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Decoding The Brain: A Legal and Ethical Inquiry into Neuro-Scientific Evidence in Indian Criminal Trials

Ms. Dipal Bhayani[1], Dr Foram Pandya[2]

[1]Research Scholar, GLS University, Ahmedabad
[2]Assistant Professor, Faculty of Law, GLS University, Ahmedabad

Abstract:

The rapid advancement of neuroscience has introduced controversial investigative techniques such as polygraph tests, narco-analysis, and brain electrical oscillation signature (BEOS) profiling into the Indian criminal justice system. These methods, often presented as scientific tools for unveiling concealed truths and enhancing the efficiency of criminal investigations, have sparked profound legal, constitutional, and ethical debate. While their use is often justified on grounds of public interest and technological progress, the reliability and constitutional validity of these measures remain deeply contested.

This research paper critically examines the admissibility, evidentiary reliability, and ethical legitimacy of neuroscientific evidence in Indian criminal trials. It focuses particularly on the constitutional guarantee against self-incrimination under Article 20(3) of the Indian Constitution. Employing doctrinal analysis and case study methodology, the paper analyses key statutory provisions and landmark judicial pronouncements, especially Selvi v. State of Karnataka, which marked a significant turning point in judicial understanding of involuntary scientific techniques. The study evaluates whether these methods genuinely contribute to truth-seeking or function as coercive tools disguised in scientific objectivity.

Further, the paper explores fundamental concerns surrounding bodily autonomy, mental privacy, and the scope for custodial abuse in the application of such techniques. It critically assesses the scientific foundation, accuracy, and procedural safeguards of these methods while drawing comparisons with international legal and ethical frameworks from jurisdictions such as the United States, United Kingdom, and the European Union. These comparisons help to identify best practices and highlight the gaps in India's current regulatory landscape.

The study concludes that while forensic neuroscience holds potential to assist justice delivery, it must operate within the boundaries of constitutional morality, human dignity, and evidentiary fairness. Without robust regulatory mechanisms, independent oversight, and strict adherence to ethical standards, the use of such evidence risks undermining due process and compromising fundamental rights. The paper advocates for a principled and rights-based framework that harmonises scientific innovation with the core tenets of Indian constitutional law, ensuring that justice is pursued not only efficiently but also lawfully and humanely.

I. Introduction

The intersection of science and law has long challenged traditional concepts of justice, particularly in the assessment of what constitutes reliable and fair evidence in judicial proceedings. In recent decades, the convergence of neuroscience and criminal law has introduced sophisticated investigative tools into the legal arena—chief among them polygraph testing, narco-analysis, and Brain Electrical Oscillation Signature (BEOS) profiling. These neuroscientific techniques promise to revolutionize fact-finding by unveiling hidden truths, revealing unconscious memories, and decoding cognitive responses that are otherwise inaccessible through conventional investigative methods. In India, their growing deployment by law enforcement agencies marks a notable shift in the approach to criminal investigations.

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Despite their technological allure, these techniques have provoked intense debate across legal, scientific, and ethical domains. Critics argue that their use often bypasses fundamental protections enshrined in the Constitution of India, particularly the right against self-incrimination under Article 20(3) and the right to life and personal liberty under Article 21. Concerns have also been raised about the scientific credibility of these tools, the absence of regulatory safeguards, and the potential for abuse in custodial settings. The lack of transparency and procedural safeguards further compounds fears of coercion, especially when the subject is unaware of the implications of undergoing such tests.

The landmark judgment of the Supreme Court in Selvi v. State of Karnataka stands as a constitutional milestone, setting crucial limits on the involuntary application of these techniques. However, the gap between judicial pronouncements and on-ground enforcement continues to widen, necessitating a deeper examination of the legal and ethical viability of neuroscientific evidence within Indian criminal jurisprudence. While the promise of science in aiding the pursuit of justice is undeniable, it cannot be permitted to operate outside the bounds of constitutional morality and due process.

This paper undertakes a doctrinal and comparative inquiry into the current state of neuroscientific evidence in India, assessing its admissibility, evidentiary reliability, and ethical ramifications. It also evaluates international jurisprudence and regulatory frameworks to identify best practices and offer a roadmap for reform.

The structure of the paper is as follows: Part II explains the nature and application of neuroscientific techniques in criminal justice. Part III delves into the constitutional and evidentiary issues surrounding their use in India. Part IV examines the Selvi judgment and subsequent legal developments. Part V provides a comparative study of international practices. Part VI offers recommendations and concludes with a rights-based approach to forensic neuroscience.

II. Neuroscientific Techniques in Criminal Justice

The growing reliance on scientific methods in criminal investigation has led to the increasing use of neuro-based techniques aimed at detecting deception, accessing subconscious information, and establishing the mental involvement of suspects in criminal acts. Among these, the three most common and debated neuroscientific techniques used in India are the polygraph test, narco-analysis, and brain electrical oscillation signature (BEOS) profiling.

Polygraph Testing: The polygraph, commonly referred to as a lie detector, operates on the premise that physiological responses—such as heart rate, blood pressure, respiratory patterns, and galvanic skin resistance—change when a person is being deceptive. During the test, a subject is asked a series of structured questions, and their physiological responses are recorded and interpreted. Proponents claim that a significant deviation in response patterns indicates lying. However, scientific studies have challenged the reliability of this assumption, pointing out that physiological responses may be triggered by anxiety, fear, trauma, or confusion rather than deception per se. The subjective interpretation of results further undermines its evidentiary credibility, and courts have largely remained skeptical about its admissibility.

Narco-Analysis: Narco-analysis involves administering barbiturates such as sodium pentothal or scopolamine intravenously to place a subject in a trance-like state. In this altered state, it is believed that the subject's capacity to deceive is diminished and that they may reveal suppressed memories or hidden information. Law enforcement agencies have used narco-analysis in several high-profile investigations, claiming it to be effective in extracting confessions or leads. However, the technique has drawn criticism for violating bodily

autonomy, the right to silence, and the right against self-incrimination. The reliability of information obtained is also contentious, as subjects under the influence of such drugs may be suggestible, hallucinate, or provide fabricated or inconsistent statements.

BEOS Profiling: BEOS, developed by Indian neuroscientist Dr. C.R. Mukundan, is a relatively new technique that analyses the electrical activity of the brain using electroencephalography (EEG). Unlike the polygraph or narco-analysis, BEOS is described as non-invasive and non-interrogative. The test involves presenting verbal stimuli (such as crime-related words or phrases) and recording the brain's electrical responses to determine whether the subject has experiential knowledge of the events being probed. Advocates argue that BEOS can objectively assess recognition-based memory traces. Yet, questions remain about the interpretation of brain responses, the accuracy of inferences drawn, and whether the technology can reliably differentiate between innocent familiarity and criminal involvement.

Despite their increasing visibility and use in investigative processes, all three techniques suffer from a lack of universal scientific validation and face considerable challenges regarding their admissibility in court. The Indian legal system continues to grapple with whether such evidence is truly voluntary, scientifically reliable, and constitutionally permissible. Without clear legislative backing and judicial consensus, the application of these techniques remains contentious and ripe for potential abuse.

1. National Human Rights Commission of India, "Use of Polygraph Tests in Investigation: Legal and Ethical Concerns," NHRC Occasional Paper Series, 2017, at 4.
2. Nandini Sundar, "Narco-Analysis and the Right Against Self-Incrimination," (2009) 44 Economic & Political Weekly 10.
3. CBI Training Division, "Scientific Techniques in Criminal Investigation: BEOS and Beyond," CBI Bulletin, Vol. 67, No. 3, 2020, at 12.

III. Constitutional and Evidentiary Concerns in India

The application of neuroscientific techniques in criminal proceedings must be critically examined through the lens of constitutional protections and evidentiary thresholds. At the heart of this discourse lies Article 20(3) of the Constitution of India, which guarantees that no person accused of an offence shall be compelled to be a witness against himself. This provision is not merely procedural—it is a fundamental right designed to preserve the integrity of the criminal justice system by ensuring that the accused is not forced to self-incriminate under duress or coercion.1

The involuntary administration of narco-analysis, polygraph, and BEOS tests presents serious constitutional concerns regarding the voluntariness of statements made under their influence. These techniques often involve scenarios where the accused may be in altered states of consciousness, under psychological pressure, or without adequate legal counsel. Such conditions undermine the voluntariness of any disclosure and may result in the extraction of information without genuine consent. This was unequivocally affirmed in Selvi v. State of Karnataka, where the Supreme Court held that subjecting individuals to these tests without their explicit and informed consent constituted a clear violation of Article 20(3).2

Beyond the constitutional dimensions, there are significant concerns under the Indian Evidence Act, 1872. Section 24 of the Act renders inadmissible any confession procured through inducement, threat, or promise from a person in authority. Since neuroscientific techniques are frequently administered in custodial environments—where power asymmetry is inherently high—there exists a real risk that any statement obtained could be influenced by coercion or fear. Moreover, the accused may not fully comprehend the legal consequences of participation,

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especially in altered cognitive states, thereby invalidating the voluntariness required for admissibility.3

Another critical issue lies in the absence of a statutory framework to regulate the administration, procedural safeguards, oversight, and data management of neuroscientific evidence. Unlike DNA or fingerprint evidence, which are supported by legislated protocols and judicial precedents, the use of polygraph, narco-analysis, and BEOS lacks clear legal standards. This regulatory vacuum creates space for arbitrariness, misuse, and selective presentation of results. Without uniform protocols, the reliability and authenticity of neuroscientific evidence are susceptible to challenge, both procedurally and substantively.

Furthermore, the scientific community remains divided over the validity and reproducibility of results obtained from these techniques. Unlike DNA analysis, which enjoys a high level of scientific credibility and consensus, neuroscientific methods are still evolving. Factors such as emotional state, cultural background, and individual neurodiversity can influence test outcomes, making it difficult to draw conclusive inferences. Courts must therefore approach such evidence with scepticism, taking into account its potential for error, subjectivity in interpretation, and the grave implications of wrongful conviction based on unreliable science.

In sum, the deployment of neuroscientific techniques in criminal trials engages multiple layers of concern, ranging from constitutional rights and evidentiary standards to ethical and scientific legitimacy. Without robust legal frameworks and consistent judicial scrutiny, the use of such evidence risks infringing upon fundamental liberties and compromising the fairness of criminal adjudication.

IV. The Selvi Judgment and Its Impact

The Supreme Court's ruling in Selvi v. State of Karnataka7 represents a watershed moment in the constitutional treatment of neuroscientific techniques in India. The case consolidated multiple petitions challenging the compulsory administration of narco-analysis, polygraph tests, and BEOS profiling. The petitioners argued that these procedures violated fundamental rights under Articles 20(3) and 21 of the Constitution.

In a landmark judgment delivered in 2010, the Court held that subjecting an individual to such techniques without their informed consent amounted to a violation of the right against self-incrimination. The Court emphasized that any attempt to extract information from an accused through these methods—without free and voluntary consent—compromised both personal liberty and mental privacy.8

The Court also questioned the scientific reliability of these techniques. It observed that the results of narco-analysis and polygraph tests are not conclusive and that their interpretation often depends on the subjective judgment of experts. Consequently, such evidence does not meet the standards required for admissibility under the Indian Evidence Act.9

Importantly, the judgment provided a comprehensive doctrinal framework for evaluating the constitutionality of emerging investigative techniques. It articulated that the right against self-incrimination encompasses protection from both physical and psychological coercion. In doing so, it expanded the scope of Article 20(3) to include intrusive scientific procedures.

Following the Selvi judgment, law enforcement agencies were barred from forcibly administering these tests. However, the judgment did not render these techniques entirely inadmissible. If a person voluntarily consents to undergo these procedures, and the process is conducted with adequate safeguards, the information obtained may still be considered, albeit with caution.

The ruling has had a significant chilling effect on the use of neuroscientific methods in India, forcing a shift toward more constitutionally sound investigative practices. Nevertheless, the

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absence of codified procedures and oversight mechanisms continues to leave room for misuse, especially in custodial contexts where voluntary consent is questionable.

V. Comparative Perspectives from International Jurisdictions

A comparative analysis of legal frameworks governing neuroscientific evidence in jurisdictions such as the United States, United Kingdom, and European Union reveals varying approaches, yet a common emphasis on consent, reliability, and procedural safeguards.

In the United States, the Fifth Amendment protects individuals against compelled self-incrimination, much like Article 20(3) of the Indian Constitution. Courts in the U.S. have been generally skeptical about the admissibility of lie detector tests. In United States v. Scheffer, the Supreme Court upheld a military rule excluding polygraph evidence, reasoning that such tests are not sufficiently reliable and risk usurping the role of the jury.10 Moreover, the use of so-called "truth serums" has been criticized as unconstitutional due to the lack of consent and questionable accuracy.11

The United Kingdom relies heavily on the common law principle of voluntariness in evaluating the admissibility of confessions. Techniques such as narco-analysis or lie detection have not found widespread acceptance in British courts, partly due to scientific concerns and partly due to human rights obligations under the European Convention on Human Rights. Article 6 of the Convention guarantees the right to a fair trial, which includes the right against self-incrimination.

In the European Union, legal systems have adopted a cautious stance. The European Court of Human Rights (ECHR) has consistently ruled that investigative methods violating bodily or mental integrity are impermissible. In Jalloh v. Germany, the Court held that forcibly administering emetics to retrieve swallowed drugs constituted inhuman and degrading treatment, thus breaching Article 3 of the ECHR.13 This judgment has broader implications for involuntary scientific procedures like narco-analysis and BEOS.

These international perspectives underscore the importance of ensuring that scientific evidence aligns with constitutional values and procedural fairness. They reflect a global consensus on the primacy of consent, the fallibility of neuroscientific methods, and the necessity of legal safeguards.

VI. Recommendations and Conclusion

The analysis of neuroscientific evidence through constitutional, legal, and comparative lenses reveals a critical need for reform in the Indian legal system. While the Selvi judgment marked a significant step toward safeguarding individual rights, the practical enforcement of its principles remains inadequate. To uphold constitutional values and ensure fair trial standards in the age of advancing forensic science, a set of comprehensive, multidisciplinary reforms is imperative.

First and foremost, there must be a codified statutory framework that regulates the use, scope, and limits of neuroscientific investigative techniques. This legislation should clearly articulate the legal definition, scientific basis, and procedural application of polygraph tests, narco-analysis, and BEOS profiling. It must require informed and voluntary consent from the subject, with provisions for audio-visual recording of the process to ensure transparency. The law should also mandate the presence of legal counsel, a qualified forensic psychologist or neuroscientist, and medical professionals during administration. Any deviation or coercive application must be penalized stringently under both civil and criminal liability clauses.

Second, the evidentiary regime under the Indian Evidence Act must be revisited to account for the scientific validity and procedural reliability of these techniques. The Act should differentiate between scientific evidence that meets international standards of reliability and that which remains under experimental scrutiny. Neuroscientific evidence should only be

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admitted when subjected to rigorous validation tests and supported by corroborative evidence. Courts must be equipped with expert panels or amicus curiae to evaluate such evidence for its admissibility, ensuring that the judiciary does not rely on flawed science to decide criminal culpability.

Third, there must be a dedicated national-level oversight mechanism—such as a Forensic Science Ethics and Oversight Commission—composed of jurists, neuroscientists, ethicists, and civil society representatives. This body should issue standardized protocols, conduct periodic audits of law enforcement practices, provide certifications for authorized laboratories, and review complaints of misuse. Its independence from investigative agencies would safeguard against institutional bias and uphold the credibility of forensic evidence.

Fourth, capacity building is essential for all stakeholders in the justice system. Police officers, prosecutors, defense lawyers, forensic experts, and judicial officers should undergo regular training modules on the scientific, legal, and ethical dimensions of neuroscientific techniques. Such training should not only improve investigative efficiency but also instill a rights-oriented culture within institutions. Law schools and judicial academies should incorporate forensic neuroethics and procedural safeguards as core subjects.

Fifth, a redressal and compensation mechanism is crucial for victims subjected to involuntary, erroneous, or abusive use of neuroscientific procedures. Such individuals should have access to specialized legal aid, psychological rehabilitation, and speedy hearings before human rights commissions or special courts. Compensation for infringement of bodily autonomy and mental privacy must be statutorily guaranteed to serve both restorative and deterrent functions.

Furthermore, public awareness and informed consent are indispensable in a democratic society. Civil society organizations, media, and academia must foster public dialogue around the implications of brain-based evidence and advocate for a regulatory model that upholds civil liberties. Transparency in how neuroscientific tools are used will deepen public trust in the justice system.

In conclusion, while forensic neuroscience holds potential to supplement and modernise criminal investigations, its integration into the legal system must be accompanied by robust constitutional safeguards, scientific integrity, and ethical prudence. India’s justice system must resist the temptation to sacrifice rights at the altar of expediency or technological enthusiasm. The promise of forensic science must not become a pretext for undermining human dignity.

A truly just society is one where scientific progress strengthens, rather than subverts, the foundational values of liberty, fairness, and due process. The way forward lies in crafting a principled, transparent, and rights-based legal framework that harmonises innovation with constitutional imperatives. Only then can India’s criminal justice system confidently embrace the transformative power of neuroscience, without compromising the sanctity of justice.

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