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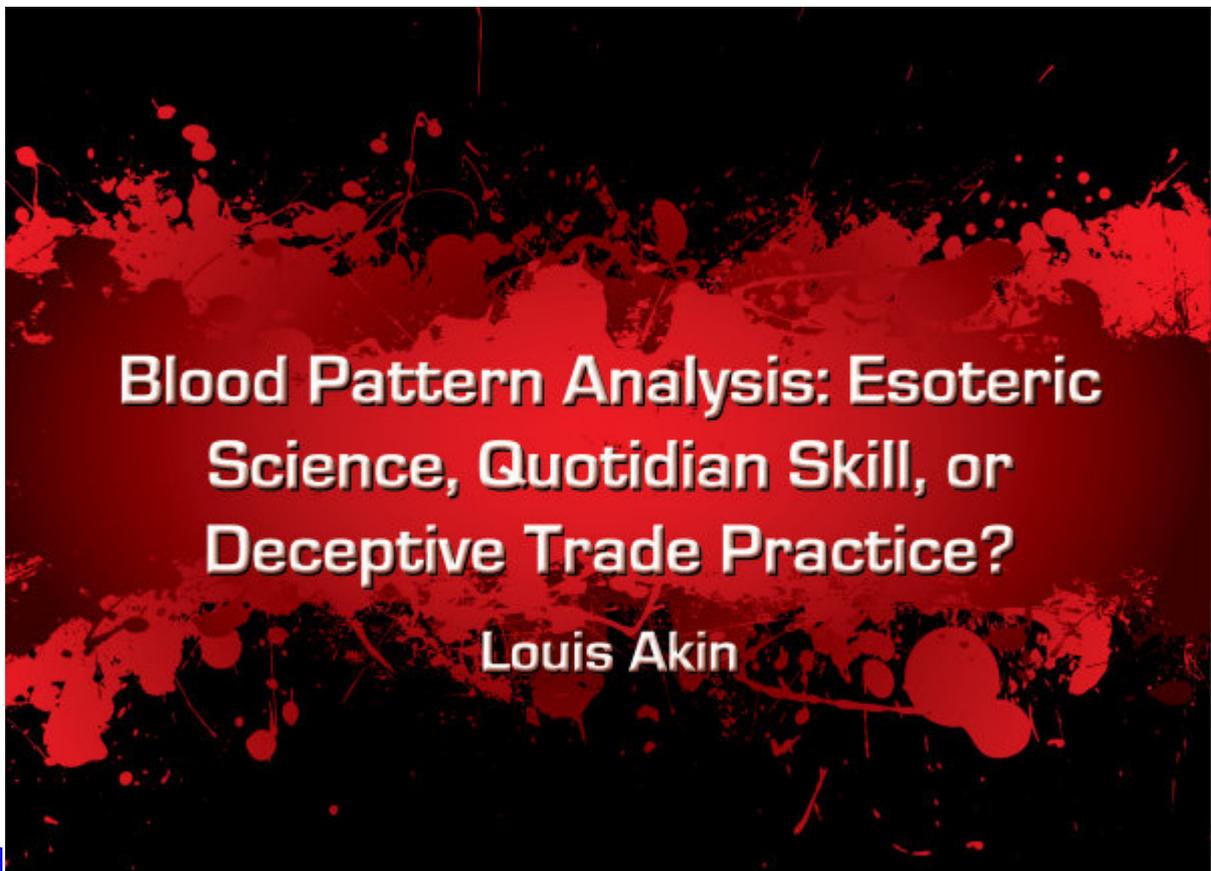
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Blood Pattern Analysis: Esoteric Science, Quotidian Skill, or Deceptive Practice?

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Too many false allegations have been offered in the name of science and too many people have suffered serious damage?even life-long damage?as a result. It is time to put all of this to an end.

?T. W. Young1

In a courtroom in Texas earlier this year, a Blood Pattern Officer swore on the stand that Blood Pattern Analysis is an exact science. She dismissed the NAS and the Texas Forensic Science Commission reports saying that neither found that blood pattern analysis wasn't a science. Her answer stayed with the jury.

Is blood pattern analysis methodology an exact science as the officer testified or merely a skill that anyone

of average intelligence can learn in a one-week course? Are parts of it outright chicanery, which would make it a deceptive practice? One thing is for certain: Blood Pattern Analysis employs irrelevant math and trigonometry calculations to disguise the fact that the analysts are guessing at key measurements upon which their conclusions are based.

Each time analysts take the stand they testify that they use physics to reach conclusions, but they don't. And if they don't, isn't that perjury?

In 1955, Berkeley biochemist and criminalist Paul Kirk introduced Blood Pattern Analysis, then called interpretation, into a courtroom in *State of Ohio v. Samuel Sheppard*. Since then, and after a long delay, the discipline has become a major part of crime-scene investigation and reconstruction. Blood Pattern Analysis has been studied by scientists and nonscientists. The application of the methodology has grown worldwide, and untold numbers of people have been found guilty as a result of blood pattern experts' testimonies.

In 1970, criminalist Herbert MacDonnell's research on blood patterns culminated in a pamphlet entitled *Flight Characteristics and Stain Patterns of Human Blood*.³ In the manual he described the characteristics of liquid blood, the shapes of blood stains, impact angles, splashed blood, projected and cast-off blood, the velocities of blood, and other related topics. MacDonnell proposed that the following determinations could be made from an analysis:

1. The distance from the stain to the Area of Origin;
2. The Area of Origin in three-dimensional space;
3. The type of impact that caused the stains;
4. The number of blows delivered;
5. The movement of the assailant and of the person assailed.⁴

MacDonnell stated that analysts must determine the Area of Origin—that is, the area in space from which the blood hemorrhaged. Those calculations, which are the first two enumerated, are the keys to making other determinations about what happened and how it happened. We will see that those first two determinations he stated could be made can only be guessed at using the irrelevant trigonometric formula relied upon by analysts.

The Tangent Method

In 1995, two Swedish police officers who taught blood pattern analysis at the Swedish National Police College arrived at the 42nd Blood Stain Institute in Corning, New York, and announced what is called the Tangent Method of determining the Area of Origin.⁵ They explained that the analyst could discover the Area of Origin (AO) by using a scientific calculator. This function would supposedly indicate the Area of Origin on the vertical axis based on an estimation of where the Area of Convergence was imagined to be.

Professor Victor Baltazard had proposed how the angle a drop of blood struck a surface could be determined in a paper he presented in 1939.⁶ Unfortunately, Baltazard's discovery was a contribution to analysis that has been grossly misused and tells nothing more than the angle at which the drop struck the floor. It does not determine the trajectory of the droplet through the air, and this is where the deception begins. Neither strings at that angle nor the hypotenuse of a triangle imposed by laser upon the stain gives any insight to the droplet's flight path. Consequently, the first two determinations that MacDonnell enumerated were not discoverable through trigonometrics.

False Impressions on the Jury

When blood pattern analysts with no academic science education take the stand and are asked by the prosecutor, "What is blood pattern analysis?" they are trained to parrot the following memorized lines:

?Bloodstain pattern analysis involves the scientific study of the static consequences resulting from dynamic blood shedding events.?7

To impress the jury, analysts are trained to state that the analysis involves the use of math, physics, biology, and trigonometry. They have memorized answers about those topics. In fact, no physics or biology are taught in blood pattern classes, and the only trigonometric formula taught is a wrong one. Does that testimony amount to perjury?

When, in the second edition of their text, Bevel and Gardner defined the terms they wanted blood pattern experts to use, they instructed their readers to use the term *analysis* instead of *interpretation* as previous experts had used because ?interpretation,? on the other hand, alludes to a more subjective viewing.?8 Yet, *subjective* is the primary word scientists use to describe their opinion of the blood pattern discipline.

To a juror, the word *science* connotes methodology, precision, accuracy, and exactness based on testing by a qualified scientist. When a witness takes the stand and tells the jury that he, or she, is a scientist, or that what she or he is doing is science, the jury gives more credence to what the witness says. The jurors assume that the witness arrived at his or her conclusions based not just on a week or two of training but on previous scientific education, and that he or she is using proven formulas that reach accurate conclusions.

The International Association of Blood Pattern Analysts (IABPA) and International Association of Identification (IAI) have requirements for training, yet they have none for academic education. The National Academy of Science (NAS) *Strengthening Forensic Science* report stated quite clearly: ?This emphasis on experience over scientific foundations seems misguided. In general, the opinions of bloodstain pattern analysts are more subjective than scientific.?9

An FBI communique produced for the Scientific Working Group on Bloodstains (SWGSTAIN) in 2008 gave analysts twelve questions prosecutors should ask analysts when they take the stand.¹⁰ The answers to be memorized are two or three sentences long, and every answer uses the word ?science? at least once?and in some answers as many as three times (?the purpose of the *scientific* study of blood pattern analysis . . .?¹¹).

The instructions go on to state that ?an answer should reference the use of mathematics and scientific principles from biology and physics . . .?¹² That statement is particularly deceptive in that there is no instruction in either biology or physics in the three classes required to become an expert.

Blood pattern examiners, who prefer to be called analysts because it sounds more scientific, tell the jury that pattern interpretation involves the use of math, trigonometry, and even fluid dynamics and physics. Yet the single operation in which interpreters use trigonometry is in calculating the Area of Origin (which is the heart of the analysis), and they use an irrelevant trigonometric formula?the Tangent Method?which was derived to calculate the hypotenuse of a triangle. A glance at classic architecture will tell you why.

The Tangent Method and Its Misuse

The Tangent Method is accurate when it is used in the applications it was intended for, but not when it is used to calculate the origin of blood stains. The Tangent Method gives only the maximum length of the hypotenuse of a triangle?which, in turn, gives at best the maximum height from which the drop could have traveled on a straight plane and does not allow for the parabolic arc of droplets in flight caused by gravity. Gravity simply cannot be left out of the equation and replaced with guesswork. Gravity is altering the course of the drop every nanosecond as it flies through the air.

Importantly, physicist Varney and Gites proved that ?even when its vertical axis is known, however, the height of a source is not deducible from the location and impact angle of individual drops.?13 That single

statement proves blood pattern analysis to be a false pretense of science.

Blood pattern instructors teach that the analyst should ignore the results of the calculations of the Tangent Method after performing them and instead fantasize an area the size of a volleyball as the Area of Origin. In other words, since the trigonometry doesn't provide what you want, discard it and make a self-confirming guess at where the blood originated. This approach is anything but scientific no matter how much adoration one pretends to pay to Scientific Method.

When the witness says that he or she "estimates an area about the size of a volleyball," he or she is literally admitting to wild-guessing at where the Area of Origin was located. Passing those guesses off as scientific conclusions is deceptive. The volleyball could as easily be a beach ball or the box a refrigerator came in. So where should the analyst hold the volleyball in the possible area? Wherever he or she wants to hold it. The point is that the current calculation of the origin using the straight-line Tangent Method is irrelevant and would seem to be fraud if the analyst tries to foist it on a jury.

Confirmation Bias

The "holistic"¹⁴ approach to blood pattern analysis teaches that the totality of evidence the police have gathered—reports, witness statements, physical evidence, etc.—should be part of the evidence the analyst uses to analyze blood patterns. Few, if any, true scientists would agree with that proposition.

William C. Thompson, in an article for *Scientific Testimony*, an online journal, stated: "Forensic DNA analysts often rely on subjective judgment when interpreting test results. Whether a test is interpreted as a damning incrimination or a complete exculpation may depend entirely on a subjective determination. If analysts were blind to the expected result when they made these determinations, then their reliance on subjective judgment would create few problems."

He then goes on to point out: "Analysts often are in direct contact with detectives and hear all about the case at least from the police perspective. They may even see themselves as part of the law enforcement team, whose job it is to help "make the case" against an obviously guilty suspect. These circumstances create a danger that analysts may intentionally or unintentionally be biased toward the police theory of the case when making subjective determinations."¹⁵

Paul Kish, a more scientifically inclined analyst, tested the holistic theory and found that examiners who were exposed to contextual information, such as police reports and other evidence, were more vulnerable to Confirmation Bias and, as a result, misclassifying stains. "This means that at the stage of pattern classification, additional case specific information such as medical findings, case circumstances, and even witness testimony is being allowed to factor into analysts' interpretations." Kish et al. found that "it seems prudent for practitioners and agencies to take steps to minimize the effects of contextual information."¹⁶

Research by other analysts comes to the same conclusion about confirmation bias in blood pattern analysis. "Like many forensic disciplines, Blood Pattern Analysis shows all three of the characteristics that converge to form "perfect" conditions for contextual bias: ambiguity, a rich contextual environment, and subjective methodology."¹⁷

Allan Jamieson, director of the Forensic Institute, warns: "The traditional approach at crime scenes has been for the investigator to be briefed on arrival of the story or stories circulating at the time of their arrival. This briefing has been included in many procedural documents and is accepted practice in many cases. It is, however, contrary to the approach proposed here because it inevitably channels the investigator's thinking and could introduce bias in the investigation."¹⁸

In his article "Mistakes I've Made,"¹⁹ Tom Bevel attributes serious errors in his logic that led to wrongful convictions in his cases to a holistic approach and the fact that "the existing case files possessed a

concentration of documents which naturally suggested that the suspects were guilty. The files possessed many fewer documents offering other alternatives.? He says, ?I unreflectively allowed myself to think that way as well.?

This is the danger of the so-called holistic approach to Blood Pattern Analysis. Bevel?s problem is the very definition of confirmation bias resulting from exposure to contextual information. It is the reason that blood pattern analysis should be performed scientifically and not holistically. Those cases were real-life disasters for defendants that resulted from subjective, biased thinking instead of objective scientific reasoning.

Jamieson proposes a methodology in which ?the scientist must begin at the level of the smallest practical piece of physical evidence, initially without reference to any other piece of evidence.? Such an approach would disallow a great percentage of the subjective unverified interpretations made by analysts and presented as fact in courts.

There are further errors in blood pattern analysis methodology. ?Accuracy? and ?precision? are two fundamental standards in scientific measurement. Without them, measurements would be inexact and ambiguous. Accuracy refers to how close measurements are to the true value, while precision describes how close repeated measurements are to each other. The Tangent Method cannot precisely or accurately measure the Area of Origin of blood from the patterns created by a bloodletting.

A third key word in scientific research is ?reproducibility,?which means that when one scientist?s measurements or research is replicated by other scientists the results should come out the same. Yet blood pattern experts often show up in court with no report or with a report that doesn?t contain actual reproducible calculations and measurements that were used to determine the Area of Origin. Presumably, no measurements were even made.

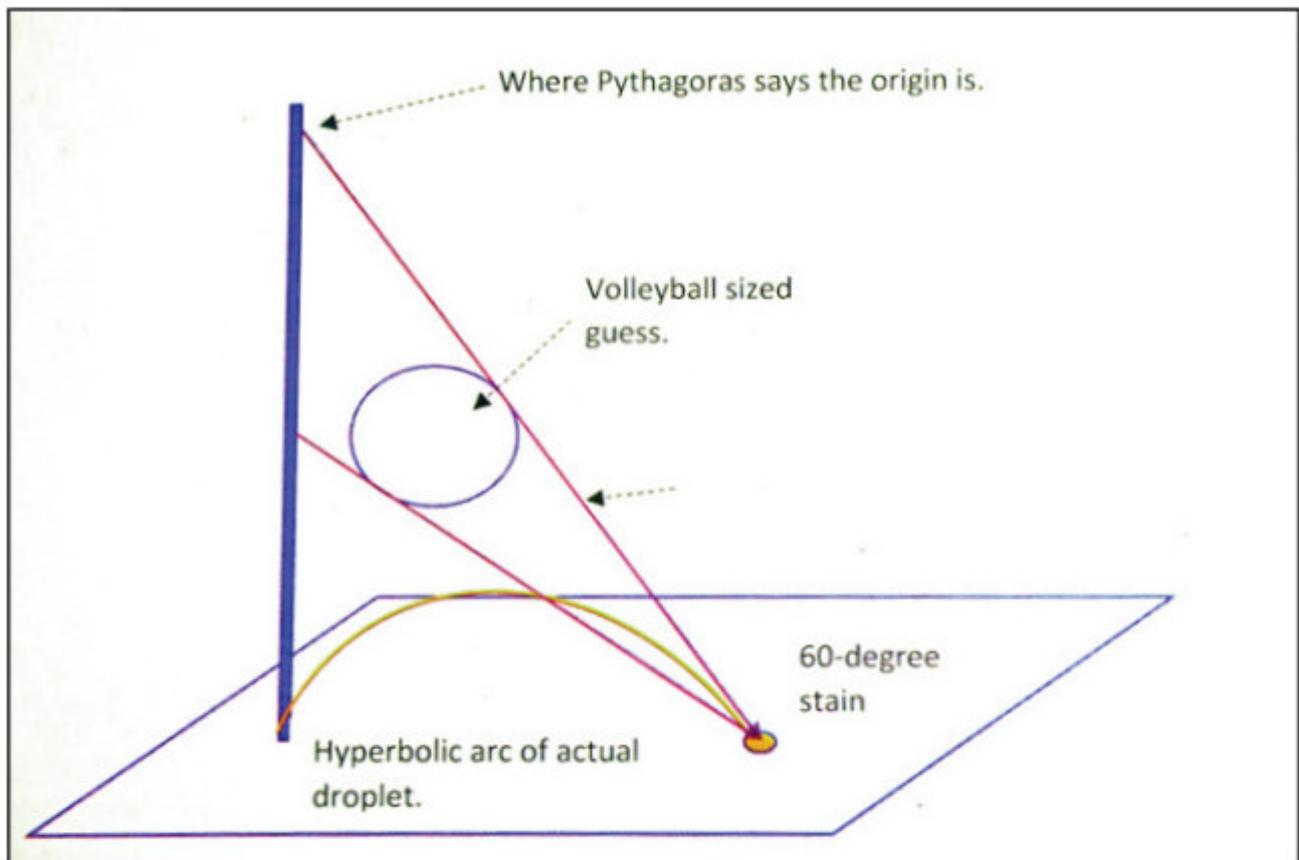


Figure 1. Errors of the Tangent Method and Volleyball Pretense

What the Trigonometry and Volleyball Pretenses Get Wrong

In the diagram above, Tangent Method does not give a trajectory anywhere near the actual trajectory of the blood drop. The Tangent Method gives a Point of Origin that is far removed from the actual Point of Origin. Calling it an "Area of Origin" does not close the gap.

Yet, while the Tangent Method miscalculates this measurement, the Volleyball Pretense only compounds the problem.

Volleyball Pretense

By holding a volleyball halfway along the hypotenuse imposed by the Tangent Method, two mathematical functions are in error. First, the hypothesis created by the Tangent Method delineates the highest possible point of the location of the Point of Origin, yet the volleyball holder could place it above that point, an impossible flight path. Secondly, the volleyball imposes hundreds of angles from the Z axis to the stain that have no mathematical support whatsoever. This could make the difference between a man on his knees and a man standing fully upright.

Is There a Formula to Accurately Define an Area of Origin?

In February 2011, physicists Christopher Varney and Fred Gites published an article²⁰ that shook up the world of blood pattern analysis. Varney and Gites had experimented with blood spatter and derived an equation that would pinpoint the origin of a pattern. The equation is:

$$Z_0 = (t_1 - t_2) / 2r_2 - 2r_1$$

The new equation uses physics to reverse-calculate height by finding an elevation consistent with two blood drops. If enough of the pairs of drops approximately agree (indicating that they flew off the victim at a similar angle), then the investigator can state an accurate Area of Origin. Unlike the Tangent Method, the new equation will determine the actual Point of Origin.

Unfortunately, Gites and Varney found the blood pattern community unreceptive to the new equation.²¹ Blood pattern instructors are still teaching police officers the Volleyball Pretense. If the opposing expert on the stand has told the jury that blood pattern analysis involves the use of physics, ask him or her to explain Gites and Varney's formula.

So, Is Blood Pattern Analysis a Science, a Quotidian Skill, or a Deceptive Practice?

As to determining the point, or area, of origin, the analytic methodology is mere chicanery that does not determine the position in space for which it is used. The Volleyball Pretense is the rabbit in the hat.

Except for determining the Area of Origin in a bloodletting incident, Blood Pattern Analysis is an effective skill to use in crime-scene investigation. From the blood patterns, the examiner might determine approximately where a person was standing, about where the person moved in the scene, if the person was repeatedly struck with a sharp or blunt object, and estimate how many times the person was struck. It can reveal if an artery was breached, what the person touched as they moved about the room, as well as approximating how much blood was lost²²and, with the help of DNA analysis, how many persons were bleeding in the scene. Basically, analysis can help approximate what happened in a scene.

What blood pattern interpretation cannot do is give accurate answers to the question of the Area of Origin of blood to a scientific certainty as is routinely claimed in court. In fact, some of the most popular textbooks on blood patterns fail to convince scientists that the text's authors have even a competent understanding of science.²²

Blood pattern interpretation, as it is currently taught in blood pattern textbooks and classes, is at best a skill that can be taught to persons with no scientific education. In the hands of a non-scientist, no matter how grand his or her titles or certifications granted by the IABPA, analysis remains a skill that may be developed into an art and possibly, at best, an applied science, but it is largely subjective and parts of it are illusory.

As the NAS pointed out in its Report, Rule 702, 2000 Amendment, Federal Rules of Evidence: If scientific, technical, or specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education may testify thereto in the form of an opinion or otherwise (1) the testimony is based upon sufficient facts or data, (2) the testimony is the product of reliable principles and methods, and the witness has applied the principles and methods reliably to the facts of the case.²³

Rule 702 does not distinguish between scientific and other forms of expert testimony. Nothing in the amendment is intended to suggest that experience alone²⁴or experience in conjunction with other knowledge, skill, training, or education²⁴may not provide a sufficient foundation for expert testimony.²⁴

Therefore, a person with specialized knowledge and training in blood pattern analysis does not have to be a scientist to qualify as an expert.

This argument that blood pattern analysis as currently practiced is a skill rather than science is supported by the National Academy of Science's summary assessment:

- a. Scientific studies support some aspects of bloodstain pattern analysis.
- b. The uncertainties associated with analysis are enormous.

In view of the NAS perspective on blood pattern interpretation, perhaps the best title for an on-scene practitioner is Blood Pattern Technician.

One Last Note

For too many years, blood pattern authors have been teaching their students, who never question them, that it is "blood spatter" rather than "blood splatter" because *spatter* is a noun and *splatter* is a verb.²⁵ No one bothered to look it up. Actually, spatter and splatter can both be used as a noun or a verb. Spatter connotes a light sprinkling, whereas splatter connotes a heavier splashing. In a scene where there is scant blood, only a sprinkling of a few drops, the proper word would be "spatter." Where there was a stabbing or clubbing to death, the proper word would more likely be "splatter."

Notes

1. Young, TW. [5]<http://www.heartlandforensic.com/writing/putting-it-all-together-the-log...>
2. Sec. 37.03. AGGRAVATED PERJURY. (a) A person commits an offense if he commits perjury as defined in Section 37.02, and the false statement:
 - (1) is made during or in connection with an official proceeding; and
 - (2) is material.
- Sec. 37.04. MATERIALITY. (a) A statement is material, regardless of the admissibility of the statement under the rules of evidence, if it could have affected the course or outcome of the official proceeding.
3. McDonnell, Herbert L., *Flight characteristics and Stain Patterns of Human Blood*, National Institute of Law Enforcement and Criminal Justice, Us Dept of Justice 1971.
4. The lists of precisely what information can be learned by the interpretation of bloodstain patterns are similar for James and Eckert, Hueske, Slemko, Bevel and Gardner, and Sutton.
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 11. *Ibid.*
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 13. Christopher Varney and Fred Gites, "Locating the source of projectile fluid droplets," Dept of Physics and Astronomy, Washington State University, Pullman WA 99164-2814.
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 15. Thompson, William C. "Examiner Bias in Forensic RFLP Analysis," Scientific Testimony, An Online Journal. [7]<http://www.scientific.org/case-in-point/articles/thompson/thompson.html>.
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 17. Rachel Zajac, Niki Osborne, LeeAnn Singley, and Michael Taylor. "Contextual Bias: What Bloodstain Pattern Analysts Need to Know," *Journal of Bloodstain Pattern Analysis* 11, Vol. 31 No. 2, September 2015 [9]<http://www.iabpa.org/uploads/files/iabpa%20publications/September%202015...>
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