
BRAIN SCIENCE IN THE COURTROOM: ASSESSING THE IMPACT OF NEUROLOGICAL ABNORMALITIES ON VIOLENT OFFENDING AND LEGAL CULPABILITY

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ABSTRACT

The rise of neurocriminology has challenged long-established assumptions about criminal responsibility. Advancements in functional neuroimaging, cognitive neuroscience, and forensic psychiatry have revealed that abnormalities in the prefrontal cortex, amygdala, paralimbic regions, and structural brain pathways are associated with heightened aggression, impulsivity, and violent offending. This paper critically examines the integration of neuroscientific evidence in criminal trials, focusing particularly on the Indian legal context. Drawing from Indian case law on insanity and mental incapacity, the controversial use of Brain Electrical Oscillation Signature (BEOS) analysis, and comparative international jurisprudence, the paper evaluates the reliability, admissibility, and ethical implications of brain-based evidence. It argues that while neuroscience can illuminate underlying vulnerabilities, it cannot determine legal culpability on its own. The study concludes that Indian criminal courts must develop structured admissibility standards and judicial training to prevent misuse while enabling legitimate scientific assistance.

Introduction:

The intersection of law and neuroscience has witnessed significant developments over the past two decades. Neurocriminology—the study of the neurological basis of criminal behaviour—suggests that certain brain abnormalities may predispose individuals to violence, impulsive aggression, or diminished decision-making capacity. Functional MRI (fMRI), PET scans, EEG, and neuropsychological assessments are increasingly cited in global courtrooms, raising fundamental questions: *Can the brain make someone less culpable? Should neurological abnormalities mitigate punishment?*

Indian criminal courts have traditionally relied on Section 84 of the Indian Penal Code, which follows the M'Naughton Rule of legal insanity. However, the advent of neuroscience presents new complexities beyond classical psychiatric diagnosis. This paper analyses how Indian courts approach neurological abnormalities, the challenges of admitting neuro-evidence, and how such evidence may impact assessments of mens rea, voluntariness, and sentencing.

Neurological Abnormalities and Violent Behaviour:

Research demonstrates that deficits in the prefrontal cortex (PFC), responsible for executive functioning, impulse control, and moral reasoning, correlate strongly with violent offending (Yang & Raine, 2009). Amygdala dysfunction is associated with reactive aggression, while traumatic brain injury (TBI) disrupts emotional regulation. Meta-analyses (Aoki et al., 2014) confirm structural and functional anomalies in violent offenders.

Neuroscience in Criminal Law:

Internationally, neuroscientific evidence has been used in:

- **Roper v. Simmons (2005, US)** – Brain development used to abolish juvenile death penalty.
- **People v. Weinstein (1992)** – Frontal lobe cyst considered for sentencing reduction.
- **Bouchard twin studies** – Genetic and neural predispositions to antisocial behaviour.

Neuroscience is increasingly used not to excuse, but to *explain* behaviour.

Indian Context:

India lacks a structured framework for admitting neuroscientific evidence. Judicial reasoning still depends primarily on:

1. Psychiatric diagnosis,
2. Fitness-to-stand-trial assessments,
3. The narrow McNaughton-based test of legal insanity.

However, India is among the first countries to experiment with **BEOS profiling**, a controversial EEG-based test used to detect “experiential knowledge” (Wired, 2008). Although not neuroscience in the strict sense, it shows India’s early attempts to incorporate brain science.

Key Indian Cases & References on Neuroscience / Mental Abnormality:**1. Singh vs State of Uttarakhand (Supreme Court, 9 July 2024)**

- The Supreme Court acquitted the appellant under Section 302 IPC, accepting medical evidence that he was suffering from **chronic schizophrenia**.
- This shows the Court giving weight to psychiatric diagnosis, though not “brain imaging.”
- Use in paper: as an example of *medical-psychiatric evidence* being accepted, even if not classical “neuro criminology.”

2. CRL.A (J) / 111 / 2018 (18 December 2023)

- The court considered whether the accused was *fit to stand trial* (i.e., whether he understood the trial process, could follow the 313 CrPC examination).
- The judgment refers to **Surendra Mishra vs State of Jharkhand (2011)**, reaffirming that what needs to be proved under Section 84 IPC is **legal insanity**, not necessarily “medical insanity.”
- Use in paper: relevance to *competency and capacity assessment*, a key legal-

psychological intersection.

3. How India's Courts Use Neuroscientific Evidence (BEOS / Brain-Electrical Evidence)

- There are documented uses of **BEOS (Brain Electrical Oscillation Signature)** profiling in India.
- According to a *Wired* article, an Indian court convicted a woman (Aditi Sharma) of murder partly based on EEG-type brain scan evidence showing “experiential knowledge.”
- This is controversial: scientific community has criticized BEOS's reliability.
- Use in paper: this is probably the closest real-world **neuro-evidence** case in Indian criminal courts. Use it as a historical / controversial example, not as a high-scientific standard precedent.

4. 2024 Sikkim High Court: Pradeep Khatiwara vs State of Sikkim

- In this case, the High Court reiterated the difference between **medical insanity** and **legal insanity**, stating legal insanity under Section 84 IPC “must be shown” such that the accused was “incapable of knowing ... what he was doing was either wrong or contrary to law.”
- Use in paper: supports argument that Indian courts currently emphasize *cognitive capacity* over purely medical diagnosis — which is significant when considering future integration of neurocriminological evidence.

5. Schizophrenia and Trial Fitness / Liability

- The *High Court verdict review article* shows that out of 102 insanity pleas in High Courts, only ~18 were accepted.
- Use in paper: empirical support for how **psychiatric evidence** (disorders like schizophrenia) is actually treated in Indian criminal judgments.

6. Journal Article / Legal Scholarship

- **Prerna Singh (2024)**, “*Admissibility of Neuroscientific Evidences in Courtroom: A Critical Analysis of the Indian Law*”. White Black Legal Law Journal. This paper critically analyzes how Indian law can admit neuroscience-based evidence.
- Use in paper: to provide scholarly backing for neurocriminology in Indian context, especially legal analysis on admissibility, reliability, and ethical issues.

7. Brainware University Journal Case

- *Brainwave* (Vol. 5, No. 1, March 2024) publishes a case where the court recognized that **arteriosclerosis** (a physical disease affecting the brain) caused a temporary lapse of awareness, affecting criminal liability.
- Use in paper: demonstrates real legal recognition in India of *physical brain disease* (not just psychiatric) affecting criminal responsibility.

8. Pradeep Khatiwara v. State of Sikkim (2024)

- The Sikkim High Court discussed physical brain diseases (arteriosclerosis) and their influence on awareness and intent, showing judicial openness to brain-based medical evidence.

9. Surendra Mishra v. State of Jharkhand (2011)

- This is a landmark Supreme Court case about *unsoundness of mind* under Section 84 IPC.
- The Court stressed that *legal insanity* is not the same as medical insanity; just having a psychiatric diagnosis does **not** automatically exempt someone from criminal liability.
- The judgment looked at the conduct of the accused before, during, and after the crime to assess whether he understood his act.

10. **Dahyabhai Chhaganbhai Thakkar v. State of Gujarat (1964) — AIR 1964 SC 1563**

- This Supreme Court case sets out important principles about the *burden of proof* in pleading insanity.
- The Court held:
 1. The **prosecution** must prove beyond reasonable doubt that the accused committed the offence with mens rea.
 2. There is a **rebuttable presumption** that the accused was sane; the accused must present relevant evidence (oral, medical, etc.) to rebut this.
 3. Even if the insanity defence isn't “conclusively” proved, raising a **reasonable doubt** about one or more ingredients of the offence (e.g., mens rea) may be sufficient.

11. **T. N. Lakshmaiah v. State of Karnataka**

- In this case, the Karnataka High Court rejected the insanity plea under Section 84 IPC because the accused's behavior and the available medical evidence did not convincingly show he lacked legal capacity at the time of the crime.
- The court emphasized that the plea seemed like an “after-thought” to escape liability.

12. **Murder Convict Acquitted on Grounds of Insanity (2018, SC)**

- In a more recent case (reported by SOnline), the Supreme Court acquitted a murderer (convicted under Sections 302 & 324 IPC) because of doubts about his mental condition at the time of crime.
- The Court found that the prosecution had *withheld relevant psychiatric evidence* and that when viewed in totality (medical records, witness statements), there was enough to invoke **Section 84 IPC**.
- The Court cited **Surendra Mishra v. State of Jharkhand** to underline that the

burden on the accused is to prove unsoundness by *preponderance of probabilities*.

13. Recent 2023 SC Case (non-reportable) – Section 84 IPC

- In a 2023 Supreme Court judgment, the Court reiterated that to avail the benefit under Section 84 IPC (insanity), the accused must: (a) show *what mental illness* he has, and (b) show that at the *time of the crime* he was so affected that he could **not know or understand** what he was doing.
- This enforces the principle that it's not enough just to have a diagnosis — the mental illness must impair cognitive capacity at the *relevant time*.

How Neuroscience Affects Legal Culpability:

➤ **Mens Rea-**

Brain abnormalities may affect:

- intention,
- knowledge,
- impulse control,
- capacity to form criminal intent.

However, neuroscience usually demonstrates *predisposition*, not *determinism*.

➤ **Fitness to Stand Trial-**

Cognitive evaluations increasingly incorporate neuropsychology. If the accused cannot follow court proceedings due to brain injury, trial must be postponed.

➤ **Sentencing Mitigation-**

Internationally, neuro-evidence is widely used to reduce sentences where offenders show:

- reduced executive functioning,
- early childhood brain trauma,
- developmental abnormalities.

Indian courts have not consistently adopted this approach yet.

Discussion:

Advantages of Using Neuroscience in Criminal Law-

- Provides objective data instead of subjective behavioural impressions.
- Helps distinguish voluntary from involuntary actions.
- Aids in diagnoses of psychopathy, TBI, dementia, and impulse disorders.
- Supports individualized sentencing and rehabilitation.

Concerns & Ethical Challenges-

- Risk of deterministic interpretations (“my brain made me do it”).
- Quality and admissibility of neuro-evidence vary widely.
- Judges and lawyers lack scientific training.
- Brain scans show *correlation*, not *causation*.
- Potential violation of mental privacy and Fifth Amendment–like protections.

Indian Legal System Limitations-

- No neuroscientific admissibility guidelines under the Indian Evidence Act.
- Heavy reliance on outdated McNaughton Rules.
- Lack of forensic neuroscience experts.

- BEOS misuse shows danger of premature adoption.

Interpreting neuroscience within legal frameworks:

Neuroscience offers mechanistic explanations (e.g., impaired impulse control due to PFC dysfunction) that can inform assessments about capacity and culpability; but law's normative questions — whether a person is morally blameworthy — cannot be reduced solely to neural description. The most defensible legal role for neuroscience is to contribute to a holistic, individualized assessment: as one input among psychiatric history, behaviour, social context, and clinical assessment. Courts should avoid categorical inferences (e.g., “brain scan shows X — therefore not responsible”) and instead use neuroscience for nuanced mitigation (reducing sentence where impairment is demonstrated) or for tailored rehabilitation plans.

The juvenile example: when neuroscience led to categorical reform:

Roper v. Simmons is instructive because neuroscientific evidence about adolescent brain immaturity supported a categorical change (banning execution of juveniles). That decision combined neuroscience with developmental psychology and normative judgments about proportionality and culpability. It demonstrates that, when neuroscience uncovers consistent, population-level developmental differences with moral significance, it can justify doctrinal shifts. Nevertheless, applying similar categorical approaches to adults based solely on imaging is not currently justified by the evidence.

Forensic validity, standards, and expert communication:

To reduce misuse, forensic neuroscience must adopt standards: validated neuropsychological protocols; blinded, peer-reviewed methods for interpreting scans; reporting of sensitivity/specificity and population context; and careful expert communication emphasizing probabilistic interpretation. Judges should function as gatekeepers to exclude testimony that overstates causal claims or predictive certainty. Trainings for judges, defense counsel, and prosecutors in basic neuroscience would improve adversarial testing of claims.

Policy Recommendations:

1. **Develop National Guidelines-** A framework under the Indian Evidence Act similar to the *Daubert Standard*.

2. **Judicial and Prosecutorial Training-** Training modules on neuroscience, impulsivity disorders, and neuroimaging interpretation.
3. **Allow Use Only Through Accredited Experts-** Mandatory certification for neuroforensic analysts.
4. **Use Neuroscience Primarily for Sentencing, Not Guilt Determination-** Global systems are more cautious during guilt determination but more flexible during sentencing.
5. **Safeguard Against Mental Privacy Violations-** Brain-based tests should never be conducted without informed consent.

Conclusion:

Neuroscience has immense potential to enrich criminal justice by offering insights into the cognitive and emotional processes underlying violent crime. However, courts must adopt a cautious, evidence-based approach. Indian case law demonstrates both openness and hesitation, reflecting the need for clearer standards. Brain abnormalities can explain behaviour but cannot excuse crime outright unless they meet the legal threshold of incapacity. Ultimately, neurocriminology should complement—not replace—legal judgment, ensuring justice that is both scientifically informed and ethically grounded.

Neuroscience has enriched understandings of violent behaviour by identifying brain systems linked to impulse control, affect regulation, and empathy. These findings can legitimately inform criminal justice decisions — especially mitigation, competency, and rehabilitation — but they do not absolve courts from normative responsibility. Given current scientific limits, neuroscience should be treated as a probabilistic, contextual input within a multidisciplinary assessment. Courts, policymakers, and forensic scientists must collaborate to develop standards that allow neuroscience to contribute responsibly to justice while guarding against overreach, stigma, and determinism.

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