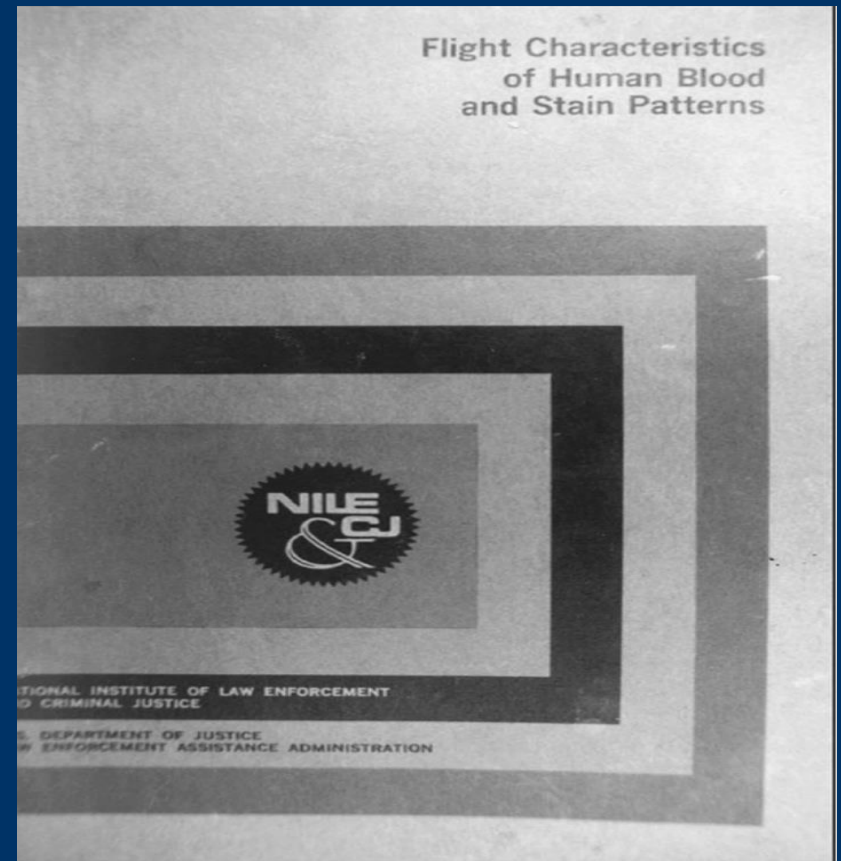


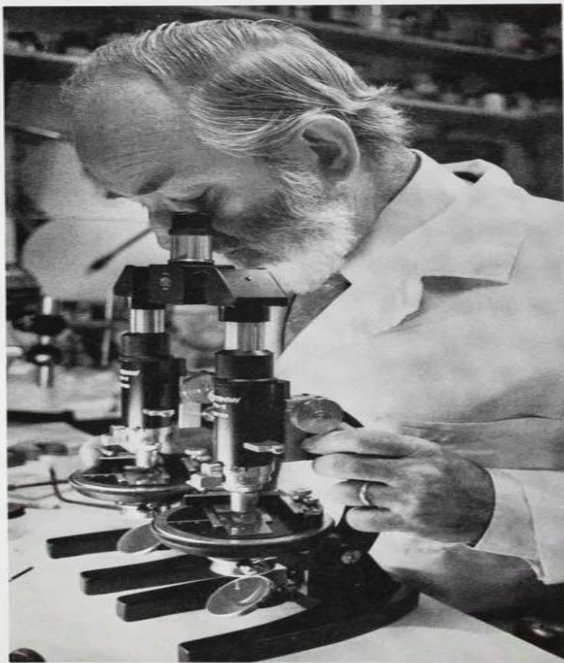
Bloodstain Pattern Analysis and the Gatekeeping Role of Canadian Courts

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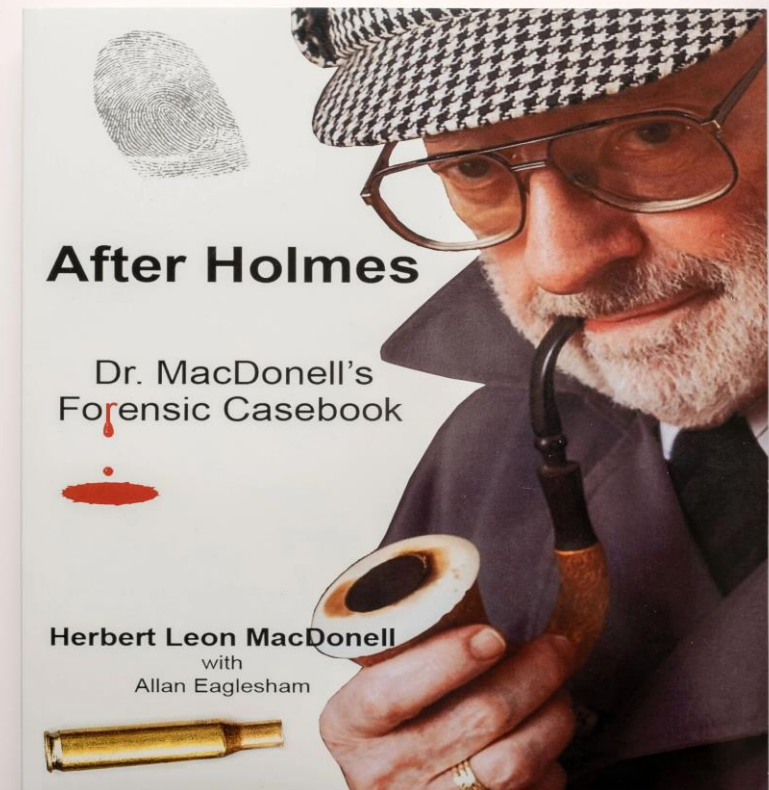
The Birth of the Discipline of BPA



The Birth of the Discipline of BPA



Professor Herbert Leon MacDonell, Director of the **BLOODSTAIN EVIDENCE INSTITUTE**, conducting a comparison polarization study of evidence in the **LABORATORY OF FORENSIC SCIENCE**.



The Birth of the Discipline of BPA



Journal of

Bloodstain Pattern Analysis

The official publication of the International Association of Bloodstain Pattern Analysts

One Thing To Note



What is BPA?

R v A.S.D., 2017 BCSC 2487

336 The premise is that blood is consistent in how it behaves in various situations and its movement follows the laws of physics, mathematics, and biology. This permits an analyst to work backwards from the presence of a bloodstain in a location and to make observations about the type of physical action that likely placed it there. As Sgt. Dubyk elaborated in his evidence, the amount of information available to him in a given situation governs how specific he is able to be about the mechanism by which blood was deposited.

What is BPA?

Stage One: Classification

Descriptive Classification

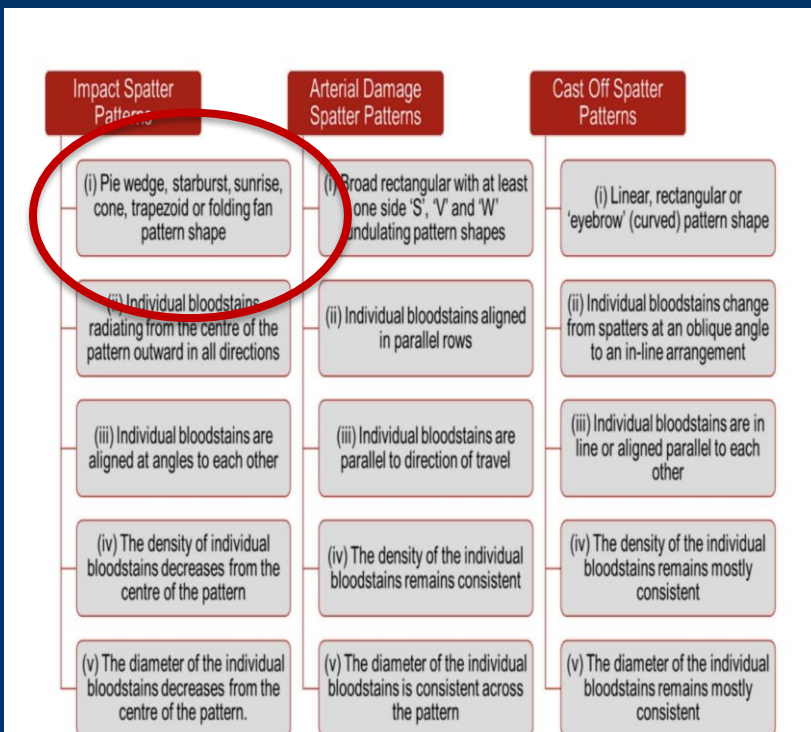
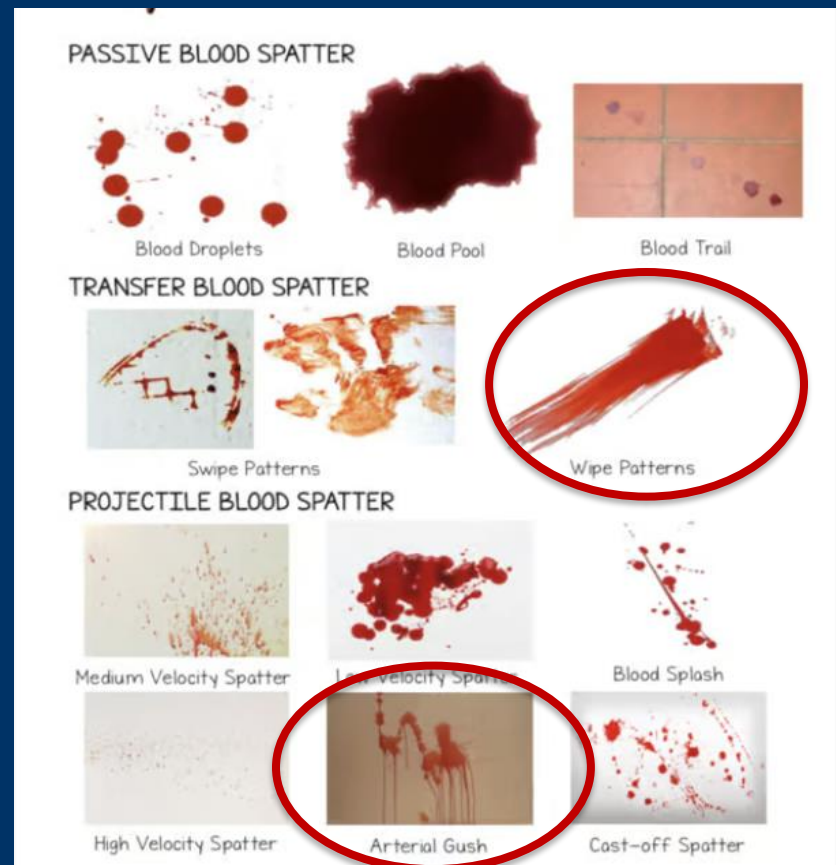


Fig. 3. The 'objective criteria' Wonder [44] used to differentiate between the different categories of spatter patterns for classification.

Mechanistic Classification



What is BPA?

Stage 2: Crime Scene Reconstruction



"No, Goldstein, I don't think we should try a silly one."

[36] Sergeant Spenard, an expert in blood spatter analysis, analyzed the pattern of blood spatter in the kitchen, on the rifle and on Mr. McDonald's clothing and came to the opinion that Laurie McDonald was standing upright at the kitchen counter slightly left of the sink looking towards the doorway between the kitchen and the hall when she was shot in the front of the head. He concluded that when Mr. McDonald fired the rifle he was standing slightly inside the kitchen entrance holding the rifle at the same height or slightly lower than the entrance wound at a distance of between 33 and 42 inches from Laurie McDonald. Sgt. Spenard concluded Mr. McDonald was holding the rifle in a shooter's stance, i.e. with the butt against his shoulder and the gun levelled.

What is BPA?

Reconstruction & Mens Rea

apartment. In at least five different locations blood spatter attributed to the deceased was discovered that could have been caused by a kick to the head of Mr. Gonsalves while he was on or close to the ground. Blood spatter was found at other locations of similar heights that have yet to be tested. In at least two locations the blood source, which the Crown contends to be the head of the deceased, was on or centimetres from the floor when the impact took place the directionality of the blood in these locations was travelling upwards and parallel.

as the bloodstain pattern evidence indicating that the accused was likely prone and defenceless on the apartment floor when he was either kicked, punched or struck with a piece of marble tabletop.

There is little, if any, evidence suggesting that Mr. Walters and the deceased were engaged in a “fight”. To the contrary, a jury would be entitled to infer that this was a one-sided attack upon Gonsalves where Mr. Walters directed multiple blows to the head and neck of the deceased with an intention to either kill him or cause bodily harm of such a grave and serious nature that he knew was likely to result in the death of the death of Mr. Gonsalves.

What is BPA?

Blurred Boundaries

[561] I appreciate the submission by Mr. Zhao's counsel that once Mr. Yuan began bleeding, every area on which he had bled was a potential source of impact patterns based on the ongoing struggle between him and Mr. Zhao, along with Mr. Zhao's evidence that Mr. Yuan's blood was dripping on him. Nevertheless, I am satisfied that S/Sgt. Cockle's findings with respect to small spatter stains (indicative of greater force being applied than larger ones) at three different heights in the corner of the foyer near the garage door, including perpendicular stains on the wall indicating close proximity of the source to it are inconsistent with a back and forth exchange of blows that ended up hitting more than one deposited blood source, and much more consistent with a series of blows to one person within that location, which in light of the origins of the blood and my finding that Mr. Zhao struck him in the head while he was alive, I am satisfied was to Mr. Yuan. Given the need for a first blood source before spatter can be created by further blows, I find that these stains were the product of at least two such blows by Mr. Zhao with the hammer in that area and, in view of the different heights at which they were deposited, likely more, with Mr. Yuan positioned at different heights during them.

Descriptive
Classification

Mechanistic
Classification

Crime Scene
Reconstruction

What is BPA?

“Consistent With”

[13] Both Crown and defence called blood spatter experts. The Crown's blood spatter expert, Sergeant Mellis, opined that the blood spatter may have been limited given the nature of the blows and the wedge shape of the axe. The defence expert on blood spattering, Daniel Christman, testified that the small blood stains were consistent with the appellant having discovered, but not killed, the victims.

[33] Sgt. Mellis testified that the larger cast off blood spatter around the deceased was consistent with kicking but there could have been some stomping. Unlike Dr. Gray, he was reluctant to admit that the injuries to Mrs. Larochelle were probably caused by kicking. He was asked, if the assailant had stomped Mrs. Larochelle to death, would there not have been blood on the pants of the assailant, to which he answered, “You look for it – you will not always get that result.” He did not agree with Mr. Heller, that it was more likely than not to find blood on the pants from stomping.

Expert Testimony

White Burgess (SCC 2015)



Judges Are Gatekeepers

The Threshold Requirements (*Mohan* factors) + The Gatekeeping Stage

Stage One: The Threshold Requirements

1. Logical relevance
2. Necessary to assist factfinder
3. Does not violate any other exclusionary rule
4. Properly qualified expert
5. For opinions based on novel science, contested science, or science used for a novel purpose, the underlying science must be reliable.

Stage Two: The Gatekeeping Stage: If threshold requirements are met, the judge undertakes a cost/benefit balancing analysis to determine whether the evidence should be admitted.

Stage One: Novel & Contested Science

R v J-L.J., 2000 SCC 51

25 Expert witnesses have an essential role to play in the criminal courts. However, the dramatic growth in the frequency with which they have been called upon in recent years has led to ongoing debate about suitable controls on their participation, precautions to exclude “junk science”, and the need to preserve and protect the role of the trier of fact – the judge or the jury. The law in this regard was significantly advanced by *Mohan, supra*, where Sopinka J. expressed such a concern at p. 21:

Dressed up in scientific language which the jury does not easily understand and submitted through a witness of impressive antecedents, this evidence is apt to be accepted by the jury as being virtually infallible and as having more weight than it deserves.

(1) whether the theory or technique can be and has been tested:

Scientific methodology today is based on generating hypotheses and testing them to see if they can be falsified; indeed, this methodology is what distinguishes science from other fields of human inquiry.

(2) whether the theory or technique has been subjected to peer review and publication:

[S]ubmission to the scrutiny of the scientific community is a component of “good science,” in part because it increases the likelihood that substantive flaws in methodology will be detected.

(3) the known or potential rate of error or the existence of standards; and,

(4) whether the theory or technique used has been generally accepted:

A “reliability assessment does not require, although it does permit, explicit identification of a relevant scientific community and an express determination of a particular degree of acceptance within that community.”

What is “novel science”?



What is “novel science”?

R v Trochym, 2007 SCC 6



32 While some forms of scientific evidence become more reliable over time, others may become less so as further studies reveal concerns. Thus, a technique that was once admissible may subsequently be found to be inadmissible. An example of the first situation, where, upon further refinement and study, a scientific technique becomes sufficiently reliable to be used in criminal trials, is DNA matching evidence, which this Court recognized in *R. v. Terceira*, 1999 CanLII 645 (SCC), [1999] 3 S.C.R. 866. An example of the second situation, where a technique that has been employed for some time comes to be questioned, is so-called “dock”, or in-court, identification evidence. In *R. v. Hibbert*, [2002] 2 S.C.R. 445, 2002 SCC 39, at para. 50, Arbour J., writing for the majority, stated that despite its long-standing use, dock identification is almost totally unreliable. Therefore, even if it has received judicial recognition in the past, a technique or science whose underlying assumptions are challenged should not be admitted in evidence without first confirming the validity of those assumptions.

“Fairly Basic Blood Spatter Stuff”

[99] S/Sgt. Watts took the Court through an informative PowerPoint presentation to explain the science of Bloodstain Pattern Analysis. Basically, it is the examination of the number, size,

R v Harkness, 2025 BCSC 633

[335] Like the science underlying DNA identification, the basic principles that permit the analysis of bloodstain patterns are not in issue in this case, although certain variations on the application of those principles were raised in cross-examination.

[336] The premise is that blood is consistent in how it behaves in various situations and its movement follows the laws of physics, mathematics, and biology. This permits an analyst to work backwards from the

R v ASD, 2017 BCSC 2487

[67] This ground of appeal is without merit and warrants little comment. In the context of this trial, this was uncontroversial evidence, aptly described by the trial judge as “fairly basic blood spatter stuff”. Nor was it objected to by trial counsel (not counsel on

R v Soroush, 2022 MBCA 84

“The uncertainties associated with bloodstain pattern analysis are enormous.”

STRENGTHENING
**FORENSIC
SCIENCE**
IN THE UNITED STATES

A PATH FORWARD

FORENSIC SCIENCE DISCIPLINES

179

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.

TEXAS FORENSIC
SCIENCE COMMISSION

Justice Through Science

FINAL REPORT ON COMPLAINT BY THE HARRIS COUNTY PUBLIC DEFENDER'S OFFICE AGAINST THE HARRIS COUNTY INSTITUTE OF FORENSIC SCIENCES, HARRIS COUNTY SHERIFF'S OFFICE AND HOUSTON POLICE DEPARTMENT (BLOODSTAIN PATTERN ANALYSIS)

February 2, 2018



Henderson did recommend to the Commission that all bloodstain analysis reports be peer reviewed. Because bloodstain pattern analysis is typically performed outside the accredited laboratory setting, the checks and balances inherent in the quality system of a laboratory are not necessarily present. Henderson observed that “a local officer or a lab person becomes the “go-to guy” on bloodstain analysis and his work is never questioned.”

Testing & Known Error Rates - Classification

("An alarming number of errors")

Bloodstains on Rigid Surfaces

Pattern Classification Accuracy

Twenty-seven analysts made judgements on 15–16 target patterns each, yielding 416 unique assessments. Three assessments were removed from the analysis because no response was provided; 413 responses remained. In total, analysts were correct for 69.5% of classifications and made errors for 13.1% of classifications. The remaining 17.4% of responses were inconclusive. Chi-squared (χ^2) tests were performed to determine whether the frequency of correct, incorrect, and inconclusive responses varied significantly ($p < 0.05$) as a function of each of the variables under examination.

Michael C. Taylor et al, "The Reliability of Pattern Classification in Bloodstain Pattern Analysis, Part 1: Bloodstain Patterns on Rigid Non-absorbent Surfaces" (2016) 61:4 Journal of Forensic Sciences 922 [Taylor Rigid Surfaces]

Bloodstains on Fabric

Pattern Classification Accuracy

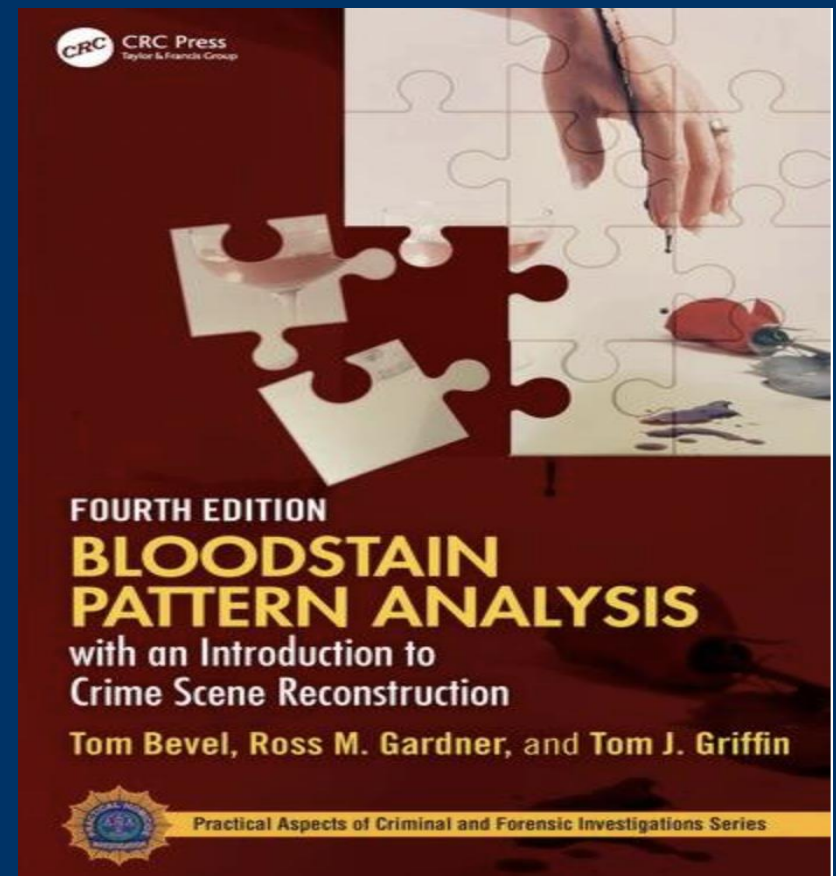
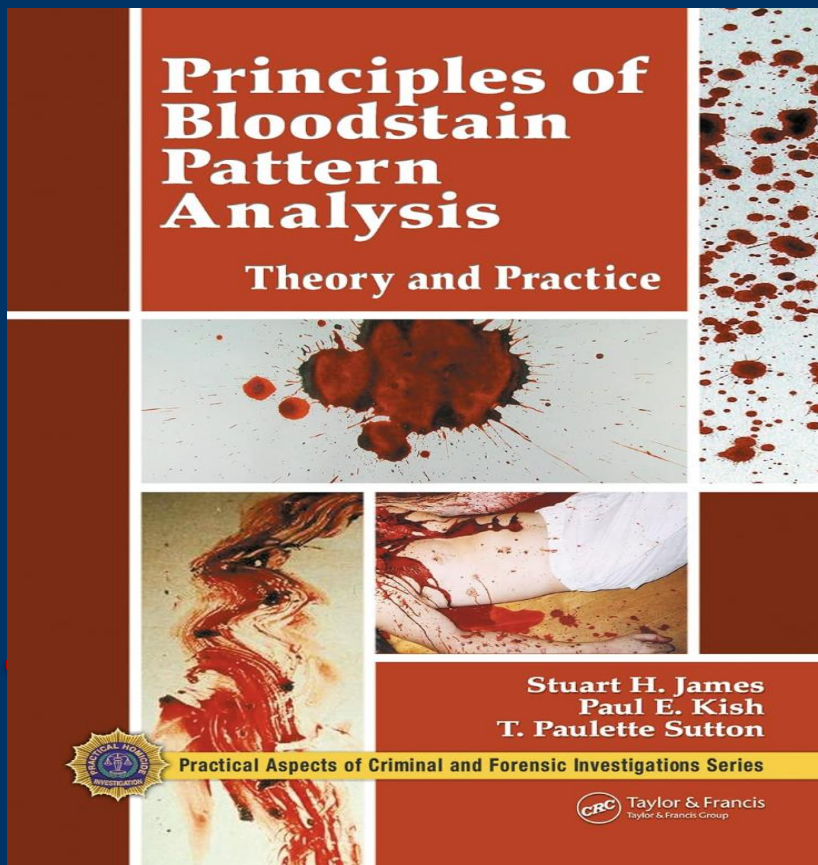
Across the study, 321 unique assessments were made. Overall, analysts were correct for 62.3% of classifications and made errors for 23.4% of classifications. The remaining 14.3% of the assessments were inconclusive. Chi-square tests were performed to determine whether the frequency of correct, incorrect, and inconclusive responses varied significantly ($p < 0.05$) as a function of each of the variables under examination.

Michael C. Taylor et al, "The Reliability of Pattern Classification in Bloodstain Pattern Analysis—Part 2: Bloodstain Patterns on Fabric Surfaces" (2016) 61:6 Journal of Forensic Sciences 1461 [Taylor Fabrics]

Testing & Known Error Rates – CS Reconstruction (“Overall error rates...are problematic”)

Swipe and wipe are types of transfer patterns commonly encountered at bloodied scenes. So far, there have been little published data on the reliability of evaluating these patterns. In this study, 36 bloodstain patterns were randomly assigned to 12 analysts in three separate trials, and the analysts were required to evaluate the pattern type and directionality. The results revealed that correct classifications of patterns type were problematic, with an overall error rate of 32%. Wipes created from wet bloodstains were the most difficult to identify due to the absence of signs of alteration. The directionality of swipes made with a gloved finger had a 100% success rate; however, for swipes made with cloth, the analysts mistook the direction in nearly every case, which is of significant concern, considering these are common patterns at crime scenes. This study suggested there is a need for revising the current protocols for interpretation of these pattern types.

Subjected to Peer Review & Publication



R. v. Luciano, 2004 CanLII 36087 (ON SC)

Subjected to Peer Review & Publication

[20] The report of Detective Webber was reviewed by a peer, Sergeant Illes, an experienced person in the field of bloodstain pattern analysis. The peer review involved Sergeant Illes having the report of Detective Webber as well as all his materials used to make his findings. Detective Webber advised that Sergeant Illes did not find anything wrong with the process and resulting conclusions reached in the report. That adds to the reliability of the evidence of Detective Webber.

R. v. Luciano, 2004 CanLII 36087 (ON SC)

General Acceptance



“Your Honour, I call Nigel From The Pub ... expert witness on whatever you like.”

[48] The appellant did not call BPA evidence at either his first or second trial. The appellant now says that issues concerning expert evidence such as bloodstain analysis are evolving, difficult and complex. In support of this argument, he refers to *R. v. Jenkins*, [2004] EWCA Crim 2047, that he calls a bellwether case and in which Mr. Slemko testified, and Terry Laber et al., “Reliability Assessment of Current Methods in Bloodstain Pattern Analysis” (2014) National Institute of Justice Final Report No. 247180. However, as the respondent argues, Canadian courts have considered BPA evidence for more than two decades and the appellant does not explain how any issue arising in this case has a connection with *Jenkins* or the report. Further, the *Jenkins* decision and the report were available to defence counsel well before trial.

White Burgess Stage 2: Gatekeeping & the Cost-Benefit Analysis

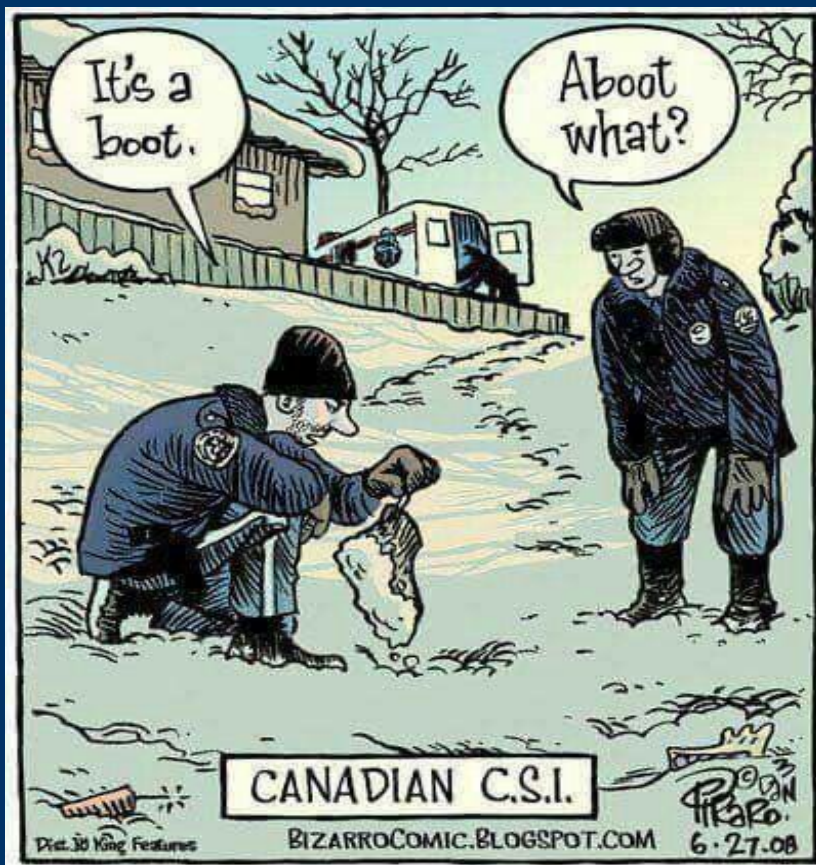
[16] At the second stage, the trial judge retains the discretion to exclude evidence that meets the threshold requirements for admissibility if the risks in admitting the evidence outweighs its benefits. While this second stage has been described in many ways, it is best thought of as an application of the general exclusionary rule: a trial judge must determine whether the benefits in admitting the evidence outweigh any potential harm to the trial process: *Abbey*, at para. 76. Where the probative value of the expert opinion evidence is outweighed by its prejudicial effect, it should be excluded: *Mohan*, at p. 21; *White Burgess*, at paras. 19 and 24.

[115] Expert evidence of dubious or questionable reliability has little probative value, and offers little benefit to the trial process. At the same time, evidence of questionable reliability risks distorting and prejudicing the fact-finding process: see *Mohan*, at p. 21.

R v Abbey, 2017 ONCA 640

R v Bingley, 2017 SCC 12

BPA Has Low Probative Value and High Prejudice



- Lack of a standardized methodology or agreed-upon terminology
- Reliance on nonscientist forensic examiners
- High susceptibility to bias due to subjective nature

Lack of Standardized Methodology

Classifying bloodstains is an essential part of Bloodstain Pattern Analysis. Various experts have developed methods. Each method considers the same basic bloodstain pattern types. These use either terminology based on the observable characteristics or the mechanistic cause of the bloodstain patterns as part of the classification process. This review paper considers ten classification methods from fourteen sources, which are used to classify bloodstain patterns. There are fundamental differences in how the patterns are classified, how differentiated the classification is, and whether the classification process uses clear, unambiguous criteria, and is susceptible to contextual bias. Experts have also reported issues with classifying bloodstains that have indistinguishable features. These differences expose key limitations with current classification methods: mechanistic terminology is too heavily relied on, and the classification process is susceptible to contextual bias. The development of an unambiguous classification method, based on directly observable characteristics within bloodstain patterns is recommended for future work.

Emma Hook et al, "Bloodstain Classification Methods: A Critical Review and a Look to the Future" (2024) 64:4 Science & Justice at 409

Reliance on Nonscientist Forensic Examiners

Energy per unit volume before = Energy per unit volume after

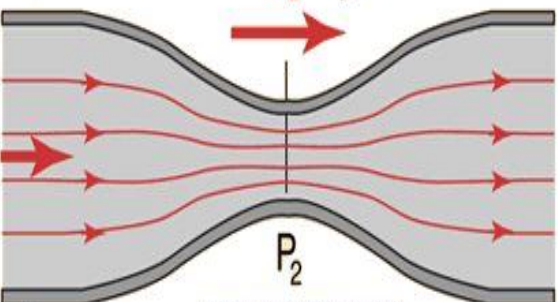
$$P_1 + \frac{1}{2}\rho v_1^2 + \rho gh_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho gh_2$$

Pressure
Energy

Kinetic
Energy
per unit
volume

Potential
Energy
per unit
volume

The often cited example of the Bernoulli Equation or "Bernoulli Effect" is the reduction in pressure which occurs when the fluid speed increases.



$A_2 < A_1$
 $v_2 > v_1$
 $P_2 < P_1!$

Increased fluid speed,
decreased internal pressure.

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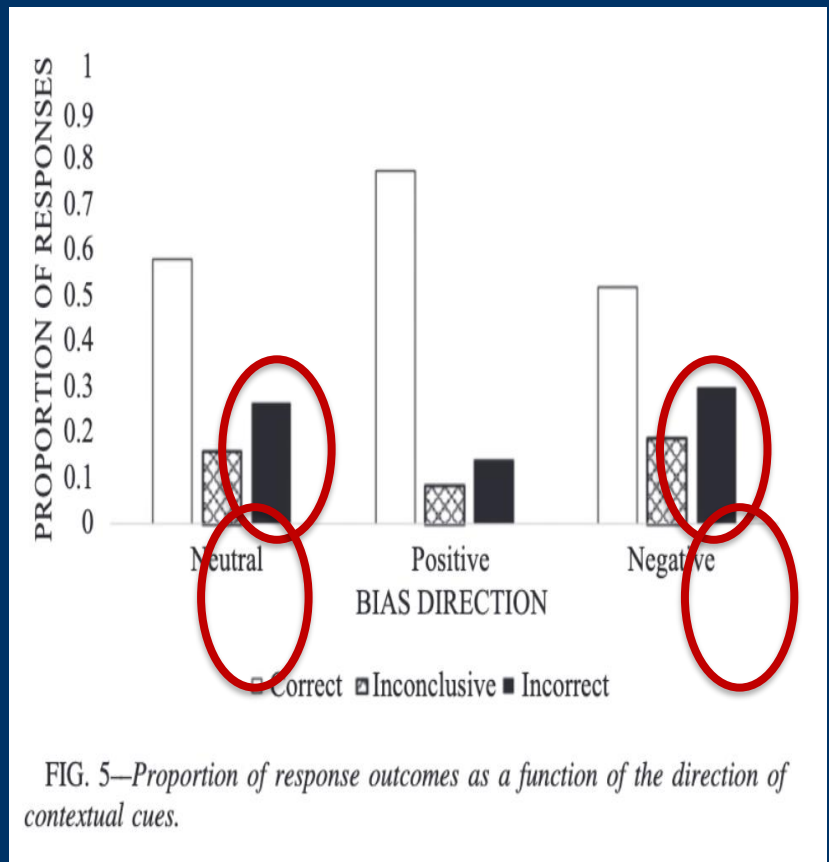
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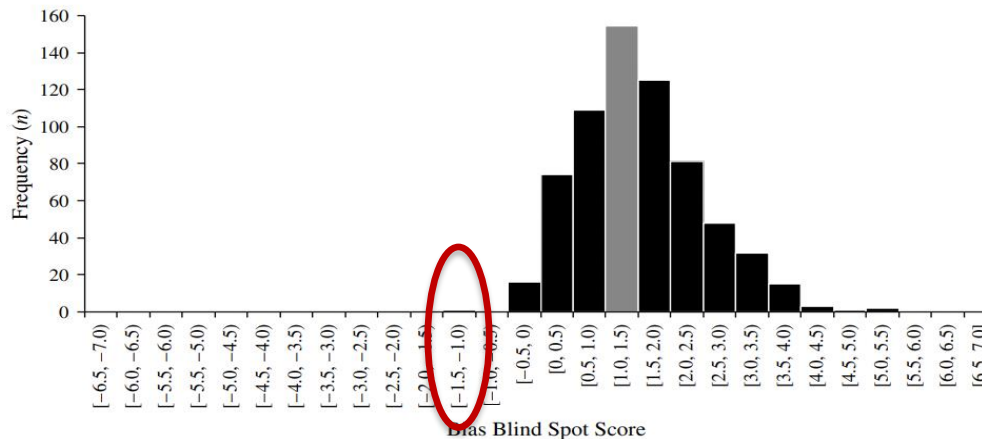
DEATH
INVESTIGATION
TRAINING ACADEMY

High Susceptibility to Bias



The Bias Blind Spot

Figure 1 Distribution of Bias Blind Spot Scores in Study 2



Notes. Scale ranges from 7 to -7. Scores greater than zero indicate bias blind spot. Median column is indicated by gray bar.

all p s < 0.001. At the individual level, a large majority (85.2%) of participants exhibited a significant bias blind spot across the 14 items, with the averages of their scores being marginally or significantly greater than 0; all t s(13) > 1.79, all p s < 0.10. Only one participant (0.1%) had an average bias blind spot score that was significantly lower than 0 ($t(13) = -2.46$, $p = 0.03$).

The Bias Blind Spot in Forensic Examiners

Table 1

Beliefs (%) about the Scope of Bias

	Yes	No	Don't know
In your opinion, is cognitive bias a cause for concern in the forensic sciences <i>as a whole</i> ?	70.97	17.37	11.66
In your opinion, is cognitive bias a cause for concern in <i>your specific domain</i> of forensic science?	52.36	36.97	10.67
In your opinion, are <i>your own judgments</i> influenced by cognitive bias?	25.69	54.11	20.20

Despite ample research showing that forensic science experts are influenced by irrelevant contextual information (e.g., a detective's opinion, a suspect's confession, forensic evidence from other domains; see [Kassin et al., 2013](#)), our findings suggest that many examiners have only a limited appreciation of cognitive bias or see themselves as impervious to it. Overall, our respondents believed their own judgments to be nearly infallible, including 37% who self-reported a 100% accuracy rate. Although they recognized that examiners sometimes form expectations that can influence their analysis, they denied that these expectations affect their conclusions. Moreover, while most examiners acknowledged cognitive bias as a cause for concern in other forensic domains, fewer saw their own domain as vulnerable, and still fewer saw themselves as vulnerable. This pattern suggests that many examiners maintain a *bias blind spot*—they tend to recognize biases in others while denying the existence of those same biases in themselves ([Pronin, Lin,](#)

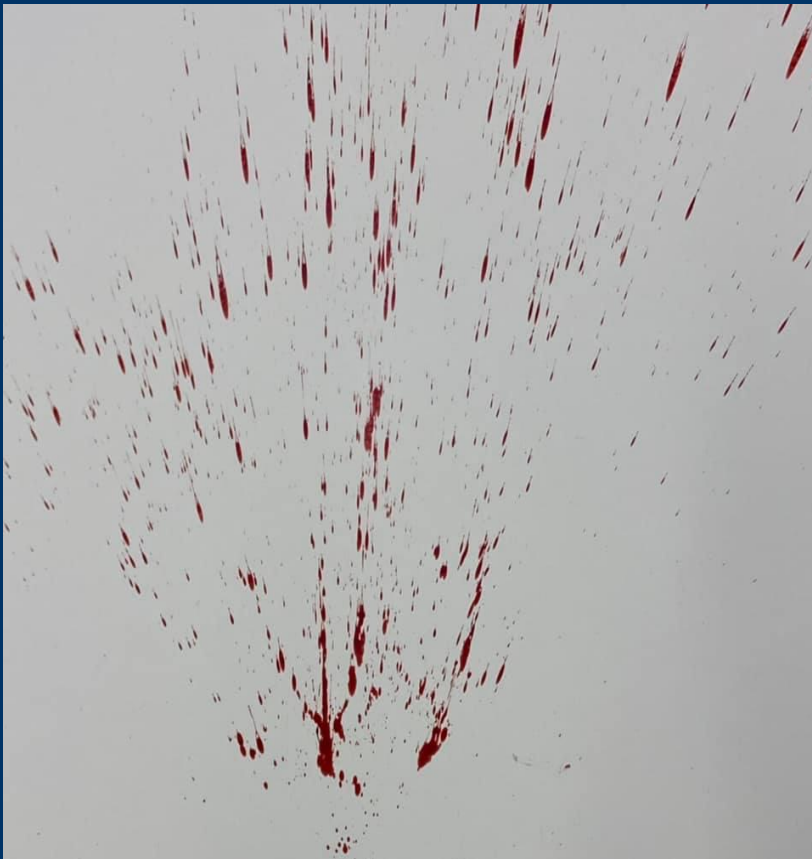
A Case-by-case Approach to BPA

Admissibility is not an all or nothing proposition. [See Note 6 below] Nor is the trial judge limited to [page351] either accepting or rejecting the opinion evidence as tendered by one party or the other. The trial judge may admit part of the proffered testimony, modify the nature or scope of the proposed opinion, or edit the language used to frame that opinion: see, for example, *R. v. Wilson*, [2002 CanLII 49653 \(ON SC\)](#), [2002] O.J. No. 2598, 166 C.C.C. (3d) 294 (S.C.J.).

- Descriptive classification
- Mechanistic classification
- Crime scene reconstruction

R v Hurtado, 2009 BCSC 1891

Descriptive Classification

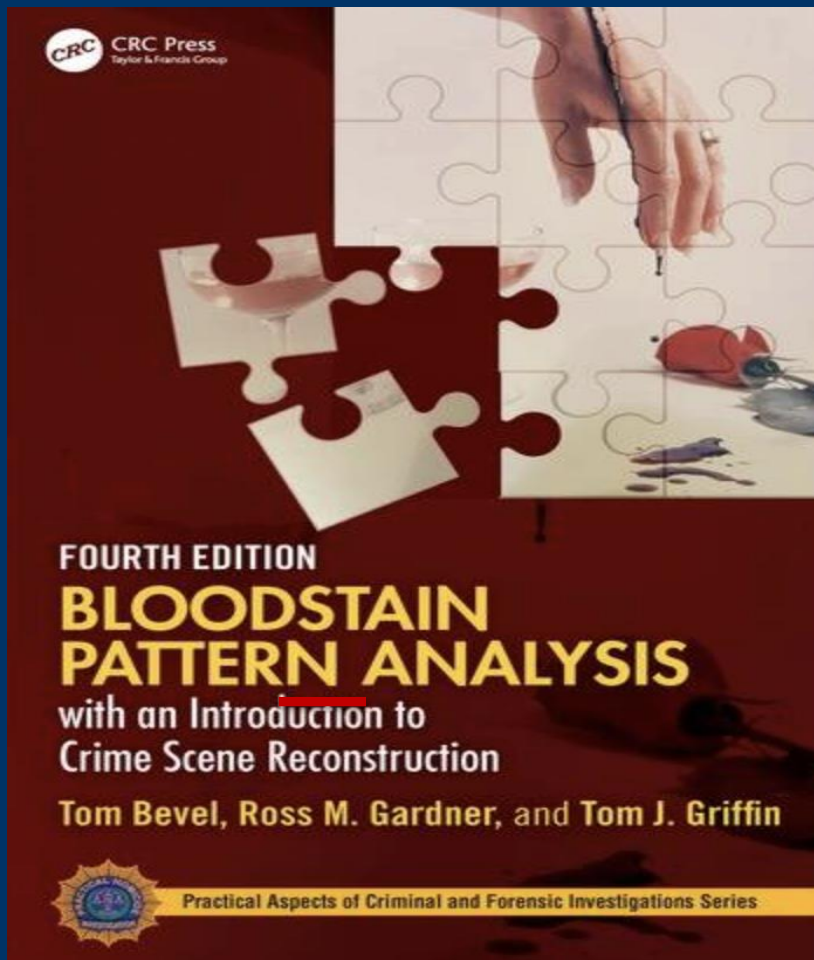


("medium-velocity impact spatter")

- Descriptive classification evidence should be treated as novel or contested science
- Courts should limit expert testimony to what is supported by the literature
- Examiners should disclose error rates and exposure to contextual information

R v Hurtado

Mechanistic Classification



Medium-velocity impact spatter (MVIS) were patterns in which the preponderant stain size was generally 1–4 mm in diameter, created as a result of some application of force.⁴ This type of spatter would now simply be referred to as Impact Spatter. Historically, they were reported as resulting from a force of up to 25 ft/s and were often associated with blunt force situations. The droplets produced are smaller than that found in low-velocity events, thus the resulting stains are smaller as well. This increased breakup (the smaller drops) is due to the additional force applied in the event.

High-velocity impact spatter (HVIS) were patterns in which the preponderant stain size was reported as 1 mm or less in diameter. These stains were reported as being

R v Hurtado

Mechanistic Classification

[26] The bloodstain expert expressed the opinion that the chair had been used for at least two medium-velocity impacts delivered to a passive blood source. That passive blood source was already bleeding at the time of the impacts, at or very near to the floor level, and at the time of the impacts was not moving or, if moving, moving very little.

[27] The Crown says that from all of that, the evidence should lead me to conclude that the so-called struggle between these two people at least ended in the following way: with Mr. Parker on the floor already bleeding, barely moving, if at all. And yet, in that situation, receiving several more blows to the head from the chairs. The Crown also suggests that the likely conclusion is that of the person delivering the blows with chairs, standing above Mr. Parker and slamming the chairs down on his body and head area.

- Examiners should limit terms used to describe and classify bloodstain patterns to the directly observable characteristics of the pattern.
- Should an expert attempt to classify a bloodstain pattern with reference to its mechanistic cause, they should be required to demonstrate that the specific mechanistic claim being made can be reliably distinguished from alternative explanations.

R v Hurtado

Crime Scene Reconstruction

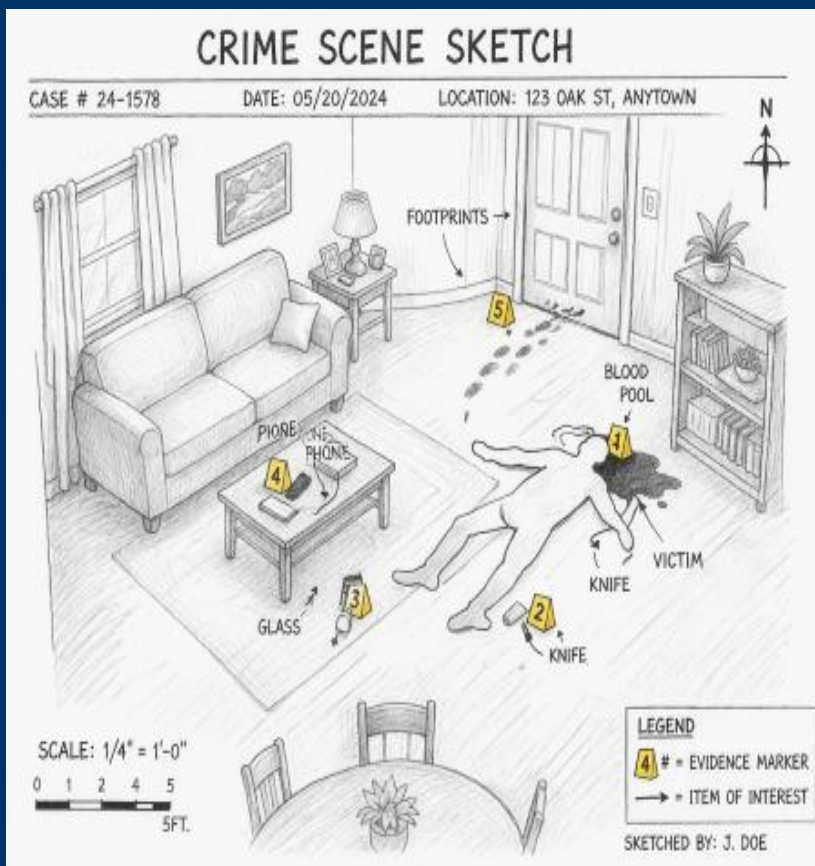
[26] The bloodstain expert expressed the opinion that the chair had been used for at least two medium-velocity impacts delivered to a passive blood source. That passive blood source was already bleeding at the time of the impacts, at or very near to the floor level, and at the time of the impacts was not moving or, if moving, moving very little.

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[74] The Crown points me to the bloodstain evidence that shows projected blood on the chairs prior to the final blow, meaning that Mr. Parker was already bleeding, and arguably significantly injured, perhaps even fatally injured by this point, prior to the final blow being delivered; the evidence from the other inmates that Mr. Parker was crying for help during the beating; the evidence of the accused that he knew that Mr. Parker was old, small, and a weakling, although he gave that evidence in a different context as I have previously mentioned.

R v Hurtado

Crime Scene Reconstruction



Crime scene reconstruction testimony – particularly testimony about mental state – should be inadmissible under the strict scrutiny required of novel scientific evidence, absent additional research establishing the reliability of these conclusions.

Bloodstain Pattern Analysis and the Gatekeeping Role of Canadian Courts

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