INSIGHTS

Using the Likelihood Ratio in Bloodstain Pattern Analysis

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OVERVIEW

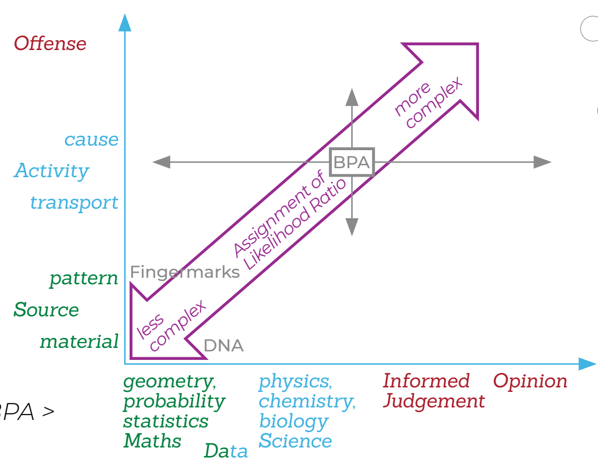
Using likelihood ratios (LRs) when reporting forensic evidence in court has significant advantages, as it allows forensic practitioners to consider their findings from the perspective of both the defense and the prosecution. However, despite many organizations adapting or recommending this practice, most experts in the field of bloodstain pattern analysis (BPA) still use a more traditional, subjective approach, indicating whether their findings are "consistent with" stated allegations. Researchers funded by CSAFE explored the challenges that come with using LRs when reporting BPA evidence, and proposed possible solutions to meet these challenges, concluding that the LR framework is applicable to BPA, but that it is a complex task.

GOALS

- Determine why many BPA experts do not use LRs in their reporting
- Present directions the community could take to facilitate the use of LRs
- Provide an example of how LRs are applied in a relevant field

CHALLENGES OF USING LIKELIHOOD RATIOS

Likelihood ratios (LRs) compare two competing hypotheses to see which better fits the evidence. While this practice has several advantages for use in court, as it provides a more objective and transparent view of an expert's findings, there are challenges when it comes to applying LRs to bloodstain pattern analysis.



Graph displaying factors that can affect the complexity of BPA >

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Attinger et al. identified two key factors affecting a likelihood ratio's complexity:

- The methods and knowledge used to evaluate the forensic observations
- The type of evaluative propositions

This is further complicated by the nature of bloodstain pattern analysis itself. BPA focuses on questions of activity (how far, how long ago, in what direction the blood traveled) or the type of activity (what caused the blood pattern), rather than questions of source as is normal for most forensic LR models. In addition, BPA as a field consists of a wide range of methods, and is a complex science that is still being built.

EXAMPLE OF LIKELIHOOD RATIOS IN ACTION

A recent study demonstrated how LRs could be used in BPA by applying them to the related field of fluid dynamics. In their test, they compared the time between the drying of a blood pool in a laboratory setting and one observed in photographs.

Using this model, they were able to create a physical model factoring in time, the scale and shape of the blood pool, and the surface on which the pool formed. This model could then be applied into a likelihood ratio, comparing propositions from the prosecution and defense.

$$LR = \frac{P\,(\text{evidence}|H_{\text{p}})}{P\,(\text{evidence}|H_{\text{d}})} = \frac{\frac{1}{\sqrt{2x}} \int_{-\infty}^{420} e^{-\frac{(x-480)^2}{2\text{-}18^2}}\,dx}{\frac{1}{\sqrt{2x}} \int_{420}^{+\infty} e^{-\frac{(x-480)^2}{2\text{-}18^2}}\,dx} = \frac{1}{2330}\,.$$

In this instance, the defense's proposition would be 2330 times more likely than the prosecution's.

FOCUS ON THE FUTURE

Attinger et al. propose three directions to facilitate the use of LRs in the field of BPA:

- Promote education and research to better understand the physics of fluid dynamics and how they relate to BPA
- Create public databases of BPA patterns, and promote a culture of data sharing and peer review
- Develop BPA training material that discusses LRs and their foundations

LEARN MORE

For further details, the full paper can be found here: forensicstats.link/LikelihoodRatiosInBloodstain-Patterns

Additionally, explore relevant publications:

- **Thinking About Likelihood Ratios for Pattern Evidence**
  forensicstats.link/ThinkingAboutLikelihoodRatios
- **Bloodstain Pattern Analysis Black Box Study**
  forensicstats.link/BloodstainPatternBlackBox

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