In the end, the committee stressed that “substantial improvement is necessary in the forensic science disciplines to enhance law enforcement’s ability to identify those who have or have not committed a crime and to prevent the criminal justice system from erroneously convicting or exonerating the persons who come before it”: *Id.* at 1-2.

2. The *NAS Report* on Bloodstain Pattern Analysis makes plain that this field of forensics suffers from several of the deficiencies observed in other forensic areas. There is a lack of scientific methodology, a lack of confirmatory experimentation and subjectivity and over extrapolation is the order of the day. In short, as the *NAS Report* concludes, “The uncertainties associated with bloodstain pattern analysis are enormous.”

3. At the time of the *NAS Report*’s release, the professional organizations that existed for blood stain analysts provided inadequate oversight. As the Report notes, the IAI (International Association for Identification) had “no educational requirements for certification in bloodstain pattern analysis.”⁸ The Report observed that this “emphasis on experience over scientific

⁸ See “Bloodstain Pattern Examiner Certification Requirements,” available at: theiai.org/certifications/bloodstain/requirements.php

foundations seems misguided given the importance of rigorous and objective hypothesis testing and the complex nature of fluid dynamics.”

Cases have held that mere attendance at a 40 hour course is sufficient to qualify as an expert. The NAS Report makes clear that such an overview course is worth little more than putting the student in the position of an issue spotter – one who can only be trusted to see that a true scientist should be called in.

4. Experience without more can simply reinforce shoddy practice. Experience must be informed by education. Whether experience is an accurate teacher can only be assessed by proficiency testing and determination of error rates, both of which are cited by *Daubert*. Bloodstain pattern analysts have little or none of either.

5. The IAI certification requirements are dismal.⁹ A forty hour course and passing examination score of 75 percent are sufficient. Suggested, but not required topics of study include such basics as a) correlation of stain and patterns to the scene surroundings and/or body trauma; b) serological/DNA considerations; c) chemical and light source absorption and enhancement; d) blood detection/collection techniques; e) stain pattern reconstruction. These “suggested” topics are the very topics that the government is seeking to have its examiner testify to.

6. The IAI’s President responded to the NAS Report in a letter written to the Chair of the Senate Committee on the Judiciary, Patrick J. Leahy, dated March 18, 2009, noting that each of the forensic fields criticized by the NAS report has “a deep seated history of research based on the hard sciences.” Blood pattern analysis is said to date from a Polish doctor’s study in 1894. But there are many fields of “science” that had lengthy historical pedigrees – and even were

⁹ Id.

generally accepted - that have since been debunked. Examples abound. It was once thought that infection sprang from thin air – like maggots feasting on trash. The world was thought to be flat for over a century. For decades it was believed that one’s mental state and capabilities could be reliably diagnosed from phrenology, the study of bumps on the head. Historical pedigree is no substitute for scientific reliability.

7. The IAI concedes the validity of several criticisms lodged in the NAS Report and recommends significant changes including but not limited to standardization of education and training, short and long term research agenda, implementations of standard operating procedures, enforcement mechanisms to confirm compliance with minimum standards, standardization of terminology. But none of these safeguards informed the government’s examiner’s findings in the instant case.

8. SWGSTAIN, the Scientific Working Group on Bloodstain Pattern Analysis, can recommend but not require standards, proficiency testing and determination of error rates. Individual examiners are free to ignore SWGSTAIN’S admonishments. The organization is simply a “professional forum” for practitioners who choose to participate. While SWGSTAIN intends to “build consensus-based “best practice” guidelines, such guidelines are unenforceable.

9. In response to the NAS Report, SWGSTAIN acknowledges:

1. “that a limited number of bloodstain pattern analysts have tendered opinions beyond the scope of available evidence.” No indication is given as to how the group concluded that such abuses were limited. No empirical data is provided.
2. “that the opinions of bloodstain pattern analysts may contain an element of subjectivity.”

3. “[t]he combination of formal education and training is critical for analysts to gain an understanding of bloodstain pattern analysis,” but experience is also important. No indication is given as to how the formal education and training requirements would be enforced. And, of course, they have never been enforced in the past.

10. SWGSTAIN promulgated a standardized terminology for bloodstain experts in April of 2009. On April 30, 2009, the group published a bibliography on its website. They have also published:

- a. “Guidelines for Developing Standard Operating Procedures for Bloodstain Pattern Analysis”– that is to say, they are not willing to mandate actual standards of practice, but only to suggest that labs have a standard in several identified areas.
- b. “Guidelines for a Quality Assurance Program”
- c. “Guidelines for the Minimum Educational and Training Requirements for Bloodstain Pattern Analysts”

The bottom line of SWGSTAIN’s efforts: they are all guidelines and have no enforcement mechanism.

11. Since the United States Supreme Court’s decision in *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579, 113 S.Ct. 2786, 125 L.Ed.2d 469 (1993), *Kumho Tire Co. v. Carmichael*, 526 U.S. 137, 119 S.Ct. 1167, 143 L.Ed. 2d 238(1999) and promulgation of the reliability prerequisite for admission of scientific evidence in Evid. R. 702, all forensic testimony, including bloodstain pattern analysis, should be subjected to greater scrutiny in light of the more significant gatekeeper role that the trial

courts were required to play. The Supreme Court made clear in *Daubert* that no purportedly scientific expert testimony could be admitted unless it met certain rigorous requirements. *Daubert* directed the trial courts to examine:

- a. Whether the expert's theory or technique "can be (and has been) tested;"
- b. Whether the theory and technique has been subjected to peer review and publication;"
- c. "The known or potential rate of error" in the theory's application and "the existence and maintenance of standards controlling the technique's operation;" and
- d. The "general acceptance" of the theory or technique in the relevant scientific community.

Daubert, 509 U.S. at 593-94.

12. *Daubert* and/or *Frye* scrutiny of bloodstain pattern analysis has been wholly inadequate. Bloodstain pattern testimony has largely been admitted as a matter of course. Few courts have recognized the systemic scientific problems with the field. To date, there has been no calculation of error rates. There has been little or no proficiency testing. There are no standards for specific applications of the technique to anything but the most basic bloodstain patterns. No doubt, this wholesale lack of a *Daubert* type scrutiny is a direct consequence of the attorneys, and especially the criminal defense attorneys' lack of understanding of scientific method and scientific inquiry, as well as, in some instances, a lack of funds to retain defense experts to critically evaluate the government's claims. Because of the risk that innocent persons will be convicted and even sentenced to death on the basis of erroneous bloodstain analysis, all such testimony should be excluded until adequate statistical empirical foundations and a rigorous regime of blind proficiency testing are developed and implemented in this field.

13. Recently, an abstract noting the absence of any research on a key *Daubert* component, error rates, was published urging analysts to help out by taking a 15 minute web test of very basic blood stain patterns in order to begin to generate information

regarding error rate.¹⁰ The test will in no way provide a realistic assessment of error rate in actual crime scenes. The rudimentary nature of this proposed research is tantamount to an admission by the bloodstain analysts' field that no error rate or proficiency testing has ever been done.

14. The most respected experts in the field, each of whom has a degree from an academic institution in a relevant scientific field, have decried the lack of qualifications of too many bloodstain pattern analysts. "Numbers of individuals without scientific backgrounds have been trained [in BPA]....these individuals have stepped beyond this important investigative role to offer scientific evidence as expert witnesses. The danger inherent in this development cannot be overemphasized. No amount of experience can supplement scientific knowledge and a thought process based on

¹⁰ **Research into the Error Rates Associated with Bloodstain Pattern Analysis**

Breeanna Meneses and Brian J. Gestring, M.S. Cedar Crest College Forensic Science Program Allentown, PA 11804(BPA) has long been accepted in the courts around the world. Under the Frye or the general acceptance standard, there were no significant challenges to BPA in the United States. The advent of the *Daubert* standard in 1993 introduced new variables that needed to be evaluated such as the error rate of the technique. While essentially no process has a negative error rate (not even computers), finding an effective way to evaluate it for BPA is problematic. Current proficiency testing in BPA has proved to be an ineffective method to establish known or potential error rate. This is a serious issue and needs immediate attention. Under the direction of Professor Gestring (IAI Member and SCSA), Breeanna Meneses from the forensic science program at Cedar Crest College has designed a preliminary study to evaluate error rate. Since basic pattern recognition is the first critical step in this process, this study will focus exclusively on pattern recognition. To achieve this goal, a web based survey has been created. Participants can log on to the survey and complete it in less than 15 minutes. The survey is composed of **very basic bloodstain patterns** that have been created in a controlled environment and photo documented. Since there are a number of valid terminologies, this study will ask participants how a given pattern was created and discount terminology altogether. After participants have completed the pattern recognition portion of the survey, they will be asked some basic questions about their background. Participants will need a password to access the web survey, but their identity will remain anonymous. **We need your help!** If you have any questions about this research or would like to participate, please send an e-mail to bloodstain08@gmail. [Emphasis added].

careful adherence to the scientific method.” *A Review of Bloodstain Evidence at Crime Scenes*, J.Forens.Sci. 35: 1491-1495, Nov. 1990; quoted in Forensic Sciences, ed. Cecil Wecht, *Bloodstain Pattern Interpretation*, Herb MacDonell and Catherine Panchou, Chapter 37, Sec. 37.12[b], p. 37-68, Matthew Bender, 1992.

15. Frustrated by the lack of regulation of the field, some of the degreed bloodstain analysts, such as Herbert MacDonell have even sought to have rogue analysts removed from the roles of bloodstain analysts’ professional organizations.¹¹ Efforts at policing themselves have met the same fate as those of defense lawyers.

16. In his article in the May 2005 *Champion*, Louis Akin describes BPA as an art “far more akin to a tracker reading a trail sign than a hematologist working in a lab.” Louis L. Akin, *Interpretation of Blood Spatter for Defense Attorneys*, *The Champion*, May 2005, at 28. Mr. Akin goes on to say:

The analyst interprets the evidence at the scene just as if it were tracks in the sand. In fact, the analyst uses every item of evidence at the scene, as well as autopsy reports, the police reports, witness statements, and knowledge that he brings to the scene himself such as knowledge about the dynamics of the behavior of blood, knowledge of guns and ballistics, and knowledge of wounds to the human body. The analyst looks at the evidence, and based on what he sees in the blood spatter evidence, makes a pronouncement

¹¹ See *Englert v. MacDonell*, (D. Ore 2006)

This opinion arises from several motions made during a civil defamation action. The plaintiff in the case was Rodney D. Englert, who offered his services as an expert witness. As a former police officer, Englert’s area of expertise related to bloodstain pattern analysis. Englert, a member of the FBI’s Scientific Working Group on Bloodstain Pattern Analysis (known as SWGSTAIN), the American Academy of Forensic Science (AAFS), and the International Association of Blood Pattern Analysis (IABPA), filed suit against the defendants for defamation. Defendants in this case also “provide expert testimony in criminal trials, although primarily for defense attorneys.

The complaint was in response to allegations that Englert made false representations about his expertise on his Curriculum Vitae and during trial testimony. The defendants filed ethical complaints with the various professional associations Englert was affiliated with. After Englert was exonerated by the AAFS, the defendants continued to pursue ethical complaints with other associations. The court found that the defendants’ speech was constitutionally protected free speech concerning a public issue (subject to limitations), and went on to decide the various motions according to the appropriate statutory and case law.

about what he, or she, believes happened. Seen in this light, blood stain analysis is more of an art than a science and is always open to interpretation.

Id. At 28-29.

Since the analysis is “always open to interpretation” one would assume that courts would be hesitant to permit an expert to testify to his or her *conclusions*. One would assume wrongly.

17. According to the NAS Report, “scientific investigations...must be as free from bias as possible” and “practices [must be] put in place to detect biases (such as those from measurements, human interpretation, etc.) and to minimize their effects on conclusions.” NAS Report, at 4-2. Consequently, a “body of research is required to establish the limits and measures of performance and to address the impact of sources of variability and potential bias. *Id.* at 4-9. Addressing bloodstain pattern analysis, the NAS report cautioned: “many bloodstain pattern analysis cases are prosecution driven or defense driven, with targeted requests that can lead to context bias.” *Id.* at 5-39. This is unsurprising given that publicly-funded crime labs are annexed to the very law enforcement or prosecutorial agencies to which they provide assistance, and of course, the primary objective of these agencies is to prosecute. See NAS Report at 6-2: “Forensic scientists who sit administratively in law enforcement agencies or prosecutors’ offices, or who are hired by those units, are subject to a general risk of bias.” As the NAS Report stressed, the “traps created by such biases can be very subtle, typically one is not aware that his or her judgment is being affected.” *Id.* The NAS urged forensic fields to develop “rigorous protocols to guide these subjective interpretations,” and to take advantage of research from other areas regarding “the potential for bias and error in human observers.” *Id.* at S-6. Of course, no such safety nets were in place in the instant case.

18. Assuming *arguendo* that the Court finds that generally, bloodstain pattern analysis cannot be excluded, the defendant contends that the analysis in the instant case exceeds the scientific underpinnings of the field. The instant case involves [insert your facts]. The government's expert will testify that [insert your government expert's conclusions]. Alternate hypotheses, such as [insert your expert's theory] will be dismissed out of hand.
19. In the case at hand, adequate databases do not exist for bloodstains made by [insert your case facts]. Due to the incomplete databases for this type of bloodstain, misidentifications are inevitable. Examiners will underestimate the possible similarities between bloodstains made by criminal versus noncriminal means. The defendant's contention is that he [insert your theory]. There is no valid science that has proven error rates, or proficiency testing to negate this claim. Consequently, the government should not be allowed to present the testimony of a bloodstain analyst whose testimony is tantamount to pronouncing the defendant to be the murderer.
20. Bloodstain pattern analysis of this particular application has not developed the requisite statistical empirical foundations for claims of absolute causality. Substantial resemblances exist between expired and back spatter blood stains. The scientific inquiry is not a simple binary question of determining one or the other. These similarities in bloodstains made by criminal versus noncriminal causes require that a statistical question be answered to determine whether a particular cause was the source of the bloodstain pattern under observation. What is the likelihood that the bloodstain made by proximity to a shooting would substantially match a bloodstain made by being near to a shooting victim that is expiring blood? Bloodstain pattern

analysts do not even attempt to answer this question. Instead they fundamentally mislead judges and juries by claiming to be able to single out one cause as the source of a particular blood stain, to the exclusion of all other causes in the world.

CERTIFICATION OF SERVICE

This is to certify that a copy of the foregoing was placed in the United States mail, first class, postage prepaid and/or hand delivered to the _____ on the ____ day of _____, 2009.

Jodie English

EXHIBIT A:

NAS REPORT'S COMMENTS ON BLOODSTAIN PATTERN ANALYSIS

Strengthening Forensic Science in the United States: A Path Forward
<http://www.nap.edu/catalog/12589.html>

**STRENGTHENING FORENSIC SCIENCE IN THE UNITED STATES – PREPUBLICATION COPY
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BLOODSTAIN PATTERN ANALYSIS

Understanding how a particular bloodstain pattern occurred can be critical physical evidence, because it may help investigators understand the events of the crime. Bloodstain patterns occur in a multitude of crime types—homicide, sexual battery, burglary, hit-and-run accidents—and are commonly present. Bloodstain pattern analysis is employed in crime reconstruction or event reconstruction when a part of the crime scene requires interpretation of these patterns.

However, many sources of variability arise with the production of bloodstain patterns, and their interpretation is not nearly as straightforward as the process implies. Interpreting and integrating bloodstain patterns into a reconstruction requires, at a minimum:

- an appropriate scientific education;
- knowledge of the terminology employed (e.g., angle of impact, arterial spurting, back spatter, castoff pattern);
- an understanding of the limitations of the measurement tools used to make bloodstain pattern measurements (e.g., calculators, software, lasers, protractors);
- an understanding of applied mathematics and the use of significant figures;
- an understanding of the physics of fluid transfer;
- an understanding of pathology of wounds; and
- an understanding of the general patterns blood makes after leaving the human body.

Sample Data and Collection

Dried blood may be found at crime scenes, deposited either through pooling or via airborne transfer (spatter). The patterns left by blood can suggest the kind of injury that was sustained, the final movements of a victim, the angle of a shooting, and more. Bloodstains on artifacts such as clothing and weapons may be crucial to understanding how the blood was deposited, which can indicate the source of the blood. For example, a stain on a garment, such as a shirt, might indicate contact between the person who wore the shirt and a bloody object, while tiny droplets of blood might suggest proximity to a violent event, such as a beating.

Analyses

Bloodstain patterns found at scenes can be complex, because although overlapping patterns may appear simple, in many cases their interpretations are difficult or impossible.^{135,136} Workshops teach the fundamentals of basic pattern formation and are not a substitute for experience and experimentation when applying knowledge to crime reconstruction.¹³⁷

¹³⁵ H.L. MacDonell. 1997. *Bloodstain Patterns*. Corning, NY: Laboratory of Forensic Science; S. James. 1998. *Scientific and Legal Applications of Bloodstain Pattern Interpretation*. Boca Raton, FL: CRC Press; P. Pizzola, S. Roth, and P. DeForest. 1986. Blood drop dynamics—II. *Journal of Forensic Sciences* 31(1): 36-49.

¹³⁶ Ibid.; R.M. Gardner. 2004. *Practical Crime Scene Processing and Investigation*. Boca Raton, FL: CRC Press; H.C. Lee; T. Palmbach and M.T. Miller. 2005. *Henry Lee's Crime Scene Handbook*. Burlington, MA: Elsevier Academic Press, pp. 281-298.

¹³⁷ W.J. Chisum and B.E. Turvey. 2007. *Crime Reconstruction*. Burlington, MA: Elsevier Academic Press.

Such workshops are more aptly applicable for the investigator who needs to recognize the importance of these patterns so that he or she may enlist the services of a qualified expert. These courses also are helpful for attorneys who encounter these patterns in the course of preparing a case or when preparing to present testimony in court.

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Strengthening Forensic Science in the United States: A Path Forward
<http://www.nap.edu/catalog/12589.html>

FORENSIC SCIENCE DISCIPLINES – PREPUBLICATION COPY

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Although there is a professional society of bloodstain pattern analysts, the two organizations that have or recommend qualifications are the IAI and the Scientific Working Group on Bloodstain Pattern Analysis (SWGSTAIN). SWGSTAIN's suggested requirements for practicing bloodstain pattern analysis is outwardly impressive, as are IAI's 240 hours of course instruction. But the IAI has no educational requirements for certification in bloodstain pattern analysis.¹³⁸

¹³⁸ See "Bloodstain Pattern Examiner Certification Requirements," available at: theiai.org/certifications/bloodstain/requirements.php.

This emphasis on experience over scientific foundations seems misguided, given the importance of rigorous and objective hypothesis testing and the complex nature of fluid dynamics. In general, the opinions of bloodstain pattern analysts are more subjective than

scientific. In addition, many bloodstain pattern analysis cases are prosecution driven or defense driven, with targeted requests that can lead to context bias.

Summary Assessment

Scientific studies support some aspects of bloodstain pattern analysis. One can tell, for example, if the blood spattered quickly or slowly, but some experts extrapolate far beyond what can be supported. Although the trajectories of bullets are linear, the damage that they cause in soft tissue and the complex patterns that fluids make when exiting wounds are highly variable. For such situations, many experiments must be conducted to determine what characteristics of a bloodstain pattern are caused by particular actions during a crime and to inform the interpretation of those causal links and their variabilities. For these same reasons, extra care must be given to the way in which the analyses are presented in court. The uncertainties associated with bloodstain pattern analysis are enormous.
