SPECULATIVE EVIDENCE AND CONSTITUTIONALISM: THE LIMITS OF NEUROSCIENCE IN INDIAN JURISPRUDENCE

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ABSTRACT

Neuro-jurisprudence in India represents an evolving frontier of legal thought where neuroscience, law, and constitutional philosophy converge. With advances in brain science offering insights into memory, cognition, and decision-making, Indian courts have been confronted with novel forms of evidence such as narco-analysis, polygraph testing, and brain electrical oscillation signature (BEOS) profiling. These technologies, initially celebrated as potential tools of truth-finding, have since been subjected to rigorous scrutiny owing to their speculative reliability and profound constitutional implications.

The concept of speculative evidence is central to this inquiry, as neuroscientific techniques often promise more than what they can scientifically deliver. In India, the landmark judgment in Selvi v. State of Karnataka (2010) firmly rejected the involuntary use of such techniques, holding them unconstitutional under Articles 20(3) and 21. This ruling reflects a broader judicial hesitation to admit evidence that risks violating individual dignity, privacy, and the right against self-incrimination, even when presented under the banner of scientific advancement.

This project examines the theoretical foundations of neuro-jurisprudence and situates speculative evidence within the Indian legal framework, particularly the Evidence Act, 1872. By analyzing judicial responses, key case law, and comparative perspectives, it evaluates whether neuroscientific methods can ever attain the reliability necessary for evidentiary acceptance. Further, it addresses the philosophical and ethical challenges posed by such evidence, including issues of consent, voluntariness, and the danger of technological determinism in law.

Ultimately, this study argues that while neuroscience holds promise for enriching legal understandings of human behaviour and culpability, its evidentiary role in India must remain circumscribed. The future of neuro-jurisprudence lies not in uncritical acceptance of speculative techniques but in carefully balancing scientific innovation with the constitutional commitment to liberty, fairness, and human dignity.

CHAPTER 1: INTRODUCTION TO NEURO JURISPRUDENCE

Neuro jurisprudence (or NEUROscience) is a branch of law whose definition and scope is defined inconsistently, but typically, all areas of law and neuroscience on a case-by-case basis.

Under various circumstances, neuroscience is becoming a fashionable application in the contemporary legal issue. Human Behaviour is implicitly used as a key consideration as part of the legal system and as the modernization was taking its momentum, it started playing a leading role in explaining the behaviour of an individual in this case the alleged criminal cases.[1] Law is so that it is subject to actions of individuals in distinguishing the intentional and unintentional behaviour and neuroscience, which is a branch of human behaviour and psychology that provides to determine the actions of such behaviours. Neuroscientific evidence refers to the view of specialists regarding how the brain works, or is organized, which is often supported by neuroimaging.[2] It is such discipline that provides the study of the mental processes and correlates them with behavioural patterns. By doing so, scientists will be able to experiment with how the brain works and how it is affected by disorders, injury or certain interventions. Intersection between neuroscience and law is especially pertinent to the diagnosis, evaluation of the risks and drawing up treatment plans. The applicability of neuroscientific evidence in a criminal case or otherwise depends generally on how the evidence is defended.[3] There are three primary lines of thought, which the courts consider in most instances:

Actions involuntary: in this case, the defence tries to prove that the accused was not mindful of their actions in cases like epilepsy or sleeping walk. In them, as in one who will inadvertently cause injury to another in his sleep, the absence of intent will bar criminal responsibility.

Lack of mens rea: Since criminal law also requires that the guilty incidence that is the existence of a guilty psyche or intent, the defence can answer by giving neuroscientific proof of that the psyche is dysfunctional to such an extent that the intention is difficult to plan or convey.

Sanity defence: The presumption of sanity can be proven wrong through demonstrating the fact that at the time the crime occurred, the accused was mentally ill to the extent that he or she could not comprehend the nature or impact of his or her actions.

Neuroscience and law have been indirectly correlated, and the history of scientific evidence in law. Much early legal philosophy borrowed the extrinsic behavior and witness-testimony as a concept of criminal responsibility. Nevertheless, in the 19th and 20th centuries, due to the development of

[1] Garland, Brent, and Bryan A. Garner. *Neuroscience and the Law: Brain, Mind, and the Scales of Justice*. Dana Press, 2004.
[2] Ibid.
[3] Morse, Stephen J. "New Neuroscience, Old Problems." *Journal of Law, Medicine & Ethics* 6, no. 3 (2008).

psychiatry and the concept of medical jurisprudence, the court started to consider the inner mental conditions in the form of insanity defence and the expert testimony of medical specialists.[4] This was subsequently to be reversed in the late 20 th century with the introduction of neuroimaging through fMRI, PET scans and the EEG which enabled it to be learnt more about the biological basis of behaviour.[5] It enabled the courts to listen to neuroscientific evidence, particularly in Western legal systems, to take into account in such fields as diminished responsibility, impulse control disorders and sentencing. Neuroscience use is still a taboo since it is dubious in its reliability and can be abused though, neuroscience is widening the factual foundation, closing the distance between laws and behavioural science.[6]

Constitutional framework is a primary factor in India when it comes to determining admissibility or otherwise of such evidence. The fourth amendment of the Constitution (20(3)) guarantees the citizens the protection against self-incrimination, which can be practically observed in relation to non-consent neuroscientific methods, such as narco-analysis, brain mapping or polygraph test. The Supreme Court, in Selvi v. State of Karnataka (2010)[7] in Article 21 placed the value of personal liberty and mental privacy at the forefront and limited involuntary use of neuroscientific procedures. Meanwhile, Article 51A encourages the scientific temper in that it means that the State is open to technological progress. Even so that the scheme under the Indian constitution is in great part a compromise of the imperative to be innovative in the practices of evidentiary and the chief rights of dignity, autonomy and due process.

[4] Jones, Owen D., et al. "Law and Neuroscience in the United States." *Nature Reviews Neuroscience* 14, no. 9.
[5] Ibid.
[6] Garland, Brent, and Bryan A. Garner. *Neuroscience and the Law: Brain, Mind, and the Scales of Justice*. Dana Press, 2004.
[7] Selvi v. State of Karnataka, (2010) 7 SCC 263.

CHAPTER 2: SPECULATIVE EVIDENCE IN INDIAN JURISPRUDENCE

Speculative evidence is the kind of evidence that is highly doubtful or controversial in terms of its scientific validity along with its legal admissibility. In contrast to more traditional forms of evidence such as witness testimony, documentary evidence, or forensic data formed based on an already established scientific principle, speculative evidence is made out of an experimental or controversial foundation.[8] Its application in the courts has a way of leading to dispute regarding fairness, accuracy and constitutional protection. In India it found sufficient steam with the narco-analysis, polygraph tests and foreshadowing Brain Electrical Oscillation Signature (BEOS) profiling, which would find some dark secrets but also a few very big questions of morality and science.[9]

Narco-analysis is use of drugs of a truth drug known as sodium pentothal to put the victim into a trance like state and the subject may recollect. Polygraph tests are tests of physiological reactions, e.g. heartbeat, sweat or high blood pressure etc. to identify the lie. BEOS profiling is an Indian elaborated process that purports that through the examination of electrical activity, it is possible to ascertain whether or not the brain contains experiential knowledge.[10] These methods were initially labeled as innovative tools in the investigation process and presented the opportunities of reaching the subconscious mind and debinding the traditional interrogation.

These approaches were more or less eagerly demonstrated at Indian courts. In high profile crime cases such as the 2007 Aarushi Talwar case, the Abdul Karim Telgi stamp paper scam, narco-analysis and polygraph findings have found their way into the investigation. At this point, hopefully, these technologies could influence the process of truth-seeking positively and minimize the use of unreliable confessions, or circumstantial evidence. Although, judicial attitudes were transformed due to raising the issue of scientific reliability and constitutional rights. In Selvi case The Supreme Court in the year 2010 in the case of State of Karnataka placed significant restrictions on the use of these techniques assembly methods on the grounds that they were found to infringe the right against self-incrimination under the Articles 20(3) and the right to personal liberty under the Articles 21. This ruling was one toward the attainment of the speculative and possibly coercive quality.[11]

Scientific skepticism of speculative evidence is not only constitutional but also scientific. Studies indicate that narco-analysis should not be trusted to provide the truth and the subjects are capable of lying or misrepresenting information because of the drugs. However, contrary to the belief of many, polygraphs do not determine lies, but detect stress reactions, and that is why polygraphs can also give

[8] Ratanlal & Dhirajlal. *The Law of Evidence*. 27th ed., LexisNexis, 2020.
[9] Kaur, Paramjit. "Narco-Analysis, Polygraph and Brain Mapping Tests: A Legal Analysis." *Journal of Indian Law Institute* 52, no. 3 (2010).
[10] Satish, Manupatra. "Narco-Analysis and Indian Criminal Jurisprudence: A Critical Review." *Indian Journal of Criminology* 38, no. 2 (2010)
[11] Selvi v. State of Karnataka, (2010) 7 SCC 263.

false positive results or be manipulated by trained people. BEOS profiling is not a native invention, because it is neither peer-reviewed enough nor even accepted in the scientific community. No standard procedures are established and abuse can be done and threat of infringing individual dignity exists making such evidence an issue in the procedure.[12]

In speculative evidence in Indian jurisprudence, is illustrated the conflict between the necessity of scientific innovation, and the necessity of maintaining basic rights. Despite the fact that the techniques which were initially appealing as making investigations more robust, judicial and scientific criticism showed the weaknesses and dangers these techniques possessed.[13] This shift of initial enthusiasm to a questioning of issues indicates the necessity of the judiciary to ensure that truth seeking is not accompanied by the bias of constitutional assurances. Strict scientific verification should not be abandoned in the Indian legal system in the future and act by the law of rights first suffering emerging technology as a credible evidence.

[12] National Human Rights Commission of India, *Report on Narco-Analysis, Polygraph Test and BEOS Profiling*. NHRC, 2011.
[13] Ibid.

CHAPTER 3: CONSTITUTIONAL SAFEGUARDS AND JUDICIAL RESPONSES

Selvi v. State of Karnataka (2010)[14] is a key decision by the Supreme Court of India that reshaped the rules around collecting scientific evidence in criminal investigations. The case brought together several criminal appeals that questioned whether techniques like narcoanalysis, polygraph exams, and Brain Electrical Activation Profile (BEAP or brain-mapping) could be used on suspects, accused persons, or witnesses without their consent. These investigations showed the tension between the State's goal of efficient crime solving and the individual freedoms guaranteed by the Constitution.

The main questions for the Supreme Court were whether these forced scientific tests violated the right against self-incrimination under Article 20(3)[15], whether they counted as forcing someone to give testimony, and whether they could be seen as a reasonable limit under Article 21[16], which protects personal freedom. Article 20(3) forbids compelling an accused person to testify against themselves. The petitioners argued that these neuroscientific techniques extract information directly from a person's thoughts, turning private ideas into evidence through coercive methods. The State argued that these tests are effective tools for uncovering the truth about crimes and that the information obtained is not purely testimonial. Lower courts had given mixed rulings on these techniques, which led the Supreme Court to provide clear legal guidance.

The Court issued a broad ruling after thoroughly examining scientific, legal, ethical, and global aspects. It stated that the right against self-incrimination goes beyond physical coercion to include mental intrusion. In simpler terms, human dignity and mental privacy are also protected by the Constitution. The Court ruled that narcoanalysis, polygraph, and BEAP tests conducted without the subject's voluntary and informed consent represent a form of testimonial compulsion. Any results obtained in this way cannot be used in court, as they violate fundamental rights and lack the necessary reliability and fairness for evidence. The Supreme Court also noted that these forced scientific methods do not meet the standards of due process under Article 21; they compromise both bodily and mental autonomy and undermine a person's dignity.

From a constitutional standpoint, Selvi v. State of Karnataka broadened the interpretation of Article 20(3). By including coerced neuroscientific responses within the definition of self-incrimination, the Court stressed that forcing out someone's private thoughts cannot be justified solely by its benefits for law enforcement. The ruling established conditions for the acceptable use of these tests: they must have clear, informed consent, and the individual must understand the implications and risks involved. Even then, statements taken through these methods must adhere to procedural protections to be admissible.

[14] Selvi v. State of Karnataka, (2010) 7 S.C.C. 263.
[15] India Const. art. 20, cl. 3.
[16] India Const. art. 21.

Importantly, the Court referenced both Indian and international case law, including State of Bombay v. Kathi Kalu Oghad (1962)[17], which differentiated between physical evidence and testimonial coercion, and Nandini Satpathy v. P.L. Dani (1978)[18], which broadened safeguards against self-incrimination. The verdict aligned Indian criminal procedures with international human rights standards, echoing principles found in global privacy and fair trial agreements. The ruling also affects Section 27 of the Indian Evidence Act[19] (now Section 23 of the Bharatiya Sakshya Adhiniyam, 2023[20]), which governs the admissibility of information obtained under police detention, thus tightening the limits on coerced confessions in legal proceedings.

The wider impact of Selvi v. State of Karnataka lies in its role as a guardian of the rights of accused individuals. Following this case, the legal system must obtain consent from individuals before using such techniques and must provide complete information about the procedures and possible consequences. The ruling emphasizes that protections against self-incrimination apply broadly, not just to witnesses but also to suspects at early stages of investigation. This represents a significant move towards stronger respect for personal freedom and mental privacy, reinforcing the idea that the convenience of investigations cannot trump essential principles of justice and human dignity.

In summary, Selvi v. State of Karnataka (2010) strongly reaffirmed the constitutional protection of individual rights in light of advancing investigative technologies. It ruled that involuntary narcoanalysis, polygraph, and BEAP tests are unconstitutional, and their results cannot be presented as evidence.

The application of Articles 20(3) and 21 of the Indian Constitution is crucial when examining neurojurisprudence and the use of speculative neuroscientific evidence in criminal investigations. Article 20(3) ensures that no person accused of a crime can be forced to testify against themselves. This right against self-incrimination prevents coercion and forced confessions, which violate the autonomy and will of the accused. In neurojurisprudence, where tools like narco-analysis, polygraph tests, and brain mapping (BEAP) aim to extract information directly from a person's mind or physiological responses, self-incrimination protections extend beyond spoken or written testimony. They also include forced neurological or biochemical responses. The Supreme Court in Selvi v. State of Karnataka (2010) clearly stated that involuntary use of these neuroscientific techniques violates Article 20(3) because they compel the accused to reveal their thoughts and mental states, thus breaching the principle of non-compulsion. This ruling confirms that testimonial compulsion covers mental interrogation through scientific means, not just verbal responses in traditional questioning.

[17] State of Bombay v. Kathi Kalu Oghad, A.I.R. 1961 S.C. 1808.
[18] Nandini Satpathy v. P.L. Dani, A.I.R. 1978 S.C. 1025.
[19] The Indian Evidence Act, 1872, No. 1 of 1872 § 27.
[20] The Bharatiya Sakshya Adhiniyam, 2023, No. 47 of 2023 § 23.

Article 21 protects the right to life and personal liberty, which includes the right to privacy, mental integrity, dignity, and bodily autonomy. In neurojurisprudence, this means that any method of collecting neuroscientific evidence that invades mental privacy or forcibly manipulates brain or nervous system functions without informed consent violates this article. The Supreme Court recognized in Selvi that forced use of narco-analysis, polygraph tests, or brain mapping is a serious violation of individuals' mental and bodily privacy, undermining their dignity and human rights. The ruling highlights that personal liberty includes protecting the sanctity of one's thoughts and consciousness from unauthorized government intrusion. Therefore, speculative neuro-evidential techniques must strictly follow the protections outlined in Article 21, which requires procedural fairness, informed consent, and respect for human dignity during evidence collection.

Together, Articles 20(3) and 21 provide a legal shield that limits how far the State can employ neuroscientific methods in criminal investigations. They demand that speculative evidence from these technologies does not infringe upon a person's constitutional rights to silence, privacy, and dignity. This reinforces that finding the truth cannot justify methods that amount to mental torture or involuntary self-incrimination. These provisions establish an ethical and legal framework that ensures advancements in neurojurisprudence do not undermine fundamental principles of justice but function within clear constitutional protections.

CHAPTER 4: NEUROSCIENCE AND THE INDIAN EVIDENCE ACT, 1872

Balancing individual rights with the State's interest in finding the truth through neuroscientific evidence is a complicated constitutional challenge. It requires protecting basic freedoms while allowing effective law enforcement. The State's need to uncover the truth and prosecute crime is crucial for maintaining public order and ensuring justice. Neuroscientific methods such as narco-analysis, polygraph tests, and brain mapping provide new ways to gather information. These techniques can significantly help investigations by exposing hidden facts or detecting lies. However, their use often impacts important individual rights, especially the right against self-incrimination under Article 20(3) and the right to life, liberty, and dignity under Article 21 of the Constitution.

The Supreme Court's decision in Selvi v. State of Karnataka (2010) highlights how the judiciary tries to balance these interests. The Court acknowledged that while finding the truth is important for delivering justice, it cannot be achieved through methods that violate constitutional principles ensuring fairness and human dignity. The ruling specifically stated that involuntary neuroscientific tests violate mental privacy and autonomy, constituting unconstitutional pressure contrary to Articles 20(3) and 21. As a result, the Court stressed the need for informed and voluntary consent along with procedural safeguards. This ensures that the State's investigative powers do not turn into tools of coercion or mental invasion.

There are broader constitutional implications of neuroscientific evidence due to its potential effects on privacy, human dignity, and changing ideas of liberty. As these scientific methods explore the neurological and psychological aspects of the human mind, they raise serious questions about mental privacy, which is increasingly recognized as vital to human dignity and personal freedom under Article 21. The use of such evidence requires careful evaluation, as it can reveal thoughts, memories, and mental states that are usually considered private. Unauthorized or forced extraction of this information could turn investigative procedures into forms of mental surveillance, potentially violating the right to privacy as defined by recent court rulings, including the important Puttaswamy[21] judgment. This situation challenges the legal system to redefine the limits between acceptable evidence and unacceptable intrusion.

Furthermore, the admissibility, trustworthiness, and ethical application of neuroscientific evidence must conform to strict constitutional standards. The uncertain nature of these techniques—due to issues about scientific reliability, chances of error, and differences in interpretation—calls for caution from the courts. Judges must ensure that such evidence does not compromise fair trial rights or lead to wrongful convictions. So, the constitutional framework requires careful assessment of these technologies in

[21] Justice K.S. Puttaswamy (Retd.) v. Union of India, (2017) 10 S.C.C. 1.

relation to fundamental rights. This calls on lawmakers and judges to actively engage with scientific developments while protecting constitutional values.

Balancing individual rights with the State's truth-seeking in neurojurisprudence requires safeguarding mental privacy, ensuring informed consent, and keeping judicial control over the use of neuroscientific evidence. The constitutional implications show that neither investigative effectiveness nor technological advancement should infringe on core human rights protected by Articles 20(3) and 21.

The Indian Evidence Act, 1872[22] plays a key role in deciding the admissibility and assessment of neuroscientific evidence in criminal trials. The Act sets legal standards that govern the authenticity, reliability, and value of all evidence, including methods like narco-analysis, polygraph tests, and brain-mapping.

The basic framework for admissibility under the Indian Evidence Act requires evidence to be relevant, logically useful, and collected in line with legal protections. Section 45[23] of the Act is important because it addresses expert opinion. Neuroscientific evidence needs specialized interpretation, which courts may not have the technical skill to assess on their own. Therefore, expert testimony is essential for explaining the scientific principles behind the methods used, the scope and limitations of the tests, and the accuracy of the results. Experts help bridge the gap between complicated neuroscientific data and its legal interpretation. They assist the court in determining whether the evidence meets foundational admissibility standards like relevance, voluntariness, and reliability.

Process of Engaging an Expert

1. Appointment: Experts may be appointed either by the court (court-appointed experts) or engaged by one of the parties (party-appointed experts). In sensitive or complex scientific evidence cases, courts often rely on neutral, court-appointed experts for unbiased opinions.
2. Examination and Testing: The expert conducts or reviews the scientific tests or procedures relevant to the case, such as narco-analysis, polygraph tests, or brain mapping. They examine the subject, analyze the data generated, and verify the methodology followed to ensure scientific accuracy.
3. Analysis: The expert thoroughly studies the collected data against established scientific principles. They consider factors like the validity, reliability, and limitations of the neuroscientific techniques used.

[22] The Indian Evidence Act, 1872, No. 1 of 1872.
[23] The Indian Evidence Act, 1872, No. 1 of 1872 § 45.

4. Report Preparation: After examination and analysis, the expert prepares a detailed report explaining the findings, the science behind the tests, and any limitations or possible errors in the results. This report is submitted to the court.
5. Testimony in Court: The expert appears in court to provide oral evidence (expert testimony). They explain technical details in a simplified manner, respond to questions from judges and lawyers, and clarify any doubts regarding the scientific evidence.
6. Cross-Examination: The opposing party can cross-examine the expert to challenge the findings, methodology, or credibility—testing the expert's qualifications, independence, and the scientific basis of their conclusions.

However, the use of neuroscientific evidence under the Indian Evidence Act can be complex. The Supreme Court's ruling in Selvi v. State of Karnataka (2010) places constitutional limits on evidence obtained from techniques such as narco-analysis and brain-mapping. This ruling focuses on voluntariness and constitutional rights under Articles 20(3) and 21. As a result, any neuroscientific evidence that is obtained involuntarily or that violates fundamental rights is not admissible, even if it follows procedural standards. Consequently, the Evidence Act's rules must work alongside constitutional protections, ensuring that expert testimony considers the context of how the neuroscientific data was collected, including consent and coercion issues.

Furthermore, the reliability of neuroscientific evidence must align with scientific validation and acceptance within the forensic community. Courts expect such evidence to meet principles similar to those established in Indian case law and other jurisdictions for new scientific methods. This requires clear reliability, general acceptance, and low risk of error or manipulation. Experts are responsible for clarifying these scientific standards, helping courts take a careful and informed approach to speculative neuroscientific evidence that might be controversial.

In summary, under the Indian Evidence Act, 1872, the admissibility of neuroscientific evidence depends on traditional standards of relevance, reliability, and proper procedures. Expert testimony plays a crucial role in clarifying the scientific details and legal validity of this evidence. Importantly, the Evidence Act operates alongside constitutional protections, as highlighted by key rulings like Selvi v. State of Karnataka. This ruling emphasizes strict adherence to consent and protection against self-incrimination. Therefore, neurojurisprudence demands a comprehensive legal framework that combines evidence standards with constitutional rights to responsibly integrate neuroscientific techniques into India's criminal justice system.

The Indian Evidence Act, 1872 establishes the basic legal structure for the admissibility and evaluation

of evidence in Indian courts, including neuroscientific evidence in criminal cases. Under the Act, all evidence must be relevant, reliable, and obtained through lawful means. Section 45 specifically addresses expert testimony, which is crucial in neurojurisprudence since neuroscientific techniques like narco-analysis, polygraph tests, and brain mapping create complex data beyond ordinary judicial understanding. Expert witnesses explain these scientific methods, evaluate their accuracy, limitations, and relevance, and help the court decide if the evidence meets the necessary standards for admissibility.

However, the admissibility of this neuroscientific evidence is also influenced by constitutional protections, especially after the Supreme Court's ruling in Selvi v. State of Karnataka (2010). The Court stressed that the involuntary administration of neuroscientific tests violates fundamental rights under Articles 20(3) (right against self-incrimination) and 21 (right to life and dignity). This makes any unlawfully obtained evidence inadmissible, regardless of its nature. This layered protection means that beyond standard evidentiary criteria, courts must ensure that neuroscientific evidence is gathered with informed and voluntary consent and does not violate constitutional rights. Consequently, expert testimony also needs to provide context concerning how the evidence was collected.

Moreover, the reliability of neuroscientific evidence is a major concern. Courts require that such scientific techniques gain general acceptance within the scientific community, demonstrate proper methodology, and show a low margin of error to be credible. Expert testimony aids judicial bodies in understanding the level of scientific agreement, potential issues, and the interpretative framework needed to assess speculative neuroscientific evidence in trials. This careful approach ensures that new evidence supports rather than undermines the principles of fair trials and justice.

The use of new scientific tools, such as neuroscientific methods, in criminal investigations creates important conflicts with traditional evidence rules. Traditional evidence law, as outlined in the Indian Evidence Act of 1872, focuses on principles like relevance, reliability, voluntariness, and procedural fairness. These principles were mainly developed for physical and testimonial evidence. However, new scientific tools, including narco-analysis, polygraph tests, and brain mapping, often produce indirect or speculative forms of evidence that challenge these established rules. For example, while direct testimonial evidence includes clear statements, neuroscientific methods may show unconscious or physiological responses that need interpretation. This raises questions about how well such indirect evidence fits within standard categories for admissibility and how courts should assess its value without compromising fair trial rights.

One significant issue is reliability. Traditional rules require evidence to be trustworthy and factually relevant. Scientific evidence, especially newer or experimental techniques, may not have widespread scientific agreement or may involve considerable error margins, which creates doubt about its reliability.

In India, the Supreme Court in Selvi v. State of Karnataka (2010) emphasized the constitutional need for voluntariness and protection against self-incrimination, adding another layer beyond basic evidentiary reliability. This is different from some common law jurisdictions, where courts use standards like the Frye or Daubert rules. These emphasize acceptance in the scientific community, testability, error rates, and peer review when judging reliability before evidence is allowed. Indian courts do not follow a formal reliability test like Daubert but generally evaluate scientific evidence on a case-by-case basis, considering expert testimony and procedural adherence alongside constitutional protections.

Looking at other countries, jurisdictions differ in how carefully they examine neuroscientific evidence. The U.S. Daubert standard requires judges to act as gatekeepers, making sure that scientific evidence is relevant and reliable based on clear criteria like method validity and error rates. The U.K. uses similar cautious measures under its Criminal Procedure Rules and the Police[24] and Criminal Evidence Act[25], focusing on the scientific validity and ethical administration of tests. Indian courts are evolving in their approach, gradually emphasizing voluntariness, consent, and constitutional rights as necessary conditions before assessing scientific reliability. This trend shows a growing global understanding that neuroscience-based evidence should be closely scrutinized to avoid wrongful convictions linked to overreliance on speculative or intrusive scientific methods.

The conflicts between traditional evidence rules and new scientific tools point to the need for legal systems that balance technological progress with the protection of rights. Reliability requirements act as a crucial filter in this balance, with courts increasingly depending on expert evaluations, procedural safeguards, and constitutional mandates to responsibly integrate neuroscientific evidence while maintaining the integrity of the justice system.

[24] Criminal Procedure Rules and the Police, S.I. 2015/1490.
[25] Criminal Evidence Act 1898, 61 & 62 Vict. c. 36.

CHAPTER 5: PHILOSOPHICAL AND ETHICAL DIMENSIONS

The use of neuroscientific techniques (e.g. narcoanalysis, polygraph, brain mapping) in criminal investigations raises profound ethical questions about consent, dignity, privacy, and human autonomy. Most fundamentally, forcing or covertly subjecting a person to brain-based interrogation violates the individual's right to consent and volition.[26] As one study notes, administering sedatives or brain- scanning without *informed consent* "violates [a person's] autonomy and bodily integrity" because it alters mental functions and may compel information against one's will.[27] Courts in India agree: Selvi v. Karnataka (2010) held that involuntary narcoanalysis, polygraph or BEAP tests *per se* breach the constitutional right against self-incrimination (Art.20(3)).[28] The Supreme Court therefore, made consent a compulsory prerequisite for any such test. In practice, however, the line between "voluntary" and "coerced" can blur. Critics note that even "written consent" may be procured under psychological pressure in a custodial setting.[29] Without genuine choice, these techniques amount to non-consensual mind-probing, undermining the moral agency of suspects and witnesses.

Beyond consent, neuroscience evidence implicates core values of dignity, privacy and autonomy. Our mental life – thoughts, memories and intentions – lies at the heart of personal dignity. In *Puttaswamy v. Union of India* (2017)[30], India's Supreme Court recognized privacy (including informational and decisional privacy) as a facet of human dignity under Article 21. Scholars argue that "any technology that tampers with one's thinking is a violation of … freedom of mind" and informational privacy.[31] Neuro-evidence, by probing the mind, thus risks intruding on the most intimate sphere of the individual. As one analysis put it, brain data "represent the most intimate aspects of human personality" and demand "the strictest protection".[32] Informed consent and confidentiality are essential; without them, neural data collection can feel like involuntary self-exposure. In practical terms, tools like BEOS or fMRI generate deeply personal information (emotional states, memories, intent) which, if misused, can cause irreversible stigma or repression. For example, employees in China have been required to wear EEG headsets to monitor attention on the job, vividly illustrating how neurotechnology can invade privacy. Ethicists warn that commodification or surveillance of brain data – trading "access to our brain activity"

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[26] Vina Vaswani, Venkatkrishna Shenoy & Akuma Ifeanyichukwu, *Medicolegal and Ethical Perspectives in the Use of Narcoanalysis in Criminal Investigations in India*, 12 ARCH. MED. HEALTH SCI. 281 (2024), https://journals.lww.com/armh/fulltext/2024/12020/medicolegal_and_ethical_perspectives_in_the_use_of.29.aspx.
[27] *Id.*
[28] Selvi v. State of Karnataka, (2010) 7 SCC 263.
[29] *The Mindhunters: How Brain Mapping Detects Memories of Crime | India News - Times of India*, https://timesofindia.indiatimes.com/india/heads-up-how-brain-mapping-tests-mind-of-crime-suspects/articleshow/101073852.cms (last visited Oct. 11, 2025).
[30] Justice K.S. Puttaswamy (Retd.) v. Union of India, (2017) 10 S.C.C. 1.
[31] Frederic Gilbert & Ingrid Russo, *Neurorights: The Land of Speculative Ethics and Alarming Claims?*, 15 AJOB NEUROSCI. 113 (2024), https://www.tandfonline.com/doi/full/10.1080/21507740.2024.2328244.
[32] Nar Hari Singh, *Brain Data in India: Taking It From Your Head to the Courtroom and Dealing with All the Legal Stuff*, MAIN_LEXTALK WORLD (Jul. 7, 2025), https://www.lextalk.world/post/brain-data-india-legal-issues.

for corporate perks – risks turning thought itself into property.[33] Such scenarios contravene basic Indian norms of individual dignity and privacy.

The risk of *technological determinism* also looms large. This means uncritically assuming that because neuroscience offers new methods, it must determine legal outcomes. Commentators caution that judges may be *"overawed by the technology"* and start delegating verdicts to brain scans. In one Reuters report, a leading neuroscientist warned that courts could slip into the mistake of treating machine evidence as infallible truth.[34] If jurists come to view neuro-tech as a decisive oracle, the complex social and moral context of each case can be ignored. For instance, brain evidence cannot easily distinguish truth from confabulation: studies show that under narcoanalytic drugs or high stress, the brain may produce false memories.[35] In short, no matter how sophisticated, these tools are imperfect. Confusing neural markers with guilt could result in miscarriages of justice. Respect for justice demands caution: courts must not let cutting-edge gadgets override fundamental notions of human responsibility and error. As Colin Blakemore, a renowned neuroscientist, observed: the law should resist *"delegating the decision about guilt to a particular form of test"*.[36]

More broadly, these issues implicate fairness and social equity. Unequal trust in neuroscience may exacerbate bias. If only the wealthy can afford advanced brain scans, or if marginalized communities distrust intrusive tests, inequalities could deepen. Francis X. Shen, a leading neurolaw scholar, stresses that ethical *"guardrails"* are needed to prevent neuroscience from reinforcing existing inequities.[37] For example, in the US some judges have been more lenient when defendants present neurobiological evidence of conditions like addiction or brain injury – highlighting a tension between punishment and rehabilitation.[38] Indian courts must remain vigilant that neuroscience does not create a two-tier justice system where some defendants are "saved" by brain scans and others left behind. Moreover, communities historically mistreated by the state may view neuro-surveillance with suspicion. Shen notes the importance of community engagement to build trust in these technologies.

Finally, even as neuroscience promises new insights, its limits affect justice. No technology is fool proof. Researchers have shown that suspects can learn "countermeasures" to thwart brain-wave tests[39].

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[33] *"Cognitive Liberty" Is the Human Right We Need to Talk About | TIME*, https://time.com/6289229/cognitive-liberty-human-right/ (last visited Oct. 11, 2025).
[34] *Insight - Neuroscience in Court: My Brain Made Me Do It | Reuters*, https://www.reuters.com/article/business/healthcare-pharmaceuticals/insight-neuroscience-in-court-my-brain-made-me-do- it-idUSBRE87S071/ (last visited Oct. 11, 2025).
[35] Vaswani, Shenoy, and Ifeanyichukwu, *supra* note 1.
[36] Insight - Neuroscience in court: My brain made me do it | Reuters, *supra* note 7.
[37] *Will Neuroscience Revolutionize the Criminal Justice System? - Vanderbilt Law SchoolVanderbilt Law School | Vanderbilt University*, https://law.vanderbilt.edu/will-neuroscience-revolutionize-the-criminal-justice-system/ (last visited Oct. 11, 2025).
[38] Insight - Neuroscience in court: My brain made me do it | Reuters, *supra* note 7.
[39] The Mindhunters: How brain mapping detects memories of crime | India News - Times of India, *supra* note 3.

Similarly, brain imaging often produces ambiguous or non-specific results. Courts have taken note: in India a high court famously overturned a murder conviction obtained solely on brain-fingerprint evidence, citing doubts about its scientific reliability.[40] Such examples underscore that reliance on "mind-reading" technologies can be ethically compromising if the science is unsettled. On balance, respect for individual rights – the autonomy to think without coercion – should prevail until neuroscience is proven reliable. Any rush to embrace novel tech must not trample the constitutional values of dignity, privacy and fairness.

[40] Singh, *supra* note 5.

CHAPTER 6: THE FUTURE OF NEURO-JURISPRUDENCE IN INDIA

Neuroscience holds tantalizing promise for enriching our understanding of criminal behaviour and culpability – but only if integrated cautiously and comparably. On the positive side, modern brain science illuminates how decisions and impulses arise. Legal scholar Francis Shen explains that every mental process (choice, emotion, impulse) is underpinned by neuronal activity. In theory, detailed knowledge of the brain could help courts distinguish, say, impulsivity from premeditation, or mental illness from wilful wrongdoing. Some evidence already shapes jurisprudence: for example, US Supreme Court rulings (not India's yet) have cited neuroscientific studies on juvenile brain development to justify more lenient sentencing for minors. Shen's work foresees neuroscience supplying *"new tools"* – from AI- aided brain scans to biomarkers – that may inform decisions on sentencing, rehabilitation and risk assessment. He predicts neuroscience will increasingly influence areas like parole and treatment (not just punishment) of offenders. Portable MRI and brain-computer interfaces (BCIs) might one day be used at the bedside or prison, bringing neural data directly into legal proceedings.[41]

Concretely, India's courts may encounter cases where neural factors are probative. For example, brain imaging can detect tumours or lesions that affect behaviour. A high-profile Reuters report described an Italian doctor whose new-onset pedophilia was linked to a brain tumour.[42] After the tumour was removed, his behaviour returned to normal – a striking case suggesting biological bases for behaviour. If, hypothetically, similar cases arose in India, courts would need to weigh medical conditions as mitigating factors. Neuroscience could also inform rehabilitation strategies: consider opioid addiction. Shen discusses a case where neuroscience arguments were used to urge treatment rather than punishment for relapse.[43] Indian law already emphasizes reformative justice (e.g. under the Juvenile Justice Act); neuroscience could bolster this approach by showing when an offender's capacity for change is strong or weak.

International experience offers lessons for India. Some countries are moving quickly to codify *neuro-rights*. Chile, for instance, amended its constitution to protect "neurorights" – mental privacy, free will, and non-discrimination in neurotechnology use.[44] Its Supreme Court has even ruled that brainwave data are as inviolable as biometric data. In the U.S., a patchwork of state laws is emerging: California and Colorado now explicitly treat EEG data as sensitive personal information requiring consent. The UK has no specific neurorights law, instead relying on medical device regulations and data protection law;

[41] Will Neuroscience Revolutionize the Criminal Justice System? - Vanderbilt Law SchoolVanderbilt Law School | Vanderbilt University, *supra* note 10.
[42] Insight - Neuroscience in court: My brain made me do it | Reuters, *supra* note 7.
[43] Will Neuroscience Revolutionize the Criminal Justice System? - Vanderbilt Law SchoolVanderbilt Law School | Vanderbilt University, *supra* note 10.
[44] *Chile: Pioneering the Protection of Neurorights | The UNESCO Courier*, https://courier.unesco.org/en/articles/chile-pioneering-protection-neurorights (last visited Oct. 11, 2025).

experts there are urging courts to interpret rights to privacy and "freedom of thought" to cover neural data. By contrast, Indian law remains largely silent on these frontiers. Apart from the general right to privacy (Puttaswamy) and data protection statutes, there is no brain-specific legislation. This gap means neural data might, for now, be treated like any other personal information – a situation which some commentators call inadequate given the unique sensitivity of thoughts.[45]

On the other hand, India's legal tradition emphasizes caution with speculative evidence. Neuroscientific "tools" still raise reliability concerns, as Indian courts have learned. Early experiments with brain fingerprinting (BEOS) and narco-testing produced mixed results: initial trial courts sometimes admitted BEOS findings, but higher courts have repeatedly underscored their unreliability and constitutional risk.[46] In 2010, the Supreme Court in *Selvi* effectively barred involuntary brain probes. More recently (2023), Bombay HC acquitted defendants despite BEOS suggesting guilt, emphasizing that such tests alone cannot prove a case.[47] These precedents suggest Indian courts will impose a high evidentiary bar on neuroscience. Until clear scientific consensus emerges, novel neuro-evidence will likely be treated as supplementary – not decisive.

Looking ahead, Indian jurisprudence must balance scientific innovation with constitutional core values. There is potential for neuroscience to inform justice (e.g. in assessing mens rea, culpability, recidivism risk), but also hazards in overreliance. The comparative picture shows two paths: some systems proactively protect "brain rights," while others (like the UK) adapt existing laws. India might take a hybrid approach. For example, the 2023 Digital Personal Data Protection Act could conceivably be interpreted to cover neural data (since it defines "sensitive personal data" broadly), though it does not yet specify "neurodata".[48] Courts could also develop doctrine analogously: Puttaswamy's right to dignity and mental autonomy might imply new safeguards against "mindreading" without consent.

Ultimately, the constitution's values – liberty, equality, dignity – must frame any use of neuroscience. India's judiciary has long held that technological advances must yield to fundamental rights. In *Selvi*, for instance, the Court stressed that efficiency cannot override the "yardstick" of due process and human dignity.[49] This lesson will remain vital: novel evidence must not come at the cost of fairness or coercive practices. As neuroscience tools mature, their admissibility will likely hinge on rigorous scientific validation and consent protocols. The future of neuro-jurisprudence in India, then, is one of cautious

[45] Singh, *supra* note 5.
[46] *Id.*
[47] The Mindhunters: How brain mapping detects memories of crime | India News - Times of India, *supra* note 3.
[48] Gilbert and Russo, *supra* note 4.
[49] Selvi v. State of Karnataka, (2010) 7 SCC 263.

exploration: recognizing neuroscience's potential to illuminate human behaviour, yet holding fast to constitutional safeguards so that innovation serves justice, not undermines it.