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Only a Sith Deals in Absolutes: A Jedi Uses Likelihood Ratios

COMMENTARY

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ABSTRACT

This article explores the paradigm shift in forensic science from the use of definitive absolute conclusions to the application of Likelihood Ratios (LR). It discusses the advantages of LR, including fostering expert collaboration, upgrading the decision-making process, and integrating contradictory evidence. The paper argues that LR, similar to the Jedi approach, embraces complexity and uncertainty, providing a more nuanced and equitable framework for forensic analysis. In addition, we explore specific examples related to forensic handwriting examination to illustrate how LR can clarify and quantify the weight of handwriting comparisons, signature authenticity evaluations, and the examination of questioned documents.

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INTRODUCTION

In forensic science, the evolution from definitive conclusions (such as 'match' or 'no match') to the use of Likelihood Ratios (LR) represents a transformation similar to shifting from viewing the world in strict black and white to recognizing and embracing shades of gray (1, 2). This conceptual leap can be compared to the difference between the Sith and the Jedi in the Star Wars universe. The Sith hold a rigid perspective, seeing the universe in absolutes of right and wrong, while the Jedi acknowledge that truth is often complicated and deeply influenced by context (3).

This analogy can be translated into modern forensic practice, where an expert report that uses absolute terms may inadvertently oversimplify the evidence. When experts rely exclusively on categorical statements such as 'The handwriting belongs to the suspect' or 'The signature is undoubtedly forged,' it can create an all-or-nothing mentality (4, 5). Although straightforward on the surface, this approach dismisses the underlying uncertainties and possible alternative explanations that exist in every forensic investigation. This paper aims to explain how the use of LR in forensic handwriting examination provides a more nuanced and scientifically grounded framework for interpreting evidence.

DEFINITIVE CONCLUSIONS AND THEIR LIMITATIONS

NATURE OF ABSOLUTES IN FORENSIC STATEMENTS

For decades, many forensic disciplines have relied on definitive statements when communicating their conclusions to the courts. This practice was especially pronounced in older forensic handwriting examination testimonies, where experts might have said, 'The suspect wrote this document' or 'This signature is undeniably forged.' While such declarative statements are easily understood by judges, jurors, attorneys, and laypeople, they may overlook the complexities that experts are aware of, but which are often omitted for the sake of simplicity in courtroom communication.

Such an absolutist language could imply a finality that does not leave room for further scrutiny and gives more power to the evidence than it should. In a handwriting comparison, for instance, concluding with unequivocal certainty that a questioned note was penned by a specific individual can inadvertently hide the subtle variations and statistical probabilities inherent in handwriting features. Even among well-trained examiners, the possibility of misinterpretation or an unusual coincidence can usually not be dismissed and occurs more often than we think (6). In fact, the only way to be able to speak with a definitive voice would be if the expert witnessed the crime firsthand—a rather odd scenario. The decision of the facts is not a job for the experts, but for the judge or jury only (7).

ADVERSARIAL NATURE OF COURT PROCEEDINGS

Definitive statements feed into the adversarial nature of courtroom proceedings, often framing the debate as a zero-sum game. Each side, prosecution or defense, seeks a portrayal of the forensic evidence that aligns best with their narrative. Experts, therefore, may feel pressured to testify in more absolute terms than the data truly supports, to align their testimony with the expectations of the party that retained them.

This practice is especially challenging in forensic handwriting examination, where overlapping handwriting characteristics, disguised writing, or advanced forgeries can complicate the examiner's determination. Nevertheless, under a black-and-white approach, even a trace of complexity can be perceived as weakening the expert's conclusion, prompting some to overstate the certainty of their findings to avoid appearing unconvincing in court. To address these limitations, the forensic community has increasingly turned to the LR framework, which offers a balanced and transparent approach to evidence interpretation.

THE LIKELIHOOD RATIO APPROACH: A NUANCED ALTERNATIVE

GRADATION OF EVIDENCE STRENGTH

Likelihood Ratios embrace the notion that evidence can be more or less likely under competing hypotheses, rather than these hypotheses being simply true or false (8, 9). During a forensic examination, one can consider two primary hypotheses:

1. H_1: The suspect authored the questioned document or signature.
2. H_2: The suspect did not author the questioned document or signature.

By evaluating handwriting or other document features, an examiner can calculate (or, rather, estimate) how much more likely it is to observe those specific features if H_1 is true versus if H_2 is true. The resulting LR may be greater than 1, indicating that the observations are more likely under H_1 than under H_2 (i.e., relative support for H_1). An LR close to 1 indicates that the features are about equally likely under

both propositions (i.e., no relative support for either), and an LR smaller than 1 suggests that the features are more likely under H_2 than H_1 (i.e., relative support for H_2).

For example, consider a suspicious signature that exhibits unusual pen lifts and incongruent letter slants compared to the suspect's known signatures. Under H_1 (i.e., the suspect wrote it), the probability of observing discrepancies might be low in general, but cannot be dismissed entirely. Genuine writers can produce irregular or unexpected features due to a range of factors such as stress, particular writing conditions, illness, intoxication, etc. These naturally occurring variations contribute to the uncertainty under H_1. Under H_2 (i.e., the suspect did not write it), the likelihood of observing these irregularities is generally higher, particularly if a forger with a distinct writing style attempted to mimic the suspect's signature. The interpretation of such discrepancies depends critically on contextual information, including the writing conditions, known variability in the suspect's writing, and any external factors that may have influenced the writing process. In most cases, an LR in favor of H_2 would then emerge from such an examination, illustrating the strength of evidence that the suspect was not the author.

INTEGRATION OF CONTRADICTORY EVIDENCE

The LR framework is valuable precisely because it can accommodate contradictory pieces of evidence and still maintain a coherent overall assessment (10). Suppose that, in the same case, additional handwriting traits, such as letter connections and spacing, bear a strong resemblance to the suspect's usual writing style. While some features weigh against the suspect, others weigh in favor. Rather than forcing a single definitive conclusion, the LR approach allows each feature to contribute to the evidential strength in a logical way (11).

In scenarios where multiple questioned handwritings are submitted, some might more strongly align with the suspect's known writing habits, while others might appear more suspicious or expertly forged. The expert's final opinion, expressed as a series of LRs or a composite LR, conveys a multi-layered view of the evidence. This holistic approach reduces the risk of key contradictions being lost in the pursuit of a singular, absolute statement (11, 12). In a court system where you need to have proof beyond reasonable doubt, it is not the expert's single numerical estimate that should carry all the weight, but rather the combination of all evidence, including prior information and the circumstances of the crime (13). While the expert's role is limited to evaluating the strength of the written evidence, the court may ultimately regard even weak but consistent support for one proposition as significant when viewed in the broader context. Ultimately, the weight and integration of all evidence, including handwriting examination, rest with the trier of fact. The expert's role is to inform the process, not to decide the outcome (14).

CASE SCENARIOS

SIGNATURE AUTHENTICITY ANALYSIS

Imagine a series of checks allegedly signed by a company treasurer. The signatures on some checks match the known references closely, while on others, subtle distortions in letter formation are observed. Traditionally, a forensic handwriting examiner might be compelled to state: 'All these checks are from the treasurer' or 'Some of these signatures are definitively forged.' Under the LR model, however, an examiner could specify, for each check, the likelihood that the treasurer signed it versus the likelihood that someone else signed it while imitating the treasurer's signature. Such a nuanced statement might read:

> For Check A, the LR is approximately 50, indicating the features in the signature are 50 times more likely to be observed if the treasurer is the true author rather than a forger. For Check B, the LR is only two, reflecting only marginal support for the treasurer's authorship. For Check C, the LR is below one, suggesting the signature is more consistent with a forgery hypothesis.

This range conveys a realistic picture of each signature's authenticity, helping the judge and jury appreciate the complexity involved. Since the examiner may have no knowledge of the suspect's neurological state, factors such as physical exertion, illness, or degenerative conditions could lead to atypical writing features. The same could be true for any degenerative disease. Rather than drawing a rigid conclusion, the LR framework allows the examiner to express varying degrees of support for competing hypotheses, based on the available evidence. This approach also avoids the risk of having to reverse a conclusion later, should new contextual information emerge. In this way, it promotes transparency and prepares the opinion to withstand critical scrutiny during cross-examination.

QUESTIONED LETTERS AND HANDWRITING COMPARISON

Consider a situation where an anonymous threatening letter is mailed to a person of interest. The police collect handwritten samples from a suspect, and an examiner compares the morphological and stylistic features of the

suspect's writing to the threatening letter. Some letters or word formations strongly resemble the suspect's known style, while others show significant divergences. Under rigid, definitive assumptions, an examiner might feel compelled to say either 'Yes, it's the suspect' or 'No, it's not the suspect.'

However, employing the LR concept allows the examiner to quantify how each observed handwriting feature shifts the balance of probability. For instance:

- The shape of certain letter loops is quite distinctive and aligns well with the suspect's normal writing; this elevates the LR in favor of the suspect having written the letter.
- Inconsistencies in pen pressure patterns might be less likely if the suspect was the author, slightly reducing the LR.
- The overall style of spacing between words might moderately align with the suspect's usual spacing, further adjusting the LR upward.

By aggregating each of these features in a structured manner (often with the aid of statistical models or established empirical data), the examiner arrives at an LR that encapsulates the totality of the evidence. That final LR is then presented, often accompanied by a verbal scale to help non-experts in interpreting its magnitude.

FOSTERING EXPERT COLLABORATION AND TRANSPARENCY

ENCOURAGING DIALOGUE AMONG FORENSIC EXAMINERS

One of the most compelling advantages of the LR framework is its ability to foster transparent and structured discussions among experts. In forensic handwriting examination, where differing conclusions can arise, it is rarely due to disagreement over which features are present. Most competent examiners typically observe the same set of features, such as stroke direction, pen lifts, or letter formations. Rather, differences usually stem from how those features are evaluated, the propositions under consideration, the framework used, or the specific evidence available (15). By clearly defining these elements, examiners can more precisely identify the source of disagreement. Although discussions may involve individual features, the overall evaluation often relies on the gestalt: the holistic impression formed by the interplay of multiple features. This clarity not only supports constructive expert dialogue but also aligns well with practices like expert conferencing (or 'hot-tubbing'), where examiners collaboratively discuss their reasoning in court (16–18).

Such an approach is more difficult under an absolutist paradigm, where disagreement may devolve into a direct clash of yes-or-no statements. With the LR framework, disagreements become relative and can often be explored through differences in interpretation rather than outright contradiction. Even when LRs are expressed qualitatively (such as describing a feature as offering limited, moderate, or strong evidence for H_1 over H_2), the approach still promotes transparency and reasoned dialogue (19). If one expert interprets a certain handwriting feature as offering strong evidence in favor of H_1 over H_2 (e.g., authorship versus not) while another views it as no evidence in favor of either hypothesis, they can revisit the case data or supporting literature to clarify the basis for their views. This process improves the reliability and credibility of the final opinion, regardless of whether the expression is numerical or descriptive.

An example of Canadian legislative provisions encouraging expert collaboration:

> **Expert conference (52.6 (1))** The Court may order expert witnesses to confer with one another in advance of the hearing of the proceeding in order to narrow the issues and identify the points on which their views differ.
>
> **(2) Subsection (1)** does not preclude the parties and their counsel from attending an expert conference but the conference may take place in their absence if the parties agree.
>
> **(3)** The Court may order that an expert conference take place in the presence of a judge or prothonotary.
>
> **(4)** A joint statement prepared by the expert witnesses following an expert conference is admissible at the hearing of the proceeding. Discussions in an expert conference and documents prepared for the purposes of a conference are confidential and shall not be disclosed to the judge or prothonotary presiding at the hearing of the proceeding unless the parties consent.
>
> **(SOR/2010–176, s. 2)** (20)

These provisions illustrate how Canadian law encourages a collaborative atmosphere, allowing experts to narrow issues before trial and promoting a more nuanced,

LR-aligned approach. Comparable frameworks exist elsewhere: in England and Wales, concurrent expert evidence was introduced in the Civil Procedure Rules, Practice Direction 35, paragraph 11 (2013) (21); Australia formalized 'hot-tubbing' through the Federal Court Rules 2011 (Cth), r 23.15 (22); and New Zealand implemented expert conferencing and joint statements via the High Court Rules 2016 (rr. 9.43–9.51) (23). Despite their differences, these measures share the common goal of reducing duplication, clarifying expert reasoning, and focusing courtroom discussion on evidence rather than on discrediting experts simply because their conclusions differ.

HELPING THE LEGAL COMMUNITY UNDERSTAND NUANCE

In many legal settings, judges and juries may initially find probabilistic statements intimidating or overly technical (24). However, LRs can be conveyed in straightforward language by relating them to everyday concepts of likelihood (25). For example, if you hear a loud siren outside, that observation is more likely if an ambulance is passing than if no emergency vehicle is nearby; the observation supports one explanation over the other without making it certain. In forensic handwriting examination, a lay audience may likewise better understand a statement such as: 'The observed set of handwriting features is 10 times more likely if the suspect wrote the letter than if the suspect did not,' as it expresses support for one proposition over another without making absolute claims. While traditional reporting scales in forensic handwriting examination often aimed to reflect posterior belief about authorship, the LR framework shifts the focus to the strength of the evidence itself under each hypothesis, clarifying the uncertainty and providing a more logically grounded expression of support. Despite this shift, both approaches share many structural similarities, particularly in how direction and weight are applied to the observed features (2).

Furthermore, the LR approach helps clarify that a forensic expert is not claiming certainty or omniscient knowledge; rather, they are expressing how the observed evidence supports one proposition over another based on their evaluation (1, 26). While the method can be framed mathematically, its foundation lies in the expert's training, experience, and skill. The mathematics simply provides a structured way to communicate the strength of support but is usually still presented qualitatively or by using a verbal scale. This transparency allows for both qualitative and quantitative expression, depending on the context and the available data (19, 27–29).

CONCLUSION

The shift towards LR in forensic science marks a significant departure from the binary thinking embodied by definitive conclusions. LR-based analysis in forensic handwriting examination and other disciplines accepts that evidence interpretation is rarely absolute, often complex, and requires a leap of faith that only the triers of fact are entitled to make.

By adopting a probabilistic mindset, experts convey a richer narrative that accounts for contradictory findings, varying degrees of similarity, and the inherent uncertainties in each piece of evidence. This balanced and transparent approach not only enhances the accuracy and fairness of judicial outcomes but also encourages open-minded collaboration among forensic scientists. In an ever-evolving field, where new methods constantly emerge, the willingness to move beyond absolutes ensures that the pursuit of justice remains grounded in a realistic and comprehensive assessment of truth. It will be hard to convince everyone to shift to this way; may the force be with you (30).

†IN MEMORIAM

> "Folks are slowly coming to grips with the LR or evaluative reporting, but it's still not quite there yet. I wish it were further along but it's much better than it used to be." — R. B. Ostrum (†)

This was the last message you sent me, and I feel obligated to share it. Your contributions will endure.

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COMPETING INTERESTS

The authors have no competing interests to declare.

AUTHOR CONTRIBUTIONS

The draft was written by the first author. The review and correction were done by the second author.

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REFERENCES

1. **Lund SP, Iyer H.** Likelihood ratio as weight of forensic evidence: a closer look. *J Res Natl Inst Stand Technol.* 2017;122(27). DOI: https://doi.org/10.6028/jres.122.027
2. **Williams GA, Maskell PD.** Embracing likelihood ratios and highlighting the principles of forensic interpretation. *Forensic Sci Int Rep.* 2021;3:100209. DOI: https://doi.org/10.1016/j.fsir.2021.100209
3. **Lucas G, director.** *Star Wars: Episode III – Revenge of the Sith* [film]. Lucasfilm Ltd.; 2005.
4. **Scientific Working Group for Forensic Document Examination.** *SWGDOC Standard Terminology for Expressing Conclusions of Forensic Document Examiners.* SWGDOC; 2015 Jan.
5. **United States Department of Justice.** *Uniform Language for Testimony and Reports for the Forensic Document Examination Discipline.* United States Department of Justice, Office of Legal Policy; 2021 July.
6. **Hicklin RA, Eisenhart L, Richetelli N, Miller MD, Belcastro P, Burkes TM,** et al. Accuracy and reliability of forensic handwriting comparisons. *Proc Natl Acad Sci.* 2022;119(32):e2119944119. DOI: https://doi.org/10.1073/pnas.2119944119
7. **Jackson G, Biedermann A.** "Source" or "activity" what is the level of issue in a criminal trial? *Significance.* 2019;16(2):36–9. DOI: https://doi.org/10.1111/j.1740-9713.2019.01253.x
8. **Biedermann A, Bozza S, Taroni F.** Analysing and exemplifying forensic conclusion criteria in terms of Bayesian decision theory. *Sci Justice.* 2018;58(2):159–65. DOI: https://doi.org/10.1016/j.scijus.2017.07.002
9. **Organization of Scientific Area Committees.** Standard for the Expression of Conclusions in Forensic Document Examination; 2022.
10. **Meester R, Slooten K.** *Probability and forensic evidence: Theory, philosophy, and applications*. Cambridge: Cambridge University Press; 2021. pp. 30–60. DOI: https://doi.org/10.1017/9781108596176
11. **De Koeijer JA, Sjerps MJ, Vergeer P, Berger CEH.** Combining evidence in complex cases – a practical approach to interdisciplinary casework. *Sci Justice.* 2020;60(1):20–9. DOI: https://doi.org/10.1016/j.scijus.2019.09.001
12. **Rassin E, Arbiyah N, Boskovic I, Otgaar H, Merckelbach H.** Likelihood ratios in psychological expert opinion, and their reception by professional judges. *Int J Evid Proof.* 2022;26(4):325–41. DOI: https://doi.org/10.1177/13657127221119545
13. **Fenton N, Neil M, Berger D.** Bayes and the law. *Annu Rev Stat Its Appl.* 2016;3(1):51–77. DOI: https://doi.org/10.1146/annurev-statistics-041715-033428
14. **Shapiro DL, Mixon L, Jackson M, Shook J.** Psychological expert witness testimony and judicial decision making trends. *Int J Law Psychiatry.* 2015;42–43:149–53. DOI: https://doi.org/10.1016/j.ijlp.2015.08.020
15. **Kruse C.** The Bayesian approach to forensic evidence: Evaluating, communicating, and distributing responsibility. *Soc Stud Sci.* 2013;43(5):657–80. DOI: https://doi.org/10.1177/0306312712472572
16. **Greene E, Gordon N.** Can the "hot tub" enhance jurors' understanding and use of expert testimony? *Wyo Law Rev.* 2016;16(2):359–85. DOI: https://doi.org/10.59643/1942-9916.1366
17. **Perillo JT, Perillo AD, Despodova NM, Kovera MB.** Testing the waters: an investigation of the impact of hot tubbing on experts from referral through testimony. *Law Hum Behav.* 2021;45(3):229–42. DOI: https://doi.org/10.1037/lhb0000446
18. **Prescott DE, Fadgen T.** Adversarial systems and forensic experts in child custody: How about adding a hot tub? *J Am Acad Matrim Lawyers.* 2019;32(1):117–42.
19. **Marquis R, Biedermann A, Cadola L, Champod C, Gueissaz L, Massonnet G,** et al. Discussion on how to implement a verbal scale in a forensic laboratory: benefits, pitfalls and suggestions to avoid misunderstandings. *Sci Justice.* 2016;56(5):364–70. DOI: https://doi.org/10.1016/j.scijus.2016.05.009
20. **Federal Courts Rules.** *SOR/98-106, s. 52.6* [Internet]. Justice Laws Website; 2010. Available from: https://laws-lois.justice.gc.ca/eng/regulations/SOR-98-106/section-52.6.html
21. **Civil Procedure Rules.** *Practice Direction 35, Experts and Assessors* [Internet]; 2013. Available from: https://www.justice.gov.uk/courts/procedure-rules/civil/rules/part35/pd_part35
22. **Federal Court Rules 2011.** *(Cth), r 23.15* [Internet]; 2011. Available from: https://www.legislation.gov.au/Details/F2011L01551
23. **High Court Rules 2016.** *rr. 9.43–9.51* [Internet]; 2016. Available from: https://www.legislation.govt.nz/regulation/public/2016/0225/latest/DLM6951682.html
24. **Schneps L, Colmez C.** *Math on trial: how numbers get used and abused in the courtroom*. New York: Basic Books; 2013. p. 256.

25. **Koch SL.** Communicating Forensic Findings : Current Practices and Future Directions workshop proceedings. Gaithersburg, MD: National Institute of Standards and Technology (U.S.); 2025 Jan p. NIST IR 8510sup1. Report No.: NIST IR 8510sup1. DOI: https://doi.org/10.6028/NIST.IR.8510sup1
26. **Nordgaard A, Rasmusson B.** The likelihood ratio as value of evidence—more than a question of numbers. *Law Probab Risk.* 2012;11(4):303–15. DOI: https://doi.org/10.1093/lpr/mgs019
27. **Ballantyne KN, Summersby S, Pearson JR, Nicol K, Pirie E, Quinn C,** et al. A transparent approach: openness in forensic science reporting. *Forensic Sci Int Synergy.* 2024;8:100474. DOI: https://doi.org/10.1016/j.fsisyn.2024.100474
28. **Sigman ME, Williams MR.** Promoting transparency in forensic science by integrating categorical and evaluative reporting through decision theory. *Front Anal Sci.* 2023;3:1105642. DOI: https://doi.org/10.3389/frans.2023.1105642
29. **Sunde N, Franqueira VNL.** Adding transparency to uncertainty: an argument-based method for evaluative opinions. *Forensic Sci Int Digit Investig.* 2023;47:301657. DOI: https://doi.org/10.1016/j.fsidi.2023.301657
30. **Lucas G, director.** *Star Wars: Episode IV – A New Hope* [film]. Lucasfilm Ltd.; 1977.

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