



## BRAIN MAPPING AND LIMITATIONS OF BRAIN MAPPING TECHNIQUE

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### Abstract

*The branch of neuroscience known as "brain mapping" focuses on the spatial representation of the human brain. It is a cutting-edge biological computational technique that uses a number of different subfields, including computational biology, engineering principles, and resonance imaging, to reveal the intricate and dynamic structures of the brain. It entails the study of the structural anatomy of the brain as well as the brain's sensory nerves utilising non-invasive, collaborative biomedical techniques as well as cellular biology. Modern computational techniques like as 4-D imaging, cognitive sciences, fuzzy logic, etc. are also used. It displays the physiological and anatomical changes that the brain experiences throughout time or as a result of mental illness. The knowledge of various brain learning impairments has improved as a result of ongoing study in this field.*

*According to research on the brain mapping technique, when a skill is learned, the brain's structural makeup changes, but these changes are only permanent while the skill is being practised. So, based on the research done by various researchers in the field of the Brain mapping approach, we conducted a survey for this paper. After performing the study, we have come to the conclusion that human brain mapping has aided neurologists in better comprehending the human brain and expanding their knowledge of it, thereby enhancing the learning capacities of Homo sapiens.*

*Sets of feature-sensitive cells, ordered projections between neuronal layers, and ordered maps of abstract characteristics are three different types of neuronal structure that might be referred to as "brain maps." They reflect the essential characteristics of an organism's experiences and environment, making them the most fascinating. Such feature maps are thought to be learned through a process that involves parallel input to neurons in a particular brain area and adaptation of neurons around the cells that respond most strongly to this input. In this paper, a novel mathematical formulation for such adaptation is presented, along with a connection to physiological processes.*

*Keywords: Brain Mapping, Narco-analysis Test, evidence, admissibility*

### Research Problem

For justice evidences plays an important role and this paper deals with one of the pieces of evidence which might not be the primary evidence but plays an important role in deciding the case that is brain mapping and further it covers the limitations of the brain mapping along with the case laws in which such limitations are considered.

### Introduction

The brain is a highly complex organ made up of billions of neurons. All of the neurons in your body communicate with one another and transfer information through dendrites. Brain waves are produced by these signals, which are electrical impulses. The brain map, also known as a neuro map, is a crucial instrument we employ to assess your brainwaves and spot possibilities to enhance communication between

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various brain regions. The brain map records a window of brain activity, process the information, and provide graphic representations of each brain lobe and each distinct brain wave (Delta, Theta, Alpha).



As a more advanced form of neuroimaging, brain mapping generates brain pictures that are supplemented by the results of additional (imaging or non-imaging) data processing or analysis, such as maps that project (measures of) behaviour onto different brain areas. A connectogram, a type of such map, shows cortical areas arranged in a circle according to their lobes. Different common neurological metrics, such as cortical thickness or curvature, are represented by concentric circles inside the ring. The connections between cortical regions are represented by white matter fibres in the middle of the circles, weighted by fractional anisotropy and degree of linkage.

The creation and improvement of image acquisition, representation, processing, visualization, and interpretation techniques is essential to the ongoing evolution of brain mapping techniques. The core of the brain mapping component is functional and structural neuroimaging.

**Brain mapping** is a technique used for identification of various parts and their functions in the brain in a similar way as we use road map for finding different ways and like many other processes associated to the brain, it is a somewhat complex process. The study of the architecture and function of the brain and spinal cord is known as brain mapping. It is a test based on finding that the brain generates a unique brain wave pattern when a person encounters a familiar stimulus. Brain pattern where a person encounters a familiar instance. Firstly, the suspect is interviewed and if he is hiding some important information then undergo brain mapping. He also possesses the right to remain silent under section 161(2) CrPC which was also held in the case *Nandini Satpathy v. P.L. Dani, 1978*<sup>2</sup>

### Objectives to the study

- To know about brain mapping.
- Tools used in the brain mapping.
- Procedure for brain mapping.
- Limitations of brain mapping technique with respect to law.

### Research questions

- What do you understand by the brain mapping?
- How brain mapping is conducted?
- When brain mapping is conducted?
- What are the limitations of brain mapping? Discuss with the case laws.

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<sup>2</sup>*Nandini Satpathy v. P.L. Dani, 1978 SCR (3) 608*



In the United States, the Institute of Medicine of the National Academy of Science was asked to organise a panel in the late 1980s to examine the benefits of combining information from different neuroscientific disciplines.<sup>3</sup>

**Dr.Lawrence Farewell** along with chief scientist of brain wave science developed this test and patented in 1991. This technique is based on electrical signal known as **MERMER (Memory Encoding related Multifaced Encephalographic Response)**

Farewell's brain mapping used P300 brain response to detect the brain recognition of the known information.

**Probes** present before the accused in the brain mapping, these are the fictitious representation presented before the suspect. There are two probes:

1. **Material probe-** It is relevant to the facts being investigated, these may be auditory or in form of pictures.
2. **Neutral probes-** It is not relevant to the case regarding which brain mapping is conducted.

#### Tools used in the brain mapping-

- **Computer Axial Tomography (CAT) Scan:** During CAT scan, X-rays of the brain from many angles are taken for determination of structural abnormalities.
- **Structural magnetic resonance imaging:** During this imaging method, images of the brain can be collected with the help of water in the brain and the resolution of images is comparatively better than CAT scan.
- **Diffusion Tensor-MRI (DTI):** DTI is a tool in which imaging of “tracts” of neurons is carried out. These neurons act as a connecting link between brain regions by following movements of water in the brain.

#### Stages in brain mapping-

- Crime scene evidence collection
- Brain evidence collection
- Computer evidence analysis
- Scientific results

#### Steps of brain mapping-

- **Firstly**, the suspect is interviewed and if he is hiding some important information then undergo brain mapping.
- **Then**, subject is asked to sit in front of the system and sensors are attached to head of subject.
- **Later on**, certain videos, audios, photographs stimulus is shown to the subject and undergo P300 wave test.
- **Finally**, detection of stimulus from subject's brain. If some abnormalities are detected then those are recorded for evidences.

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<sup>3</sup> Louis St. “A brief history of human brain mapping”



Using a cap placed on the scalp, our software captures the electrical impulses in the brain. This method is known as an electroencephalogram (EEG). The results show brain wave patterns in different parts of the brain. The process takes about 15 minutes, and the data is then converted into a visual brain map report. We analyse the brain map report and identify any problem areas. The report will display the results in a clear and concise format that can be easily understood.

### **Limitations of brain mapping**

- These reports are not considered as the prime evidences in the Indian courts.
- Article 20(3)- provisions regarding privilege against self-incrimination: no person accused of any offence shall be compelled to be witness against himself is violated.
- It is admissible only when conducted with the consent of the suspect if not consented then the report can't be used in the form of evidence only the report can help in further investigation.

### **Selvy v. state of Karnataka<sup>4</sup>-**

An individual cannot be forced to undertake any of the aforementioned procedures, whether they are an accused person or a witness, in order to subject them to penalties or other negative repercussions. <sup>5</sup>A person's mental privacy cannot be invaded for any justifiable technical reason.

The guidelines given in this judgment were-

1. An option should be provided to the accused to avail the Lie Detector Tests. Such a test can be administered only after such accused has consented to it.
2. If the accused opts for the test after such option has been given to him, he should be given access to a lawyer. The lawyer and the police should explain to him the physical, emotional and legal implications of the test.
3. The consent of the accused should be recorded before a Judicial Magistrate.
4. The accused person must be explained, at the hearing, in clear terms that statements by him shall not be considered as 'confessional statements' made to the Magistrate and shall be regarded as statement made to the Police.
5. The actual procedure of Lie Detection Test shall be conducted by an independent agency, such as a hospital and shall be duly recorded. The procedure must be carried out in the presence of the lawyer.
6. The information received the full medical and factual narration of it must be taken on record.

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<sup>4</sup>*Selvy v. state of Karnataka, 2010 criminal appeal no. 1267 of 2004*

<sup>5</sup>Pirani Ishrat "Evidentiary value of narco-analysis and brain mapping in India vis-à-vis *Smt. Selvi&Ors. V. State of Karnataka (2010)*



### Nithari's case<sup>6</sup>-

In a case of serial homicides in Nithari (U.P.), police detained Moninder Singh Pandher and Surendra Koli for the deaths of 30 children and women who had been sexually assaulted either before or after the murders. Police discovered a knife and numerous other items that the two had used to dismember their victims and dispose of them individually, never all at once or in the same location in the sewer below the accused's home. From the accused's home, a copy of the Kinsey Report on sexual behaviour was also retrieved. Both defendants underwent polygraph, narco-analysis, and brain mapping examinations. Names of a few U.P. ministers of state and physicians frequently appeared in brain mapping. At DPS in Gandhinagar, a test was administered (Gujarat). In addition to a wide range of other topics, audio and video props were created to primarily focus on two issues: the nature of their sexual perversion and whether this was the only factor behind serial homicides and rapes. Following the brain mapping, a narco-analysis test was performed on both. **Sodium pentothal** was used in the experiment as a truth serum. Before being questioned, both of the accused had been cooperative. Surendra was shown by the narco-analysis test to be a cannibal psychopath motivated by sexual impotence. Firstly, supreme court sentenced death and later on changed it to the life imprisonment.

### SantokbenSharmanbhai Jadeja vs State of Gujarat<sup>7</sup>

The Court held that it was justified to make use of narco-analysis tests in the investigation process as a last resort when all the humanly possible ways to find evidence have been exhausted. It was held that the conduction of narco-analysis test on the accused is not violative of Article 20(3), however, if the self-incriminatory information obtained from the accused under such a test is used against him, then it violates the right under Article 20(3) of the Indian Constitution. It was also held that consent is necessary for admissibility of the fact.

The narco-analysis test is conducted under the supervision of doctors and proper care is taken and there is consent, observation of the state of the accused, and as such the element of risk is minimal. Risk is in fact part of life and pervades in most of human activities and on this ground, alone, therefore, the impugned test cannot be condemned.<sup>8</sup>

### Conclusion

The polygraph test, brain mapping test and narco-analysis test all have a significant place in criminal investigation process. Although the Indian Evidence Act of 1872 makes no mention of using these methods, the constitutional courts have repeatedly addressed the question of whether they should be used or not in their rulings in a limited number of cases. Jurists, academics, and regular people all disagree on whether these procedures should be allowed to be used during investigations and interrogations.

In high-profile cases like the murder of Aarushi Talwar, the Nithari killings, the Telgi fraud, and the Mumbai bomb blasts case, the narco-analysis approach has proven to be useful and remarkably effective. The provisions of the Constitution as well as other particular and local laws have limited the powers of the police authorities and serve as a barrier to how they can be used. The Supreme Court's landmark decision

<sup>6</sup> *Surendra koli v. state of U.P. criminal appeal no. 2227 of 2010*

<sup>7</sup> *SantokbenSharmanbhai Jadeja vs State of Gujarat* 2008 CriLJ 68, (2008)

<sup>8</sup> Garhwal Nishtha “right to self-incrimination and forensic science” (2015)



in Smt. Selvi clarified when these approaches can be used and when they cannot, but authorities still need to reevaluate their use of these scientific methods of inquiry.

For investigative agencies, brain fingerprinting is a godsend. Physical evidence from a premeditated crime may disappear or be manufactured to disappear, and occasionally no trace of the illegal activities is discovered. To find a culprit, the investigative agencies must snoop around in the dark. The brain fingerprinting has proven to be helpful in this situation. The criminal's intellect is always with him as he plans, becomes excited, and actually does the crime. Using this method, it is determined whether or not the suspect's brain contains information relevant to crimes. Determining the neurophysiology of stroke rehabilitation and recovery will heavily rely on brain mapping. The methods outlined in this article can be used to evaluate whether the brain reacts actively or passively to cognitive and physical demands. The most thorough procedures can include using one or more of these techniques simultaneously due to the drawbacks of each strategy and the intricacy of numerous rehabilitation-related concerns. The accurate utilization and understanding of brain-mapping techniques will play a key role in the quality of information that clinicians and clinical researchers can provide to patients.

Brain fingerprinting is used to ascertain whether a person's brain contains a particular piece of information or not. In other words, brain fingerprinting is a scientific procedure that identifies guilty knowledge that has been stored in an individual's brain. Brain fingerprinting analyses brain reactions to crime scene photos. In a nutshell, brain fingerprinting is a technique used to compare the fingerprinting data from the brain with that from the real crime scene.