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FROM LIKELIHOOD TO LEGAL PROOF: A BAYESIAN SEPARATION PRINCIPLE FOR EXPERT EVIDENCE UNDER INDIAN LAW

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ABSTRACT

Statistical and scientific evidence increasingly enters Indian adjudication through DNA profiling, electronic records, algorithmic outputs, medical studies, and other quantitative methods. The principal legal difficulty is not whether such evidence is probabilistic, but how a specialised probabilistic conclusion is translated into legal proof. A source-level DNA conclusion may be treated as an offence conclusion; a likelihood ratio may be mistaken for a posterior probability; an authenticated electronic message may be treated as proof of human authorship; and dependent findings may be counted as independent corroboration. This article develops a proposed Bayesian Separation Principle for expert evidence under Indian law. The Principle is not a new reliability test or a rule of numerical adjudication. It is an interpretive doctrine governing the allocation of inferential responsibility across four stages: proposition specification, comparative evidential assessment, judicial integration, and legal decision. Drawing on the Bharatiya Sakshya Adhiniyam, 2023, Indian Supreme Court jurisprudence, Bayesian evidence scholarship, and European forensic reporting guidance, the article explains what the Principle adds to familiar expert-evidence doctrine and why the label is analytically useful. A compact six-question protocol translates the Principle into judicial practice.

Keywords: expert evidence; Bayesian reasoning; likelihood ratio; legal proof; Bharatiya Sakshya Adhiniyam; probabilistic evidence

I. INTRODUCTION

Courts increasingly encounter evidence whose authority derives from scientific technique, statistical modelling, or computational process. DNA profiles can associate biological

material with a source; digital logs can show that a system recorded an event; statistical studies can describe population patterns; and algorithms can classify or predict outcomes. These forms of evidence may be highly probative. Their precision, however, can obscure a basic legal difficulty: the proposition evaluated by the expert is often narrower than the proposition that the court must decide.

A DNA analyst may address whether a biological sample is more consistent with originating from one person than from another. That conclusion does not by itself establish when the material was deposited, whether the accused performed the relevant activity, or whether every element of the offence is proved. A digital record may be authentic and intact without proving who authored it or acted with the legally relevant intention. A statistical disparity may be real without itself establishing unlawful discrimination or individual causation. In each setting, the evidential proposition can silently migrate into a broader legal proposition.

Bayesian reasoning is useful because it makes this movement visible. Finkelstein and Fairley famously showed how probability theory could clarify identification evidence, while Tribe warned that mathematical precision could also acquire an authority that exceeds the assumptions supporting it.¹ Later scholarship has developed both the potential and the limits of Bayesian reasoning and has emphasized that expert evidential assessment does not itself determine posterior legal truth. This article does not claim novelty for that distinction alone. Its contribution is narrower: it uses Bayesian structure diagnostically and reconstructs the resulting separations as a proposed, jurisdiction-specific doctrine anchored in the BSA and Indian case law.²

Existing international approaches address adjacent but different parts of the problem. Bayesian evidence scholarship focuses on the relation between likelihood, prior information, and posterior belief; European forensic guidance emphasises proposition formulation and comparative reporting; and conventional expert-evidence doctrine focuses on relevance, admissibility, reliability, and the allocation of decisional authority. The proposed Principle

¹ Michael O. Finkelstein & William B. Fairley, A Bayesian Approach to Identification Evidence, 83 Harv. L. Rev. 489-517 (1970); Laurence H. Tribe, Trial by Mathematics: Precision and Ritual in the Legal Process, 84 Harv. L. Rev. 1329-1393 (1971).

² Norman Fenton, Martin Neil & Daniel Berger, Bayes and the Law, 3 Annual Review of Statistics and Its Application 51-77 (2016), doi:10.1146/annurev-statistics-041715-033428; Paul Roberts, Theorising Evidence Law, 43 Oxford Journal of Legal Studies 629-649 (2023), doi:10.1093/ojls/gqad007.

does not displace any of these approaches. Its claim is that none, taken alone, supplies a single legal rule for the transitions from the proposition evaluated by the expert, to the contribution of that evidence to the whole record, to satisfaction of the legal standard. The Principle is therefore a doctrine of translation across those domains rather than another test of scientific reliability or another theory of posterior belief.³

The Indian setting makes this inquiry especially timely. The Bharatiya Sakshya Adhiniyam, 2023 (BSA), in force from 1 July 2024, retains a statutory architecture in which expert opinion is relevant but remains open to scrutiny. Section 39 addresses expert opinions; section 40 makes facts bearing upon expert opinion relevant; section 45 makes the grounds of a relevant opinion relevant; section 63 regulates specified electronic records; section 90 separates correspondence of an electronic message from any presumption about the person who sent it; and the burden-of-proof provisions preserve the court's responsibility for legal proof. Supreme Court decisions concerning DNA evidence likewise emphasise that scientific opinion must be evaluated in its factual and evidentiary setting rather than treated as self-executing proof.⁴

The article's contribution is a proposed Bayesian Separation Principle. Its novelty is not that experts should be scrutinised or that courts retain the final decision; those propositions are familiar. The new claim is that probabilistic expert evidence creates a recurring sequence of four distinct inferential transitions and that each transition should be governed by a different question and institutional responsibility. The Principle converts otherwise dispersed rules about expert opinion, proposition-level reporting, evidential dependence, and standards of proof into one doctrine governing the path from scientific comparison to legal judgment. It

³ For comparative orientation, see *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579, 589-95 (1993) (reliability and relevance gatekeeping); European Network of Forensic Science Institutes, *Guideline for Evaluative Reporting in Forensic Science*, Approved Version 3.0 (8 Mar. 2015) (proposition formulation and comparative reporting); Norman Fenton, Martin Neil & Daniel Berger, *Bayes and the Law*, 3 *Annual Review of Statistics and Its Application* 51-77 (2016); Paul Roberts, *Theorising Evidence Law*, 43 *Oxford Journal of Legal Studies* 629-649 (2023).

⁴ Bharatiya Sakshya Adhiniyam, 2023, Act No. 47 of 2023, ss. 39 (Opinions of experts), 40 (Facts bearing upon opinions of experts), 45 (Grounds of opinion, when relevant), 63 (Admissibility of electronic records), 90 (Presumption as to electronic messages), 104-106 (burden of proof), and 141 (Judge to decide as to admissibility of evidence). The Act came into force on 1 July 2024.

is an interpretive doctrine, not a claim that Parliament enacted Bayesian mathematics or that Indian courts have already used the terminology.

The research question is accordingly narrow: can the recurring legal difficulties surrounding probabilistic expert evidence be organised by a doctrine that preserves the scientific value of the evidence while preventing an expert conclusion from doing inferential work that belongs to the court? The method is doctrinal and analytical. It reads the relevant BSA provisions together with leading Supreme Court authorities and uses Bayesian concepts only to clarify the structure of inference, not to quantify the verdict.

Proposition Specification → Comparative Evidential Assessment → Judicial Integration → Legal Proof

The corresponding four separations are proposition separation, evidential separation, institutional separation, and decision separation. Together they create a structured division of inferential responsibility: scientific expertise assesses specialised findings, the court integrates them with the record, and law controls the final decision. The rest of the article develops that claim compactly. Part II explains the probability-proof gap and the limits of numerical Bayesianism. Part III identifies the statutory and judicial foundations in Indian evidence law. Part IV states the Principle as the paper's central doctrinal contribution. Part V tests it in DNA and digital evidence and provides a six-question judicial protocol. Part VI concludes.

II. THE PROBABILITY-PROOF GAP AND THE LIMITS OF NUMERICAL BAYESIANISM

The central statistical distinction can be expressed simply. $P(E|H)$ asks how probable the observed evidence would be if a hypothesis were true. $P(H|E)$ asks how probable the hypothesis is after the evidence is observed. Treating the first as the second is the transposed-conditional error commonly associated with the prosecutor's fallacy. The error is not merely mathematical. It changes the proposition being evaluated. The rarity of a DNA profile under an alternative source hypothesis may make the profile powerful source evidence, but it is not itself the probability that the accused committed the offence.⁵

Likelihood ratio: $LR = P(E | H_1) / P(E | H_2)$

⁵ William C. Thompson & Edward L. Schumann, Interpretation of Statistical Evidence in Criminal Trials: The Prosecutor's Fallacy and the Defense Attorney's Fallacy, 11 Law & Hum. Behav. 167-187 (1987), doi:10.1007/BF01044641.

A likelihood ratio expresses comparative evidential strength under specified competing propositions. It does not state the posterior probability that H_1 is true. Posterior odds require prior odds as well as the likelihood ratio. For composite hypotheses, a Bayes factor ordinarily compares marginal likelihoods and therefore depends on how uncertainty within competing models is represented. These distinctions matter in law because neither prior probability nor posterior probability has an automatic legal status. A court cannot simply assume a numerical prior probability of guilt; the relevant background information may be disputed, inadmissible, or sensitive to the reference class used. Recent legal-probability scholarship continues to debate how Bayesian priors can be reconciled with reasonable doubt and the presumption of innocence.⁶⁷

For analytical purposes, this article uses strong Bayesianism as an ideal-type model in which adjudication is represented through numerical priors, Bayesian updating, and comparison of a posterior probability with a numerical decision threshold. Bayesian scholarship contains more nuanced positions; the category is used here only to isolate the strongest numerical model. This article instead uses diagnostic Bayesianism as shorthand for a different jurisprudential use of Bayesian structure: one concerned with the integrity of the inferential path rather than calculation of the verdict.

Three objections to numerical adjudication are especially important. First, numerical form can conceal contestable assumptions and create an appearance of objectivity disproportionate to the evidence. Tribe's critique remains relevant precisely because a mathematically correct number can still be legally incomplete. Secondly, priors and reference classes are not self-selecting. The probability attached to a person or event can vary depending on the population used for comparison, and the reference-class problem cannot be solved merely by writing a prior numerically. Thirdly, legal proof involves institutional and explanatory judgments that are not exhausted by a posterior number: admissibility, credibility, competing narratives, causal explanation, burdens, and standards remain legal questions.⁸⁹

⁶ Yuval Abrams, Reasonable Doubt and Reasonable Priors, 23 *Episteme* 546-564 (2026), doi:10.1017/epi.2024.47.

⁷ Robert E. Kass & Adrian E. Raftery, Bayes Factors, 90 *J. Am. Stat. Ass'n* 773-795 (1995), doi:10.1080/01621459.1995.10476572.

⁸ Alan Hájek, The Reference Class Problem Is Your Problem Too, 156 *Synthese* 563-585 (2007), doi:10.1007/s11229-006-9138-5.

⁹ Tribe, *supra* note 1, at 1329-1393.

The debate over so-called naked statistical evidence reinforces this caution. The present argument does not depend on the stronger claim that statistical evidence can never establish an individualised fact. It makes the narrower point that numerical strength cannot change the proposition the evidence was generated to address. A population-level association, for example, does not become individual causation merely because the estimated association is large. Likewise, narrative and coherence reasoning need not be reduced to Bayes. Competing narratives can sometimes be represented as hypotheses for evidential comparison, but their temporal structure, explanatory completeness, and credibility remain part of legal evaluation. Diagnostic Bayesianism therefore claims compatibility with broader legal reasoning, not reduction of that reasoning to a single probability.

Statistical significance creates a related danger. A p-value describes the compatibility of data with a specified null model; it does not state the probability that the null hypothesis is true. The American Statistical Association has expressly cautioned against treating a p-value as the probability that the studied hypothesis is true or making decisions merely because a conventional threshold has been crossed. A p-value of 0.05 is therefore neither a 95 per cent probability that a legal claim is correct nor a legal analogue of the civil standard of proof.¹⁰

Bayesian structure is also useful when evidence accumulates. Two items should not be treated as two independent increments of proof merely because they are described separately. If E1 and E2 are dependent, the combined evidential assessment must reflect their joint or conditional relationship rather than multiply marginal likelihood ratios as though independence were established. Two expert reports based on the same sample or database may appear corroborative while largely repeating the same information. The legal implication is modest but important: dependence affects the weight of cumulative proof even when each item is separately admissible.¹¹

The probability-proof gap can therefore be stated in one sentence: comparative scientific evidence, posterior belief, and legal sufficiency answer different questions. Diagnostic Bayesianism does not ask judges to become statisticians. It asks them to identify the proposition, alternative, assumptions, and informational relationships before converting specialised evidence into legal proof.

¹⁰ Ronald L. Wasserstein & Nicole A. Lazar, The ASA's Statement on p-Values: Context, Process, and Purpose, 70 Am. Statistician 129-133 (2016), doi:10.1080/00031305.2016.1154108.

¹¹ See Fenton, Neil & Berger, *supra* note 2, at 51-77 (discussing Bayesian treatment of complex and dependent evidential structures).

III. STATUTORY AND JUDICIAL FOUNDATIONS UNDER INDIAN EVIDENCE LAW

The Bayesian Separation Principle is not presented as a statutory command. Its foundation is structural. The BSA creates a sequence in which specialised opinion may enter the evidentiary process, the basis of that opinion may be scrutinised, electronic evidence is governed by specific conditions and presumptions, and the legal burden remains with the party on whom law places it.

Section 39 operates principally as a relevance gateway for specialised opinion. It includes opinions of persons specially skilled in science and other fields and recognises the Examiner of Electronic Evidence. Relevance, however, is not conclusiveness. Section 40 makes facts supporting or inconsistent with a relevant expert opinion relevant, while section 45 provides more generally that where the opinion of a living person is relevant, the grounds on which that opinion is based are also relevant. Applied to scientific evidence, these provisions permit attention to the sample, data, method, reference population, assumptions, uncertainty, and reasons underlying the expert conclusion. They do not enact a Daubert-style test or Bayesian formula; they supply an institutional basis for scrutiny.¹²

The BSA's treatment of electronic evidence supplies an unusually clear example of proposition separation. Section 63 governs admissibility of specified computer outputs and requires the statutory conditions and certificate to be satisfied. Section 90 permits a presumption that an electronic message received corresponds with the message fed into a computer for transmission, but expressly provides that the court shall make no presumption as to the person by whom the message was sent. Transmission correspondence and human attribution are therefore separate propositions within the text of the statute itself. Compliance with an electronic-evidence regime may establish that a record is receivable or that a transmission corresponds with the input; it does not automatically prove authorship, control, intention, or liability.¹³

The burden provisions complete the structure. Sections 104-106 allocate responsibility for proving asserted facts. A likelihood ratio, statistical significance level, or algorithmic score does not, merely because it is quantitative, transfer that burden or alter the standard. Any

¹² Bharatiya Sakshya Adhiniyam, 2023, ss. 39, 40, 45.

¹³ Bharatiya Sakshya Adhiniyam, 2023, ss. 63, 90. Section 90 permits a presumption concerning correspondence of an electronic message while expressly withholding any presumption as to the person by whom the message was sent.

burden shift must arise from law, including applicable presumptions or specific statutory rules. Section 141, titled 'Judge to decide as to admissibility of evidence', preserves the court's responsibility for admissibility. Judicial responsibility therefore remains central at both the evidentiary and decisional stages.

This statutory architecture also explains why reliability and sufficiency should not be collapsed. A fact may be relevant and an electronic record may satisfy statutory conditions for reception, yet the court must still determine the weight of the material and whether the party bearing the burden has proved the legally relevant proposition. Conversely, a weakness in one link need not render the entire item irrelevant. A chain-of-custody gap, for example, may reduce confidence in identity or integrity without affirmatively proving contamination. The legal task is to identify the inferential consequence of the weakness rather than describe the evidence globally as either scientific or unscientific.

Indian DNA jurisprudence reinforces the same allocation. In *Pattu Rajan v State of Tamil Nadu*, the Supreme Court treated DNA evidence as opinion evidence and emphasised that its probative value varies with the facts, circumstances, and weight of other evidence on record. The importance of the case is institutional rather than anti-scientific: the expert provides specialised assistance, but the court determines the evidentiary and legal consequence.¹⁴

Prakash Nishad @ Kewat Zinak Nishad v State of Maharashtra shows how this principle operates when the scientific method is accepted but the evidentiary pathway is doubtful. The Supreme Court examined delays, sample handling, chain-of-custody concerns, and the absence of other cogent evidence, and concluded that the uncompromised nature of the DNA evidence had not been established. It criticised the lower courts for having presumptuously assumed guilt. The case illustrates a distinction central to this article: method reliability is not the same as case-specific evidential reliability.¹⁵

Scientific result ≠ reliable evidential integration ≠ legal guilt

Irfan alias Bhayu Mevati v State of Madhya Pradesh adds the problem of testability. The DNA report had been exhibited although the scientific experts involved in the profiling and report had not been examined. The Supreme Court held that failure to ensure examination of those experts while relying upon the report resulted in a failure of justice. The point is not

¹⁴ *Pattu Rajan v State of Tamil Nadu*, (2019) 4 SCC 771, paras 49, 52.

¹⁵ *Prakash Nishad @ Kewat Zinak Nishad v State of Maharashtra*, 2023 INSC 561; (2023) 16 SCC 357; 2023 SCC OnLine SC 666, paras 61-68.

that the expert had formally decided guilt. It is that a scientific conclusion central to the prosecution case could not responsibly carry legal weight without adequate opportunity to test its methodology, interpretive basis, and supporting material.¹⁶

Electronic-evidence cases under the former Evidence Act provide a parallel foundation. *Anvar P.V. v P.K. Basheer* and *Arjun Panditrao Khotkar v Kailash Kushanrao Gorantyal* principally concern the statutory conditions for receiving electronic records under section 65B. Their significance here is limited but useful: satisfaction of an admissibility regime does not itself resolve authorship or attribution. The BSA now makes that further separation explicit in section 90.¹⁷

The cases also demonstrate why the article distinguishes what a court held from the Bayesian diagnosis later supplied by the article. Pattu Rajan did not announce proposition separation, and Irfan did not use the analytical terminology proposed here. Their holdings operate at the level of positive law: expert evidence is opinion evidence; probative weight depends on context; chain of custody and evidentiary integrity matter; and a central scientific conclusion must remain meaningfully testable. The doctrinal implication is that the court cannot treat scientific output as self-executing. The Bayesian diagnosis is a further analytical step that explains these holdings as instances of evidential and institutional separation.

These authorities do not establish a judicially recognised Bayesian doctrine. They reveal dispersed but recurring boundaries: expert conclusion versus judicial conclusion; accepted method versus case-specific reliability; source evidence versus conduct; electronic integrity versus human attribution; and evidential strength versus legal proof. The Bayesian Separation Principle supplies a single vocabulary for those boundaries. This modest claim also limits the article's methodology: it does not assert that every diagnostic error recurs with equal frequency in reported cases, only that the framework clarifies the points at which probabilistic expert evidence requires additional legal explanation.

IV. THE BAYESIAN SEPARATION PRINCIPLE

The article's central contribution can now be stated directly. The adjective Bayesian does substantive work because the proposed doctrine is built on three features of Bayesian evidential reasoning: evidence has comparative force only relative to specified competing

¹⁶ *Irfan alias Bhayu Mevati v State of Madhya Pradesh*, 2025 INSC 150; 2025 SCC OnLine SC 359, paras 20-23, 29-32.

¹⁷ *Anvar P.V. v P.K. Basheer*, (2014) 10 SCC 473; *Arjun Panditrao Khotkar v Kailash Kushanrao Gorantyal*, (2020) 7 SCC 1, para 73.

propositions; the probability of evidence conditional on a hypothesis is distinct from posterior probability of that hypothesis; and the contribution of cumulative evidence depends on conditional relationships rather than mere accumulation. Indian evidence law, in turn, determines who may make each inferential move and what legal consequences may follow.

A separate doctrinal label is justified only if it changes the analysis. The familiar proposition that expert evidence is advisory is too coarse to identify why a technically valid conclusion may still be legally overstated. The Bayesian Separation Principle requires the court to locate the expert's proposition, distinguish comparative support from posterior truth, examine whether cumulative evidence is genuinely additional, and postpone application of the legal standard until the record has been integrated. Those questions are not captured by reliability or admissibility alone. The label therefore names a specific structure of judicial reasoning, rather than merely restating that judges remain responsible for the verdict.

THE BAYESIAN SEPARATION PRINCIPLE. Probabilistic expert evidence should pass through proposition specification, comparative evidential assessment, judicial integration, and application of the legally prescribed standard before becoming legal proof. Figure 1 summarises this sequence.

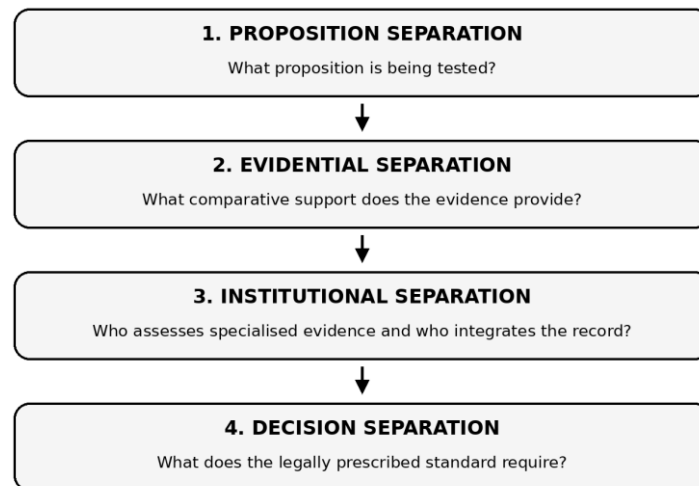


Figure 1. A Bayesian Separation Principle: the sequential movement from probabilistic expert evidence to legal proof. Source: author's formulation.

The Principle contains four separations. They are not four independent inventions; they are stages of one sequential doctrine.

A. Proposition Separation

Proposition separation requires the expert and the court to identify the precise proposition to which the scientific result is directed. Forensic evaluative practice already distinguishes proposition levels such as source and activity. A source proposition asks whether material originated from a person; an activity proposition asks whether that person performed a relevant act; and an offence proposition asks whether the legal elements of the offence have been proved. The levels may be connected, but they are not interchangeable.¹⁸

The doctrinal rule is therefore simple: a probabilistic expert conclusion should not be translated from one proposition level to another without identifying the additional evidence and assumptions that justify the transition. A likelihood ratio comparing source hypotheses cannot silently become a likelihood ratio for guilt and innocence. Likewise, an authentic digital record cannot silently become proof of human authorship. The expert may formulate or refine scientific propositions in light of the case circumstances and competing accounts, but does not define the ultimate legal issue unilaterally.

B. Evidential Separation

Evidential separation distinguishes comparative evidential strength from posterior probability and legal truth. A likelihood ratio or Bayes factor answers a comparative evidential question under specified propositions. It is not, without additional assumptions and information, the probability that the supported proposition is true. Nor is a p-value, random-match probability, confidence statement, or algorithmic score a legal standard of proof.

The corresponding rule is that a measure of comparative evidential strength should not be represented as the posterior probability or legal truth of the proposition it supports. The same separation governs accumulation. Related evidence should not be treated as independent corroboration unless the record or expert analysis identifies why it contributes distinct information under the competing propositions. Dependence is therefore not a separate innovation but an implication of evidential separation.

C. Institutional Separation

Institutional separation allocates authority. Experts may explain methods, assess specialised findings under appropriate competing propositions, identify assumptions, disclose

¹⁸ European Network of Forensic Science Institutes, Guideline for Evaluative Reporting in Forensic Science, Approved Version 3.0 (8 Mar. 2015).

uncertainty, and describe dependence. Courts must scrutinise the basis of the opinion, consider supporting and inconsistent facts, integrate the scientific result with testimony and circumstances, assess competing explanations, and determine the legal consequence.

The rule is that specialised assessment may inform but cannot displace independent judicial evaluation of the expert's basis, the surrounding record, and the legally relevant proposition. This is not an ultimate-issue prohibition. An expert opinion may bear closely on a disputed issue. Its status nevertheless remains evidentiary rather than adjudicative. Pattu Rajan, Prakash Nishad, and Irfan illustrate different aspects of that institutional allocation.

D. Decision Separation

Decision separation distinguishes evidentiary evaluation from the burden and standard of proof. Probabilistic evidence does not create, alter, or satisfy a legal standard merely because its magnitude appears impressive. Burdens and standards derive from law. A quantitative expert conclusion may contribute to satisfaction of a standard, but it does not define the standard or transfer the burden merely by being numerical.

This separation also limits the role of error asymmetry. The unequal social costs of wrongful conviction and wrongful acquittal, or erroneous liability and erroneous non-liability, may help explain why legal systems choose different standards for different proceedings. They do not ordinarily authorise an individual judge to replace the legally prescribed standard with a personal case-specific utility calculation. Error asymmetry may justify standards at the system level; it does not itself create judicial authority to invent a new one.

The four separations also generate three doctrinal consequences. First, specification: the expert report and the court should identify the proposition evaluated and the relevant alternative. Secondly, transparency: the data, assumptions, uncertainty, and material dependence underlying the conclusion should be capable of scrutiny. Thirdly, reasoned transition: where a judgment moves from source to activity, from integrity to attribution, or from evidential strength to legal sufficiency, it should identify the evidence and reasoning that justify the movement. These consequences are deliberately procedural in form. They improve the quality of reasons without fixing the weight that any class of expert evidence must receive.

Taken together, the four separations create a sequential discipline:

What proposition? → What evidential support? → Who integrates it? → What does law require?

This sequence is the paper's single doctrinal innovation. It does not replace existing evidence rules; it specifies the transitions that those rules leave scattered across expert reporting, evidential weight, and legal proof. The paper uses the term inferential jurisdiction only as a shorthand for that allocation: which inference belongs to scientific expertise, which must be integrated judicially, and which can arise only through application of law.

V. APPLICATIONS AND A SIX-QUESTION JUDICIAL PROTOCOL

The practical value of the Principle is clearest in DNA and digital evidence. These fields differ technically, but both involve chains of propositions. In DNA evidence, a strong source conclusion may leave unresolved when the material was deposited, whether transfer occurred, what activity produced it, and whether the activity formed part of the offence. In digital evidence, integrity of a file or correspondence of an electronic message may leave unresolved control of the device or account, human authorship, intention, and legal responsibility.

The Principle therefore treats source, integrity, and authenticity as evidentially important but proposition-limited. Section 90 of the BSA is particularly instructive because it expressly permits one inference about electronic transmission while withholding an inference about the sender. The same logic applies to forensic evidence: proof of source cannot be treated as self-executing proof of activity or offence. The legal question is not whether scientific evidence is strong in the abstract, but what inferential work it can legitimately perform in the case.

A digital chain illustrates the point. Evidence may establish that a device produced a record, that an account was logged in, or that a message was transmitted. None of those findings necessarily identifies the human actor. Device ownership, account control, authorship, and intention are separate factual propositions and may require different evidence. The relevant defence alternative may therefore be not that the record is fabricated, but that the record is genuine and was generated, sent, or controlled by someone other than the person alleged. Proposition separation requires the comparison to engage that live alternative rather than a weaker one chosen for analytical convenience.

Dependence must also be examined at the point of integration. Multiple digital traces may arise from the same system event; several expert reports may rely on the same sample or database; and several witnesses may repeat information from a common source. Such

material can remain admissible and probative while adding less cumulative force than its numerical or rhetorical repetition suggests.

The same proposition-limited logic operates across forensic and digital evidence. Figure 2 places the two inferential chains side by side.

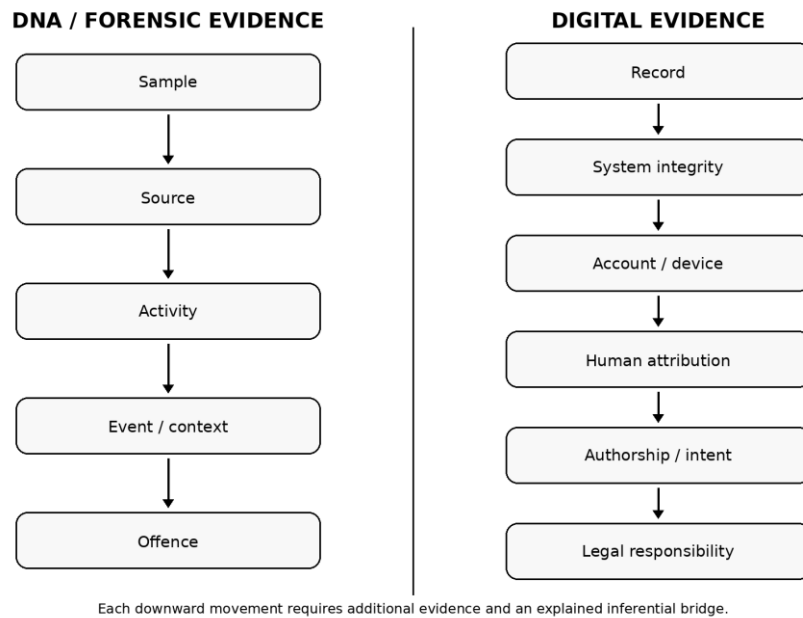


Figure 2. Proposition levels in forensic and digital evidence. Each downward movement requires additional evidence and an explained inferential bridge. Source: author's synthesis drawing on ENFSI proposition-level guidance and BSA section 90.

For trial use, the Bayesian Separation Principle can be operationalised through six questions. The protocol is not a formula for deciding cases and requires no numerical posterior probability. It is a disciplined checklist for keeping the inferential stages visible.

Table 1. Six-question judicial protocol for evaluating probabilistic expert evidence

Stage	Judicial question	Primary task / risk to test
1. Proposition	What proposition is being tested?	Identify whether the evidence concerns source, activity, event, attribution, authorship, or legal responsibility.
2. Alternative	Compared with what?	Specify the competing proposition and ensure that it reflects a live issue in the case.

Stage	Judicial question	Primary task / risk to test
3. Conditioning	What information is assumed?	Identify assumptions concerning collection, location, timing, population, device, system, or context.
4. Reliability	How dependable is it here?	Examine method, data quality, controls, chain of custody, preservation, examiner competence, and case-specific application.
5. Dependence	What is genuinely cumulative?	Determine whether findings share a source, system, witness, investigative process, assumption, or underlying event.
6. Legal contribution	What does it prove legally?	Integrate the specialised evidence with the complete record and apply the legally prescribed standard.

The protocol also structures expert examination. A material expert conclusion should be capable of being tested at the level at which it is offered: the propositions compared, the data and assumptions used, the method and validation basis, uncertainty, possible contamination or error, and the relationship between the findings and other evidence. Irfan demonstrates the consequences that may follow when a central scientific report is relied upon without adequate opportunity to examine the responsible experts and supporting material.

Judicial reasons need not reproduce the expert's statistical model. They should nevertheless disclose the inferential path. A concise judgment should identify the proposition supported, the alternative considered, any material reliability or dependence concerns, the independent evidence supplying additional links, and the reason the record does or does not satisfy the applicable legal standard. The court should avoid numerical substitution: a figure such as '99.9 per cent' cannot automatically become a finding of guilt, and the absence of a numerical conclusion does not make expert evidence irrelevant.

This form of reasoning is particularly important when a technical conclusion is linguistically broader than the analysis supporting it. Expressions such as 'the accused is the source', 'the device was used by the accused', or 'the evidence proves the offence' may compress several inferential steps into one sentence. The protocol requires the court to unpack those steps. If a missing link is supplied by independent testimony or circumstances, the evidence may properly contribute to the ultimate conclusion. If the missing link is essential and no other evidence supplies it, the expert conclusion may remain relevant yet insufficient to prove the broader legal proposition.

The protocol is intentionally limited. It assigns no fixed weight to DNA, digital records, statistical studies, or algorithmic outputs. It does not convert every trial into a statistical exercise. Its function is disciplinary: to prevent a source answer from becoming an offence answer, a likelihood ratio from becoming a posterior probability, expert authority from becoming judicial decision, and evidential strength from becoming a legal standard.

VI. CONCLUSION

Probabilistic expert evidence is difficult not because courts must choose between mathematics and law, but because specialised evidence and legal proof operate at different inferential levels. A scientifically valid conclusion may be powerful within the proposition it evaluates while leaving unresolved a broader question of activity, attribution, causation, intent, or legal responsibility. The central task of evidence law is therefore to control the movement between those levels.

The proposed Bayesian Separation Principle offers a compact interpretive doctrine for that purpose. Bayesian reasoning supplies three inferential disciplines: explicit competing propositions, separation of evidential likelihood from posterior truth, and attention to dependence. Indian evidence law supplies the institutional allocation through the BSA's treatment of expert opinion, grounds and supporting facts, electronic evidence and attribution, burdens, and judicial proof. The Principle connects them through four separations: proposition, evidential, institutional, and decision separation.

The contribution is therefore neither a new probability calculus nor a restatement of the familiar proposition that experts do not decide cases. It is a connecting doctrine. It identifies the distinct inferential transitions that existing approaches usually treat separately and assigns each transition to the actor or legal standard competent to make it. That structure is rooted here in Indian evidence law, but its analytical value is comparative: jurisdictions may differ

in admissibility doctrine and forensic practice while still confronting the same movement from proposition-level scientific evidence to whole-record legal proof.

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