

A Neuroscientific Assessment on Brain and Criminal Responsibility

Heena Singla; Dr. Rukmani Radhaswami; Dr. Asha Srivastava

Publication Date: 2026/03/19

Abstract: Neuroscientific evidence, encompassing any information related to the brain, holds the potential to function similarly to other forms of evidence in establishing or challenging claims within criminal cases. Its application extends to various scenarios, such as bolstering or questioning expert testimonies, corroborating or refuting medical diagnoses, substantiating a defendant's account of their mental state during the crime, demonstrating the causal link between a defendant's actions and significant harm, or even aiding the judge or jury in comprehending different types of evidence. In essence, neuroscientific evidence can be employed in a wide range of ways to support, question, or provide clarity in criminal proceedings. Various research has proposed that brain scans might hold the answer to detecting criminal intentions.

Keywords: Neurosciences, Criminal, Evidence, Brain, Nervous System.

How to Cite: Heena Singla; Dr. Rukmani Radhaswami; Dr. Asha Srivastava (2026) A Neuroscientific Assessment on Brain and Criminal Responsibility. *International Journal of Innovative Science and Research Technology*, 11(3), 1444-1450. <https://doi.org/10.38124/ijisrt/26mar825>

I. INTRODUCTION

The brain is regarded as key to mind and behaviour. It is the central organ in the human nervous system; thus, it has a special 'status' in human body. Study of nervous system, its function and its relating disorders are studied under Neuroscience. Human Nervous system constitute of *Brain, Spinal Cord, and peripheral nervous system*. In other words, neuroscience is the science that scientifically studies our nervous system i.e., brain, spinal cord and peripheral nervous system. The heart was considered as the seat of intelligence. Earlier it was believed that the brain was not involved with sensation. Aristotle held the belief that the heart serves as the locus of intelligence, while the brain functions to regulate the flow of heat emanating from the heart. This view was considered to be accepted until Roman physician Galen observed that when there is damage in brain, patient lose their mental faculties.

In the 20th Century, the field of neuroscience started gaining recognition as an independent academic discipline, separate from its study within other fields. Key figures such as Eric Kandel and his colleagues have acknowledged the significant contributions of David Rioch, Francis O. Schmitt, and Stephen Kuffler in establishing this field. (1) Thus, Neuroscientists delve comprehensively into exploring the various facets of the nervous system. This includes investigating its structure, functionality, development, dysfunctions, and the potential for modifications or alterations.

II. EVOLUTION OF NEUROSCIENCE IN CRIMINALITY

Neuroscientific Research is gaining popularity in understanding neural correlation with human behaviour, emotions and cognition and can be an important factor when criminal responsibility needs to be studied. Its evolution has been developed in late 19th century.

Without prior inclination, Michael inexplicably developed a sudden fascination with child pornography. Additionally, he found himself experiencing an attraction towards his 12-year-old stepdaughter, with whom he resided alongside his wife. Tragically, one night after putting his stepdaughter to bed, he committed the heinous act of sexually molesting her (5) As a result, Michael faced legal consequences and was convicted of child molestation.

Given an alternative to imprisonment, Michael was granted the opportunity to participate in a treatment program. Regrettably, his performance within the program was subpar, and he even displayed inappropriate sexual behavior towards both staff members and fellow participants. Michael began experiencing headaches, prompting a neurologist to recommend a structural magnetic resonance imaging (MRI) scan of his brain. The scan uncovered the presence of a significant orbital-frontal tumor. Consequently, Michael underwent surgery to have the tumor removed. Surprisingly, following the operation, his inappropriate sexual desires

towards children ceased. Subsequently, Michael resumed the treatment program and successfully completed it without facing any difficulties.

Unfortunately, several months later, Michael's sexual attractions towards children resurfaced. Another MRI scan confirmed the recurrence of the tumor. To address this, Michael underwent a subsequent surgery, resulting in the successful removal of the tumor once again, and subsequently leading to the cessation of his urges.

The above case sets a major stage for discussion of the role of neuroscience in dealing with human behaviour. This case offers an alternative perspective when considering the potential underlying cause of his criminal behavior, deviating from the conventional forensic psychiatric approach that primarily focuses on evaluating mental illness, particularly in cases involving claims of insanity as a defense, and sudden deviant criminal behavior.

➤ *Correlating Brain, Mind and Behaviour*

As the exploration of the connection between the brain and the mind has progressed, scientists have made strides in elucidating the mental mechanisms that link nerve cells or neural circuits to individual behaviors. Various mental processes, including cognition, emotion, perception, focus, recall, and awareness, are frequently employed in everyday language. However, despite the utility of mental processes in elucidating the interplay between the brain and the mind, the intricate and elusive mappings from brain activity to mental processes, as well as from mental processes to behavior, continue to present challenges and limited comprehension. The majority of studies exploring the connection between brain activity and behavior are conducted in simplified laboratory settings. It is challenging and uncertain to extrapolate these findings to complex real-world situations. Recognizing the limitations of neuroscientific techniques can help evaluate the usefulness of such findings and, importantly, identify areas that warrant further productive research.

➤ *Fields of Neurosciences*

- *The intersections between law and modern neuroscience can be further divided into three subsections the law of neuroscience: the initial aspect encompasses the governance of neuroscientific research, focusing on elements like informed consent and studies involving human subjects.*

- *Neuroscience:* It pertains to the neuroscience behind normative judgment and decision-making.
- *The law and neuroscience in law:* It is relevant to the ongoing discussion concerning the examination of cognition and behavioral patterns with legal implications, encompassing areas such as impulse control, moral reasoning, psychopathy, and drug addiction.

One of the primary fields of the applications of neuroscience within the context of the third category refers to the possibility of assessing criminal responsibility.

➤ *Neuroscience can be used in courts as: -*

- The utilization of brain data has been employed to indicate alterations in personality following head trauma.
- Employing brain scans has been instrumental in evaluating the ability to stand trial.
- Brain scans have been employed to mitigate sentences by providing evidence of brain trauma.
- Brain scans have played a role in cases involving sexual offenses.
- Neuroimaging evidence has been employed to support insanity cases.

➤ *Techniques Used in NeuroSciences*

Neurosciences can be applied both at prosecution and at defence level in a criminal trial. With the passage of time, there is an increasing use of evidence from neuroscience in court. Neuroimaging is an example as how neurotechnologies and neurosciences are being used to capture information about individual mental state. Some of the techniques are: -

Computed tomography (CT) or Computed Axial Tomography (CAT) scanning utilizes multiple x-rays of the head taken from various angles to generate cross-sectional images of the brain. Primarily used for rapid evaluation of brain injuries, CT scanning employs a computer algorithm that applies a numerical integral calculation (known as the inverse Radon transform) to the collected x-ray data. This estimation helps determine the amount of x-ray absorption within specific brain regions, and the resulting information is commonly presented as cross-sectional views of the brain.



Fig 1: CT Scan Machine

➤ *Magnetic Resonance Imaging*

Brain magnetic resonance imaging (MRI) employs magnetic fields to generate precise and detailed two-dimensional or three-dimensional images of the brain, brainstem, and cerebellum. Unlike X-rays or radioactive tracers, MRI imaging does not involve ionizing radiation and provides high-quality visuals of the brain structures.

➤ *Positron Emission Tomography*

Positron emission tomography (PET) is an imaging method that focuses on functional aspects by utilizing radioactive substances called radiotracers. This technique enables visualization and quantification of changes in metabolic processes, blood flow, regional chemical composition, and absorption, among other physiological activities. Tracers specific to different imaging objectives are employed, targeting various processes within the body.

Magnetic resonance imaging (MRI) is the prevailing method used to assess the structure and function of the human brain. Structural MRI captures images depicting the anatomical

aspects of the brain, while the more recent development of functional MRI (fMRI) enables the generation of dynamic images that portray patterns of brain activity. In simple words, fMRI Functional magnetic resonance imaging (fMRI) uses MR imaging to measure the tiny changes in blood flow that take place when a certain part of your brain is working. Both structural and functional MRI possess highly effective spatial resolution. However, the timing of brain activity detection in functional MRI is limited due to its dependence on the sluggish reactions of blood vessels to variations in blood oxygenation.

Unlike fMRI, which has good spatial resolution but poor temporal resolution, electroencephalography (EEG) and magnetoencephalography (MEG) detect the minuscule electrical or magnetic fields generated by brain activity on the scalp's surface. Due to their direct measurement of electrical activity, EEG and MEG provide superior temporal resolution but relatively lower spatial resolution. Consequently, neuroscientists often employ a combination of EEG/MEG and MRI to gather converging evidence that capitalizes on their respective strengths in spatial and temporal information.

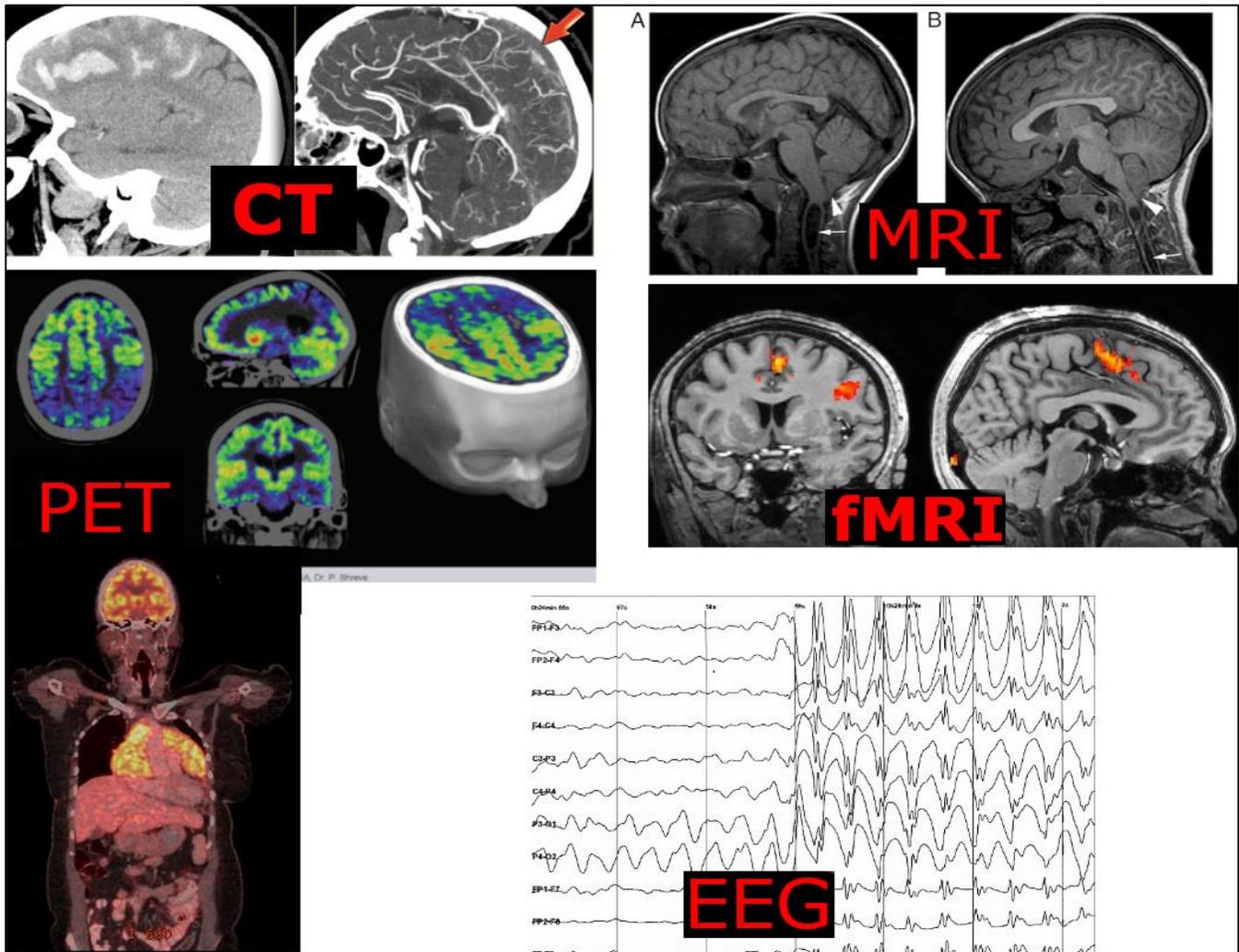


Fig 2: Depicting Three Techniques – PET, MRI & fMRI.

➤ *Brain and Criminality*

The utilization of neuroscience in legal proceedings has been observed since the early 20th century. According to Shen (9), one of the earliest instances of introducing neuroscience into courtrooms can be traced back to the 1940s when EEG was employed in a case involving a defendant with epilepsy. Initially, EEG was primarily used for diagnosing and treating epilepsy. However, some lawyers began utilizing this tool to argue against laws that deprived individuals with epilepsy of their rights, while others sought to identify neural indicators of violence (Shen, 2016). As the mid-20th century approached, EEG had become a frequent occurrence in epilepsy cases to the extent that Irwin Perr, a psychiatrist, and attorney, advised, "Lawyers interested in this subject must possess knowledge of electroencephalography principles, both to comprehend and evaluate epilepsy and due to its frequent application as a legal tool" (Perr, 7). Consequently, within a few decades of its

inception, EEG understanding was recommended for attorneys due to its evidential value and its increasing presence within courtrooms.

Neuroscience has significant potential for application in the field of criminal responsibility. Today neuroscientists can see what happens in the brain when a person recognizes a loved one, experiences failure, feels pain, effect of music on brain. Specifically, three main areas of brain abnormalities hold importance in assessing criminal responsibility: -

- Impairments in the frontal lobes,
- Abnormalities in the limbic system affecting affective processing,
- Negative consequences in affective processing and potential adverse effect of neuro control.

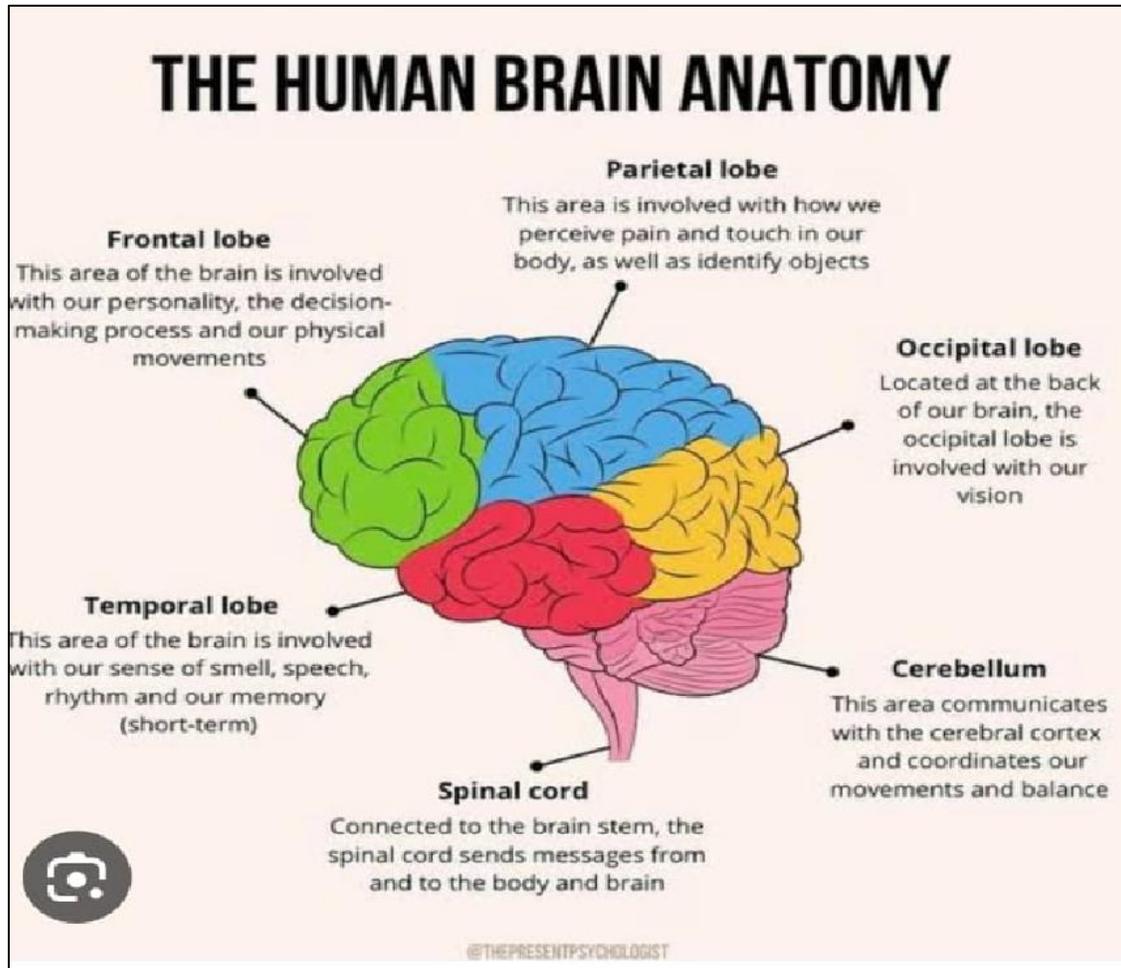


Fig 3: Brains and its Parts

Klaming and Koops indicate that research on criminal responsibility has indicated a link between frontal lobe dysfunction and criminal behaviour as well as limbic dysfunction and criminal behaviour.(4) Research indicates that damage to either of the latter brain regions could indicate pathologically disturbed mental capacities potentially resulting in a finding of diminished responsibility or even non-responsibility.

➤ *Frontal Lobe Dysfunction and Criminal Behavior*

Frontal lobe brain dysfunction has long been identified as a potential causal factor in violent crimes. Research indicates that murderers generally have lower glucose metabolism in the prefrontal cortex which in turn indicates that prefrontal deficits in antisocial individuals could potentially predispose them to higher impulsivity and inhibited self-control (8). Impairments in the frontal cortex can influence an individual's capacity to regulate impulses and consider the potential outcomes of their actions. Injuries, both mild and traumatic, as well as the presence of a brain tumor, can result in damage to the frontal lobes.

Frontal lobe dysfunction manifests in two main forms: Firstly, there is damage to the ventromedial prefrontal cortex, which contributes to impulsive behavior and aggression. Secondly, damage to the dorsolateral prefrontal cortex leads to compromised judgment and diminished moral deliberation. Symptoms associated with frontal lobe disorder including:

- Impairments in goal setting and determination.
- Difficulties in planning and executing behavior.
- Occurrence of violent behavior due to emotional detachment.
- Low tolerance for frustration.
- Impaired self-control.
- Limited adherence to societal norms and values.
- Display of sexual disinhibition.

➤ *Limbic System Dysfunction and Criminal Behaviour*

Extensive research on psychopathy indicates a notable reduction in activity within the limbic system, a central brain structure encompassing the hippocampus, hypothalamus, and amygdala. This system plays a crucial role in multiple functions, including the regulation of emotions. These neurological findings have led some researchers to view

psychopathy as a mental illness comparable to other psychological disorders.

Neuroscientist Anthony Wagner, leading a team from Stanford as part of the MacArthur network, has explored the application of machine learning, a type of artificial intelligence, in analysing fMRI scans. Their goal was to determine if fMRI scans could accurately detect when individuals were looking at familiar photos from their own personal experiences. During the experiment, participants were placed inside a scanner and presented with a series of images. Some of these images were taken from cameras they had personally worn, while others were captured by cameras worn by different individuals.

By tracking changes in oxygenation and observing patterns in blood flow, which serve as indicators of increased neural activity, the team's machine learning algorithms achieved a remarkable accuracy rate of over 90 percent in correctly identifying whether the subjects were viewing images from their own lives or someone else's.

Other researchers are using fMRI to try to identify differences in the brain between a knowing state of mind and a reckless state of mind, an important legal concept that can have powerful effects on the severity of criminal sentences.

CT and MRI scans provide grayscale images that illustrate the structural composition of the brain, while fMRI scans capture localized alterations in blood flow.

The latter is then displayed on a three-dimensional computer-generated image of the brain to provide a comprehensive exposition of the functioning and structure of the brain. (2)

According to Gazzaniga, (6) cognitive neuroscience is the scientific field dedicated to unraveling the mechanisms by which the brain facilitates the workings of the mind. The page emphasizes that advancements in brain imaging have provided objective and dependable insights into the structural and functional aspects of the brain. These insights can aid judges in comprehending the mental state of an offender. Consequently, cognitive neuroscience has the potential to address two critical aspects of criminal responsibility: intention and insanity. By focusing on the human brain, neuroscience aims to enhance our understanding of how the brain influences human behavior, including criminal behavior. ***If researchers can use neuroimages to show a direct relationship between the brain and mental and behavioural processes, neuroscience could impact the legal analysis of personal responsibility for past actions, assessment of a person's existing state of mind, and prediction of future behaviour.***

Moreover, neuroscience can be valuable in furnishing evidence regarding an individual's reaction to different types of intervention or rehabilitation. For instance, research studies

have indicated that specific individuals may not exhibit favorable responses to punitive measures. (3)

III. CONCLUSION

There is vast increase of neuroscience in the US, Canada, the Netherlands, England, and Wales. The use of neuroscientific evidence has increased at similar rates across all studied jurisdictions. Neuroscience has revealed connections between patterns of brain activity and various mental functions such as cognition, emotions, sensory perception, attention, memory, and consciousness. Additionally, there has been notable support and funding for neuroscience research in relation to law and public policy, with initiatives like the MacArthur Foundation's program on neuroscience and the law in the United States, the French government's funding for "Neuroscience and Public Policy" since 2009, and the European Science Foundation's support for the European Neuroscience and Society Network. These efforts reflect the growing recognition of the influence of neuroscience on understanding and addressing specific behaviors.

SUGGESTIONS

Extensive research demonstrates a clear connection between brain dysfunction and criminal behavior. However, it is worth noting that there has not been any established legal precedent where neuroscientific evidence has been evaluated in criminal cases. The field of neurosciences is growing and its importance in criminal cases is increasing as compared to the past decade but still much more work is needed. Evidence has shown that there are structural differences in the brains of individuals that commit crimes, and that brain injury or trauma can lead to significant behavioral changes – in some cases resulting in criminal behavior. Neuroimaging techniques along with Lie detection techniques can be taken as one of the major measures in criminal justice.

REFERENCES

- [1]. Cowan, W.M.; Harter, D.H.; Kandel, E.R. (2000). "The emergence of modern neuroscience: Some implications for neurology and psychiatry". *Annual Review of Neuroscience*. 23: 345–346.
- [2]. Compton (n 5) 540. See also OC Snead, 'Neuroimaging and the "Complexity" of Capital Punishment' (2007) N.Y.U.L. Rev 265.
- [3]. Dadds and Salmon 2003 *Punishment insensitivity and parenting: temperament and learning as interacting risks for antisocial behaviour*. *Clinical Child and family Psychology Review*. 6, 69–86.
- [4]. JM Burns and RH Swerdlow, 'Right Orbitofrontal Tumor with Pedophilia Symptom and Constructional Apraxia Sign' (2003) *Archives Neurology* 437, 440 as quoted in U Moaz and G Yaffe, 'What Does recent neuroscience tell us about criminal responsibility' (2015) *Journal of Law and Biosciences* 121.

- [5]. Klaming and Koops (n 5) 231
- [6]. IMS Gazzaniga, 'What is Cognitive Neuroscience' in AS Mansfield (ed), *A Judge's Guide to Neuroscience: A Concise Introduction* (2010) 2 as quoted in Bennett (n 5) 441
- [7]. Perr, I. N. (1958). *Epilepsy and the law*. Clev. -Marshall Law review, 7(2), 280–301.
- [8]. Redding (n 5) 57. See also Klaming and Koops (n 5) 233; A Raine, M Buchsbaum and L Lacasse, 'Brain Abnormalities in Murderers Indicated by Position Emission Tomography' (1997) 42 *biological psychiatry* 495–508
- [9]. Shen, F. X. (2016). *The overlooked history of neurolaw*. *Fordham Law Review*, 85(2), 667–695.
- [10]. Sinnott –Armstrong Walter & Nadel Lynn (eds) 2011 *Conscious Will and Responsibility*. Oxford University Press.