

# Forensic Science On Trial: A Critical Analysis Of Dna Profiling, Polygraph Test, Finger Print Test, And Brain Mapping In The Indian Criminal Justice System

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## ABSTRACT

The increasing reliance on forensic science within the Indian criminal justice system marks a paradigmatic shift from testimonial to scientific evidence. While this development purports to bolster the accuracy and objectivity of criminal adjudication, it simultaneously raises profound concerns relating to the reliability, admissibility, and ethical contours of specific forensic techniques. This research critically examines four pivotal forensic tools, DNA profiling, polygraph testing, fingerprint analysis, and brain mapping, in the context of Indian law, jurisprudence, and evolving legislative frameworks, including the newly enacted criminal laws. Despite the scientific allure of DNA evidence and fingerprint analysis, their use remains fraught with procedural lacunae, infrastructural deficits, and an absence of regulatory oversight. Meanwhile, techniques such as polygraph and brain mapping, though frequently employed during investigations, have been declared inadmissible by the Supreme Court, primarily due to concerns surrounding voluntariness and the right against self-incrimination under Article 20(3) of the Constitution. The incorporation of Sections 349 and 93 in the Bharatiya Nagarik Suraksha Sanhita (BNSS), 2023, and Bharatiya Sakshya Adhiniyam (BSA), 2023, respectively, has expanded the scope of forensic collection and evidentiary admissibility; however, these provisions lack robust procedural safeguards and risk enabling coercive and intrusive investigatory practices. This research argues that forensic science, if uncritically embraced, risks supplanting constitutional protections with technocratic authoritarianism. It advocates for a rights-based, scientifically rigorous, and judicially restrained approach to forensic evidence, anchored in procedural due process, informed consent, and independent regulatory oversight, to prevent miscarriages of justice in the guise of scientific certainty.

**Keywords:** Forensic Science, DNA Profiling, Polygraph Test, Brain Mapping, Fingerprint Analysis, Indian Criminal Justice System, Scientific Evidence, Expert Testimony

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## INTRODUCTION

The evolution of forensic science in India reflects a broader trajectory of modernization within the criminal justice system, wherein empirical inquiry increasingly supplements traditional evidentiary methods. Historically, Indian criminal jurisprudence was heavily reliant on eyewitness testimony, confessions, and circumstantial evidence, often plagued by subjectivity and human error. However, with the advent of scientific techniques such as fingerprint analysis in the colonial era and the gradual incorporation of DNA profiling and other advanced modalities in recent decades, the evidentiary landscape has undergone a paradigmatic shift. Notably, this shift has been both reactive, arising from public demands for accountability in high-profile cases, and proactive, with investigative agencies embracing forensic tools to strengthen their probative capacity. Despite this, the integration of forensic science into legal practice remains uneven, often hampered by infrastructural deficiencies, lack of standardization, and judicial ambivalence (Edmond & Roberts, 2011).

The increasing reliance on forensic techniques in criminal trials is emblematic of a judiciary grappling with the dual imperatives of evidentiary precision and procedural fairness. Courts have, in numerous instances, valorized forensic evidence as objective and immune from human fallibility, particularly in cases involving DNA testing,

fingerprint comparison, or ballistic analysis. For example, convictions in rape and murder cases have often turned on the statistical certainty offered by DNA profiling. Nevertheless, such reliance also raises critical concerns regarding the scientific literacy of judges, the capacity of forensic labs, and the ethical dimensions of evidence procurement. The tension between evidentiary expedience and constitutional safeguards, particularly under Articles 20(3) and 21, has thus emerged as a defining concern in forensic jurisprudence. While the Supreme Court in *Selvi v. State of Karnataka* (AIR 2010 SUPREME COURT 1974) attempted to draw boundaries around coercive scientific techniques, the broader normative framework regulating forensic evidence remains underdeveloped.

In contemporary investigative practice, forensic evidence is increasingly positioned as the gold standard of truth verification, offering a promise of neutrality and precision that traditional testimony lacks. Its role is particularly crucial in complex or sensitive cases where material evidence is limited or compromised. However, the epistemological allure of scientific objectivity must be carefully balanced against the legal standards of admissibility, reliability, and probative value as codified in the BSA, 2023. The integration of forensic techniques into the criminal trial process necessitates a jurisprudential reimagining, one that neither fetishizes science nor disregards its fallibility. Bridging the gap between the courtroom and the laboratory thus requires not only infrastructural reform and judicial training but also a principled commitment to evidentiary integrity, due process, and constitutional fidelity. As India stands at the cusp of a forensic turn in criminal justice, it must ensure that scientific evidence serves as a tool of justice rather than an instrument of expedient conviction (Saks & Faigman, 2008).

## RESEARCH METHODOLOGY

This research adopts a doctrinal methodology, relying primarily on the analysis of statutes, judicial decisions, constitutional provisions, and legal commentaries to critically examine the legal status and implications of forensic techniques, namely DNA profiling, polygraph tests, fingerprint analysis, and brain mapping, within the Indian criminal justice system. It involves a systematic study of both the repealed laws & newly enacted codes, supplemented by a review of judicial rulings, with the aim of evaluating the compatibility of these techniques with constitutional safeguards and principles of fair trial.

## LITERATURE REVIEW

Bansal (2016) explores how forensic science has transformed criminal trials in India by providing objectivity in evidence assessment. He highlights the lack of infrastructure, expertise, and legal regulation as key barriers to its optimal use. The article critiques the overreliance on scientific evidence without adequate safeguards. It calls for a balanced framework integrating forensic utility and legal protections.

Kaushik (2021) critically examines DNA profiling's evidentiary role in Indian courts, pointing out legal lacunae in consent and privacy safeguards. He evaluates pending legislation like the DNA Technology Bill, emphasizing its regulatory necessity. The paper underlines the conflict between investigative utility and fundamental rights. It argues for structured, transparent, and rights-compliant forensic processes.

Sharma (2010) discusses forensic science's growing relevance in criminal trials and identifies systemic flaws, such as outdated labs and lack of qualified experts. He critiques the poor evidentiary standards used by Indian courts to assess forensic data. The author emphasizes the need for legislative and institutional reforms. He also highlights wrongful convictions due to flawed forensic reliance.

Singh (2020) analyzes the Supreme Court's decision in *Selvi v. State of Karnataka*, focusing on polygraph and narco-analysis. He argues that these techniques compromise the accused's constitutional rights and fail to meet scientific standards. The paper contends that such tests blur the line between investigation and coercion. It supports the judgment's reaffirmation of mental privacy and voluntariness.

Joshi (2018) examines brain mapping within Indian jurisprudence and raises concerns about its scientific unreliability and ethical validity. The study emphasizes cognitive liberty and mental privacy under Article 21. The absence of proper statutory safeguards in India is flagged as a major gap. Joshi recommends banning its evidentiary use unless regulated and scientifically validated.

## FORENSIC SCIENCE AND THE INDIAN CRIMINAL JUSTICE SYSTEM

The incorporation of forensic science into the Indian criminal justice system has gained statutory reinforcement under the newly enacted Bharatiya Nyaya Sanhita (BNS), 2023 which replaces the IPC, 1860. While BNS primarily codifies substantive offences, it indirectly accommodates the use of scientific evidence by recognizing crimes that inherently depend on forensic detection, such as cybercrime, sexual offences involving biological traces, and technologically facilitated frauds. The statute reflects an implicit recognition of forensic methodologies as an indispensable tool in both establishing mens rea and linking the accused to the commission of an offence. However, the BNS does not explicitly lay down procedural or evidentiary rules regarding the admissibility of such evidence, thereby deferring to procedural and evidentiary statutes for operational clarity. This legislative silence, although perhaps deliberate, risks judicial inconsistency and investigative arbitrariness in cases involving complex scientific inquiries (Kaye, 2010).

The BNSS, 2023, a successor to the CrPC, 1973, plays a more active role in regulating the operational dimensions of forensic science during investigation and trial. Notably, BNSS marks a significant expansion of the state's power to collect biological samples, fingerprints, iris scans, and voice recordings from persons under investigation, arrested individuals, and even those released on bail, provided such collection is deemed "necessary and expedient". This provision builds upon the foundation laid by the Criminal Procedure (Identification) Act, 2022, but further broadens the scope and reduces procedural thresholds, potentially raising concerns under Article 21 of the Constitution, particularly in the absence of robust data protection legislation. While the intent is to streamline evidence gathering and bolster prosecutorial accuracy, the provision's vague thresholds and lack of judicial oversight mechanisms invite scrutiny for enabling investigatory overreach and undermining the principles of informed consent and proportionality.

The BSA, 2023 addresses the evidentiary value of forensic and expert testimony in a more structured manner. BSA retains the general admissibility of expert opinion, including that of forensic analysts, DNA specialists, and cyber experts. More critically, BSA, 2023 explicitly provides for the admissibility of electronic records and scientific evidence, including data generated from biometric devices, forensic labs, and digital surveillance, provided their authenticity and integrity can be reasonably demonstrated. This reflects a departure from the somewhat dated framework of the repealed Evidence Act, which treated such evidence under broad interpretative umbrellas. While these provisions in BSA bring much-needed clarity, they stop short of prescribing methodological standards or evidentiary thresholds for emerging technologies like brain mapping or AI-assisted forensics (Houck & Siegel, 2015).

### **DNA Profiling: Legal Admissibility in India**

The legal admissibility of DNA profiling in India has undergone a significant transformation under the newly enacted BNSS, 2023 & BNSA, 2023. BNSS confers explicit statutory authority upon investigating agencies to collect biological samples, including DNA, fingerprints, and other biometrics, from accused persons, arrested individuals, or even those merely detained. This provision represents a marked shift from the older regime under the CrPC, where forensic collection operated within a narrower legal framework. Furthermore, Section 51(4) of BNSS reinforces this investigative power by acknowledging the evidentiary utility of such forensic material in establishing identity and linking individuals to crime scenes. This codification arguably enhances procedural legitimacy but also simultaneously raises questions about safeguards, voluntariness, and proportionality, especially when such evidence is collected without judicial oversight (Mnookin, 2008).

Under the BNA, 2023, the admissibility of scientific and electronic evidence, thereby providing a modern evidentiary framework to accommodate DNA profiling. This provision is meant to harmonize Indian evidentiary standards with global forensic norms. Yet, while BSA recognizes scientific evidence as legally admissible, it lacks detailed procedural thresholds or reliability benchmarks, such as those found in the Daubert standard applied in the United States—that could help assess the credibility of forensic methods. In the absence of such standards, there remains a latent risk of over-reliance on technically complex evidence without adequate judicial scrutiny. Additionally, the long-pending DNA Technology (Use and Application) Regulation Bill, 2019, which aimed to create a dedicated DNA Regulatory Board, set quality assurance benchmarks, and regulate the use, storage, and destruction of DNA data, remains in legislative limbo. The failure to enact this specialized statute leaves a critical regulatory vacuum, even as procedural laws now aggressively permit DNA collection. In the case of *Karandeep Sharma @ Razia @ Raju v. State of Uttarakhand*, (2025 INSC 444), the Supreme Court overturned a POCSO death

sentence, holding that failure to call the FSL DNA expert violated chain-of-custody and trustworthiness of the DNA report. The court ruled such procedural lapses fatally undermine admissibility.

This liberalization of forensic evidence laws must also be evaluated in the constitutional context, particularly in light of the Supreme Court's landmark judgment in *Justice K.S. Puttaswamy (Retd.) v. Union of India* ((2017) 10 SCC 1), which recognized the right to privacy as a fundamental right under Article 21 of the Constitution. Compulsory DNA collection, especially when conducted without consent or in pre-trial stages, implicates core privacy interests, including bodily integrity, informational self-determination, and the right against self-incrimination under Article 20(3). While Section 349 BNSS attempts to derive legitimacy from the need for efficient investigation, it arguably fails the test of necessity and proportionality as laid down in *Puttaswamy*, particularly in the absence of statutory safeguards on misuse, data retention, or scope limitation. In this respect, the current legal framework reflects a troubling imbalance: it empowers the state to extract intimate biological data but lacks a corresponding rights-based mechanism to prevent coercion or wrongful incrimination. Until a comprehensive DNA law is enacted with built-in judicial oversight and data protection norms, the admissibility of DNA evidence, though facially legal, remains constitutionally vulnerable (Lynch, 2013).

### POLYGRAPH TEST

The legal status of the polygraph test within the Indian evidentiary framework continues to be one of categorical inadmissibility, primarily due to constitutional infirmities and questions surrounding its scientific validity. The BSA, 2023 upholds the evidentiary sanctity of voluntary, reliable, and scientifically grounded inputs. Notably, BSA allows the admissibility of electronic records and expert evidence, including forensic material, but the polygraph test, lacking consistent scientific validation and universal standards of interpretation, fails to meet the threshold of reliability and objectivity contemplated by the new law. In its current form, the polygraph remains an investigative aid rather than an evidentiary tool. Any attempt to introduce it as substantive evidence would run afoul of the foundational evidentiary principle enshrined in BSA, mandating relevancy, probative value, and freedom from prejudice. In the case of Noida double murder, *CBI v. Talwars* (ongoing review, 2024), the Supreme Court reaffirmed that polygraph, narco-analysis, and brain mapping remain inadmissible as evidence, following the CBI's refusal to disclose test reports in the high-profile Aarushi-Hemraj case.

The BNSS, 2023 is largely silent on the direct use of polygraph or similar narco-analytic methods. However, BNSS introduces a broad mandate allowing for the collection of biological and behavioural samples from accused persons, including fingerprints, DNA, and "other body measurements," subject to consent and procedural safeguards. This provision could arguably be interpreted to cover certain neuro-psychological investigative techniques like the polygraph, but the absence of explicit reference limits its enforceability in a courtroom context. Moreover, while the BNSS expands police powers of evidence collection, it does not dilute the constitutional safeguards against compelled self-incrimination under Article 20(3) of the Constitution. Thus, any deployment of polygraph testing without informed, voluntary consent would not only lack statutory basis but also risk being struck down for constitutional impropriety.

The jurisprudential foundation laid down in *Selvi v. State of Karnataka* ((2010) 7 SCC 263) continues to serve as the controlling authority even in the post-2023 legal regime. In *Selvi*, the Supreme Court decisively held that the involuntary administration of polygraph, narco-analysis, and brain-mapping techniques violates Article 20(3) and the right to mental privacy under Article 21. The judgment emphasized that the results of such tests lack conclusive probative value and are susceptible to manipulation and subjective interpretation. Even under the new BSA and BNSS, the *Selvi* doctrine remains untouched, implicitly reaffirmed by the absence of legislative overruling or countervailing provisions. As such, the continued use of polygraph tests in Indian criminal investigations may be tolerated for intelligence-gathering purposes, but any reliance on such tests in court remains legally impermissible. This reinforces the doctrinal consistency that the Indian criminal justice system must be guided not merely by technological advancement but by constitutionally compliant, rights-based procedural fairness (Garrett & Neufeld, 2009).

### FINGERPRINT TEST

The legal regime governing fingerprint analysis in India has undergone substantial statutory evolution, culminating in a more expansive and formalized authority under BNSS, 2023. Section 349 of the BNSS vests

investigative agencies with broad powers to collect biometric and biological data, including fingerprints, from persons under arrest, convicted individuals, or those detained under preventive laws. This provision, while ostensibly enabling efficient identification and record-keeping, raises concerns of proportionality and due process, especially in light of the sweeping discretion it confers without adequate procedural safeguards or oversight mechanisms. The BNSS, unlike its predecessor CrPC, does not limit such collection to persons formally accused or convicted of serious crimes, thereby enlarging the investigative net in a manner that risks infringing on bodily autonomy and privacy under Article 21 of the Constitution.

From an evidentiary standpoint, BSA, 2023 affirms the admissibility of fingerprint evidence under the broader category of forensic and technical material. It reflects a codified shift toward recognizing technologically derived data as valid forms of secondary evidence, subject to expert validation. However, this admissibility must be critically evaluated through the lens of judicial discretion under BSA, which still necessitate reliability, relevance, and the qualification of the expert. In practice, fingerprint evidence, often treated as infallible, has not always met the exacting standards of error-proof analysis, particularly in cases involving partial or smudged prints. The BSA's silence on quality benchmarks and chain of custody requirements exacerbates the risk of wrongful attribution, particularly in jurisdictions where forensic laboratories are poorly equipped and lack accreditation (Bansal, 2016).

Significantly, the new regime supplants the colonial-era Identification of Prisoners Act, 1920, with the more comprehensive Criminal Procedure (Identification) Act, 2022, which aligns with the investigatory philosophy of the BNSS. This Act dramatically expands the scope of "measurements" to include not only fingerprints and footprints, but also iris and retina scans, behavioral attributes, and even biological samples. Although couched in the language of modernization and crime prevention, the Act has drawn criticism for its apparent disregard of the principle of minimal intrusion and its potential for disproportionate targeting of marginalized and undertrial populations. The absence of express statutory provisions for consent, retention limits, or access to remedy in cases of misuse renders the biometric data ecosystem vulnerable to abuse and state overreach. In the absence of a dedicated data protection law and institutional forensic oversight, these legislative changes, though technically progressive, may operate in a legal vacuum that jeopardizes civil liberties under the guise of scientific policing.

## BRAIN MAPPING

The legal status of Brain Electrical Oscillation Signature (BEOS) profiling, commonly referred to as brain mapping, remains contentious under the newly enacted BNSS, 2023 & BSA, 2023. While there is no express statutory recognition or prohibition of BEOS under the BNSS, Section 349, which permits the collection of biological, biometric, and behavioural samples from accused persons, may be construed broadly enough to encompass neuro-physiological methods such as brain mapping, provided such procedures are conducted with the individual's consent. However, the interpretive elasticity of this provision poses concerns regarding the scope of "behavioural" evidence, particularly given the intrusive nature of BEOS into the mental and cognitive privacy of a subject. The absence of statutory safeguards or procedural rules regulating such techniques renders the provision susceptible to abuse and judicial challenge (Kaushik, 2021).

BSA, 2023 mandates that scientific and electronic evidence must meet the twin thresholds of *reliability* and *voluntariness* before being deemed admissible. In the context of BEOS, this standard assumes critical importance, as the technique itself lacks widespread scientific validation and has not gained international acceptance as a robust forensic tool. Moreover, the evidentiary reliability of BEOS is undermined by the subjective interpretation of neural responses, absence of peer-reviewed replication studies, and the potential for cognitive noise and artefacts. From a due process standpoint, any admission of BEOS results as substantive evidence would necessitate demonstrable adherence to scientifically established protocols, rigorous chain of custody requirements, and certified expert testimony, none of which are sufficiently addressed in either the BSA or in any other enabling legislation (Mehta, 2023).

The constitutional impermissibility of involuntary brain mapping was conclusively established in *Selvi v. State of Karnataka* (AIR 2010 SUPREME COURT 1774), wherein the Supreme Court held that the administration of narco-analysis, polygraph, and BEOS tests without the consent of the accused violated the protection against self-incrimination under Article 20(3) and the right to mental privacy and dignity under Article 21. The Court observed that such techniques amount to testimonial compulsion and infringe upon an individual's autonomy

over cognitive processes. This jurisprudential benchmark continues to operate with full vigor in the post-2023 legal regime, and any deviation therefrom would be subject to constitutional scrutiny. Although the new criminal laws expand investigatory powers, they must be interpreted in harmony with fundamental rights, and not as vehicles for coercive forensic intrusions. The lack of express statutory recognition for BEOS, coupled with binding precedent in *Selvi*, reinforces the view that its evidentiary use remains constitutionally proscribed unless conducted with informed consent, scientific transparency, and strict procedural safeguards. In the case of Aarushi-Hemraj murder, *Talwars v. CBI* (2024 review), the Court explicitly rejected brain mapping (and narco tests) as evidence. It highlighted that victims' family lacked access to such test results, underscoring their procedural unfairness.

## CONCLUSION

While the 2023 overhaul of India's new criminal laws marks a paradigmatic shift in procedural and evidentiary norms, it fails to adequately resolve the normative and structural tensions that plague the integration of forensic science into the criminal justice system. The expanded investigatory powers under Section 349 of the BNSS may appear to facilitate scientific policing, but in the absence of a robust regulatory framework, procedural safeguards, and scientific accreditation mechanisms, such provisions risk enabling investigative overreach and rights violations. The continued reliance on techniques of dubious scientific validity, such as polygraphy and brain mapping, despite judicial embargoes, underscores a systemic failure to distinguish between evidentiary admissibility and investigative utility. Moreover, the BSA, while recognizing forensic evidence, stops short of articulating stringent admissibility thresholds or standards of expert qualification, thus leaving scope for misuse, misinterpretation, and wrongful convictions. Therefore, the legal regime, though rebranded, remains normatively underdeveloped in calibrating forensic science with constitutional values of dignity, privacy, and fair trial, necessitating urgent legislative and judicial intervention.

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