A DECADE AFTER SELVI

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ABSTRACT

Lie detection techniques have been a buzz around the world for almost half a century. Scientific sphere to movies; everywhere these tests have sparked curiosity in minds of most of the people. The judicial domain is not alien to this concept; they have realized that if made possible then there are huge benefits that could be cashed in by the judiciary. In India in the case of Selvi v. State of Karnataka, the Supreme court has restricted the use of these tests for investigative purposes only and kept the courts outside its purview. The argument effectively is that these methods are not accurate and reliable enough and the scientific community has opposing views on its accuracy. This paper focuses on this particular argument and reviews the development that has taken place in this field. A decade has passed since this judgment was announced and there have been some critical developments that have taken within this sphere which could possibly render the case of Selvi obsolete. This paper analyses these developments to reach the conclusion that courts still should be kept lie detection techniques outside its realm. Despite the huge breakthroughs in lie detection methods, it is felt that these standards are still not up to the mark of admissibility and reliability.

Keywords: Narco-Analysis, Polygraph, Admissibility, Evidence.

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Introduction: -

Lie detection techniques like polygraph, Narco-analysis & brain mapping, etc have always been in contention. There are myths, movies, debates, and conspiracy theories revolving around the idea and working of these tests. It is believed that lying has always been human second nature but detecting lies has never been easier and most humans terribly fail at it. The judicial domain is one such sphere that could heavily benefit if there was a supernatural force that could decipher lies. We could not possibly fathom the changes that such a thing could bring if possible. Based on these attractive notions scientific community had been buzzed to make such an endeavour possible and it led to the birth of some of the tests mentioned above. Yet these techniques have raised big suspicions that are related to accuracy and creditworthiness. The legal sphere is no different than others and in India recently courts have shied away from admitting these tests in a trial. Recently strong arguments have resurfaced to reconsider the admissibility of lie detection techniques in the judicial domain. These arguments rely on various breakthroughs that have come about. It raises an important question 'should the legal standards governing the admissibility of lie detection technique be reconsidered?' I would try to answer this question through various medical findings and recent developments that have taken place and why they are still not up to the mark and ready for the legal sphere. Further, I would try and point out possible limitations and key findings that are overlooked while rooting for admitting and relying on these tests. To form a conclusive inference we must start with basics and answer the questions like 'what are the standards of admissibility' & 'what are the developments that have taken in the sphere of lie detection, admissibility, and legal domain?'.

1.1 Judicial Analysis of Lie Detection Tests:-

Section 45 of the Indian evidence act[2] deals with expert evidence. It uses the word 'science' thereby encompassing the realm of lie detection techniques which are based on science and facts. Admissibility of expert evidence has gone through quite a lot of scrutiny two major cases are reference points for most of the courts around the world for not only expert evidence but testing polygraphs as expert evidence. Daubert vs Merrel Dow Pharmaceuticals[3] & United states vs

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[2] Indian Evidence Act, 1872
[3] 509 U.S. 579 (1993)

Scheffer[4] laid down critical principles relating to expert evidence and polygraphs as subject matter and it becomes pertinent to analyze these cases. In the case of Scheffer's, there was an airman of the United States Airforce working undercover on some operations. His duty carried an obligation of undertaking regular polygraph tests and drug tests. Subsequently, the drug test came out positive, which pointed to the fact that the accused in the case was consuming drugs. He floated the defence of innocent ingestion or ingestion of drugs without his knowledge which was supported by polygraph results wherein he was asked 3 relevant questions. The results showed that there was no sign of deception. The court scrutinized the military rule 707 which stated that polygraph results must be kept out of the court's purview. The important finding was that rationale behind this section was to keep unreliable evidence out of the court and this was backed up by the fact that there was no way to know if in a particular case polygraph results findings are accurate or not. They further pointed out that certain doubts and uncertainties plague even the best polygraph results. This case draws out a direct inference of 2 major challenges to polygraphs test, the first being that technique of conducting the polygraph test itself on something that scientists don't agree on and coupling it with the fact that whether this technique is a reliable one. Second, even if there is a uniform method that is agreed upon the individual application of that test on particular facts of the case won't lead to conclusive and concrete results. It is pertinent to note that these two limitations of these tests can be challenged nowadays since this judgment was pronounced in 1998 but can it be sufficiently argued can only be answered while entering into the developments that have taken place.

1.2 Application of Daubert's Principles on Lie Detection Techniques:-

It becomes important to understand the case of Daubert which prescribes the admissibility of expert evidence and provides pointers that polygraph must satisfy to enter the realm of the judicial domain. In Daubert's case, there was a drug made to give relief from nausea, etc. A woman who was pregnant took the drug which led to birth defects. Two sets of contradicting expert evidence were brought by either party and it resulted in the court laying down certain principles to actually test/scrutinize each expert evidence and give foundational framework when such expert evidence can be brought inside a courtroom. It resulted in the birth of the Daubert Test. There are four major stages of the Daubert test, first, whether theory could be (or has been) tested, second whether it has been subjected to peer review, third potential rate of error/maintenance of standards or accuracy

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[4] 523 U.S. 303 (1998)

factor, and fourth acceptability in the scientific field. The polygraph will need to satisfy its hypothesis that a deceptive human being shows increased physiological activity than a truthful person. It must further satisfy that this hypothesis has gone through peer review and can create a negligible rate of error thereby maintaining standards of accuracy while also conforming to scientific acceptability through a uniform method of conduction of these tests.

I would argue that the first two stages of the Daubert test are easy to satisfy but polygraphy might face problems in satisfying the last 2 stages which have a lot of disparity. Supreme Court had a similar opinion in the case of Selvi vs the State of Karnataka[5] wherein they opined that that major uniform standards of lie detection, technique fall short to satisfy 3rd and 4th criterion of Daubert's test thereby ruling that lie detection should be kept for investigative purposes only. Selvi vs State of Karnataka case specifically dealt with the issue of whether lie detection techniques are courtroom ready or not. They specifically stated while citing many resources that scientific consensus and adequate levels of accuracy are lacking which would be detrimental if brought into the judicial domain. It is better to keep these techniques out to protect the legal sphere from introducing unreliable evidence. They extensively researched on various techniques like P300, BEAP, and narcoanalysis to form a conclusive opinion that these techniques are not courtroom ready as of now. The only question remains whether recent developments in the field of lie detection techniques can satisfy this disparity. This could perhaps lead to a reconsideration of courts' opinions on these lie detection techniques. To answer this question we must analyze the history of lie detection technique and where it stands now, while also scrutinizing various developments that have taken place.

1.3 Methods and Procedure of Narco-analysis: -

Polygraph tests make use of extensive electronic apparatus which monitors blood, respiratory activity, and cardiovascular activity, etc. In a typical polygraph test, there is a chair that is designed to check the movements of the person being tested and the apparatus uses pads, etc to monitor this activity. It is believed that a deceptive human has movements in form of gaze aversion, fidgeting, etc. There are two major techniques are revolving around polygraphy and framing of questions, which are CQT (Control question test) and CIT (concealed information test) also known as GKT

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[5] (2010) 7 SCC 263

(guilty knowledge test)[6]. Both the techniques have similarities with respect to pre-test interview (which is done to stimulate the apparatus to create accuracy standards). This is followed by the actual test and then results are evaluated in a post-test interview. CQT focuses mainly on three types of questions relevant, irrelevant, and comparison questions which are in form of yes and no format[7]. CIT on the other hand focuses on providing multiple choices and leading a person on effectively testing the guilty knowledge of the subject. CIT is based on the theory that there are some bits of information that are only known to the person who actually committed the crime. Some studies believe that CIT offers better accuracy standards than the CQT technique of questioning, but both are not devoid of their limitations. Let us try and understand what the possible limitations of each are.

CIT and CQT both have certain limitations like for example option-based questions might increase the chances of false-positive results if the subject has already acquired information of crime through various sources. CQT on the other hand might face the limitation of complex questions that a subject will fail to answer correctly due to stressful environmental settings[8]. These problems are determined through lab tests and anticipations. Polygraphs examiners use countermeasures to effectively curb these problems. Fear/anxiety and knowledge of crime are common examples of limitations that can reduce the reliability of these tests and affect the accuracy to great extent. For extra limitations refer to table 1 which states diseases that could skew the results and detection of physiological response. This is common knowledge for the examiners and hence there are appropriate countermeasures like noticing minute body movement like jaw movements etc or expertise in the formulation of questions help address these issues effectively. This becomes the sole reason why the expertise and experience of the examiner become important. Special training and intensive knowledge are required to use the appropriate countermeasures to combat each and every scenario that creeps up. Countermeasures raise an important question of whether it can effectively maintain accuracy standards to make tests reliable but so far this answer is negative. The reason is the lab-based experimental setup of the early lie detection technique pointed to 85 percent accuracy but when it entered the practical world the accuracy dropped to 50 percent[9]. An inference can be made that in a practical scenario more reliable countermeasures should be utilized or needed to fully bring these standards to the legal standards level.

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[6]John Synnott, David Dietzel & Maria Ioannou, *A review of the polygraph: history, methodology and current status*, 1 CRIME PSYCHOLOGY REVIEW 59–83 (2015).

[7] Ibid.

[8] Benjamin Kleinmuntz & Julian J. Szucko, *On the Fallibility of Lie Detection*, 17 LAW & SOCIETY REVIEW 85 (1982).

[9] LCDR Glen Cook & LT Charles Mitschow, *Beyond the Polygraph: Deception Detection and the Autonomic Nervous System*, 36 FED PRACT 316–321 (2019).

1.4 Historical Analysis of Lie-Detection techniques: -

CQT and CIT form the basis of the formulation of questions. Now different types of lie detection techniques have come up are ranging from systolic blood pressure to the latest one brain imaging or the fMRI technique. We must analyze the developments from historic times and critically scrutinize these methods of lie detection to see if it is really courtroom ready. Lie detection originally started from systolic blood pressure and was discovered accidentally. Nowadays the technology has advanced to such a stage that many other physiological responses like respiratory, sweating, etc are monitored to produce the best results. P300, narcoanalysis and Brain mapping (BEAP) techniques are common methods of lie detection which are used by investigative agencies all around the world. Narco-analysis relied on sodium pentothal mixed with distilled water which is induced to bring the subject in a state of trance, where a subject is in a sort of dream world[10]. Polygraphy is the basic test that uses apparatus to detect physiological changes in subjects like respiration, blood flow, sweating, etc, and based on those changes the examiner infers deception[11]. P300 is related to Brain mapping wherein the subject led on various procedures of crime. The subject's truthfulness is tested through electrical responses of the brain by checking if certain facts of the crime are stored in the brain of the subject. This is done by putting the subject under a series of questions[12]. There are two major limitations of these tests with respect to the scientific community, firstly regarding the technique itself and other standards of accuracy which raises fear of placing heavy reliance on these tests thereby convicting an innocent person. These two limitations shall be discussed with developments that have been brought about in techniques of lie detection.

In most case laws the focus is on Narco-analysis (sodium menthol to induce trance), P300 (Guilty knowledge testing), and BEAP (brain mapping)[13]. The accuracy standards for polygraphs using these techniques have been put around 60-85 percent[14]. 60 percent is the lowest that is being found so as to keep the judicial domain away from the realm of polygraphy. There is a new development in this sphere known as the fMRI technique[15] which monitors blood flow and brain

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[10] A.S. Dalal & Arunava Mukherjee, *CONSTITUTIONAL AND EVIDENTIARY VALIDITY OF NEW SCIENTIFIC TESTS*, 49 JOURNAL OF THE INDIAN LAW INSTITUTE 529–542 (2007),

[11] Supra note 9.

[12] Supra 9.

[13] Gowsia Farooq Khan, *Narco analysis test: A blessing to criminal justice system, its reliability and admissibility in light of various Judgements* 7.

[14] The Emergence of the Polygraph at Trial, 73 COLUMBIA LAW REVIEW 1120–1144 (1973). See also; Stephen E Fienberg, *TO TELL THE TRUTH: ON THE PROBATIVE VALUE OF POLYGRAPH SEARCH EVIDENCE* 11 (2020).

[15] Elena Rusconi & Timothy Mitchener-Nissen, *Prospects of functional magnetic resonance imaging as lie detector*, 7 FRONT. HUM. NEUROSCI. (2013).

activity. Interestingly most judgments have not focused on this method in great detail and the Supreme court of India only mentioned a paragraph about this technique. It is pertinent to note that fMRI is a newly developed technique and most of the results on standards of accuracy are based on a controlled environment and it has rarely been applied to real-world scenarios[16]. The accuracy of the fMRI method has been ranged between 85-95 percent[17], 85 being the lowest cited. In Selvi's[18] case, the court found out serious other complications with the Narcoanalysis technique like candidates that were tested uttered some things when under trance that they would not have if they were fully awake. Most of the subjects could not remember what they answered or said when the technique of narco-analysis was used. It is important to find out the certain limitation of these techniques not only the old ones like Narcoanalysis but newer ones as well like fMRI and Brain fingerprinting lie detection techniques.

1.5 Recent Developments in Field of Lie-Detection: -

Let us evaluate the newest literature on lie detection techniques that have brought about novel breakthroughs within this sphere. Gao et al[19] in their paper introduced certain novel methods that could potentially increase P300 lie detection test accuracy standards drastically. They concluded that this method was noteworthy for future practical applications and require further research. In another paper, Gao et al[20] introduced another method based on F-score and Extreme machine learning that could be applied to brain fingerprinting lie detection techniques. Farwell et al[21] talked about applications of CIT in P300 and Brain fingerprinting lie detection technique. They proposed various methods through which the potential rate of error can be lowered. They concluded that their method could be used by investigators to get reliable results. Haider et al[22] suggested the use of emotiv headsets and other technological apparatus that could potentially detect the deceptive signals more accurately, they further went on to state these could apply to fMRI or P300 technique. Bhutta et al[23]

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[16] Martina Vicianova, *Historical Techniques of Lie Detection*, 11 EUR. J. PSYCHOL. 522–534 (2015).

[17] Id note 13.

[18] (2010) 7 SCC 263

[19] Junfeng Gao et al., *A Novel Algorithm to Enhance P300 in Single Trials: Application to Lie Detection Using F-Score and SVM*, 9 PLoS ONE e109700 (2014).

[20] Junfeng Gao et al., *A Novel Approach for Lie Detection Based on F-Score and Extreme Learning Machine*, 8 PLoS ONE e64704 (2013).

[21] Lawrence A. Farwell et al., *Brain fingerprinting classification concealed information test detects US Navy military medical information with P300*, 8 FRONT. NEUROSCI. (2014).

[22] Syed Kamran Haider et al., *Evaluation of P300 based Lie Detection Algorithm*, 7 ELECTRICAL AND ELECTRONIC ENGINEERING 69–76 (2017).

[23] M. Raheel Bhutta et al., *Single-trial lie detection using a combined fNIRS-polygraph system*, 6 FRONT. PSYCHOL. (2015).

suggested that the FNRIS system that detects deception based on changes in haemoglobin levels of the prefrontal cortex results in better accuracy. It could possibly be used in a real-world criminal application, but further research is needed. Lukacs et al[24] in their article stated certain methods and various probes that could increase the accuracy of P300 lie detection tests thereby making it more real-world-ready, they suggested various other ways that need to be researched so as to increase the practicality of novel P300 techniques. Littlefield et at[25] and Langleben[26] in their respective articles talk about the applicability of the fMRI lie detection technique and how to make it practical ready. They said that the fMRI technique has shown an interesting potential that could eventually meet practical standards, but more research is required. Langleben[27] further suggested that for now fMRI should be kept outside the court's reach. These studies show that significant work is being done within the sphere of lie detection technique and more research is required to make them practice ready. Further, most of the papers writing about the accuracy standards or evaluating the new methods of countermeasures/lie detection technique suggest that they should be kept out of the legal domain. This further points out that these techniques are in an experimental setup and not quite practical world ready.

Palmer[28] in his paper talks about brain fingerprinting lie detection technique and whether or not is a practical world ready. What makes fMRI so special is that it taps directly into the brain of the individual. The theory is that the brain stores the information relating to our activities which can be tapped/replayed using necessary measures to generate physiological responses thereby resulting in high accuracy standards. It was developed by Farwell and they claim the error rate to be less than 1% in a controlled environment. Farwell achieved this by further developing this technique and incorporating the CIT questioning format and successfully applying this to the P300 test. An important fact is that reliance on the subject was completely removed in this form on the test, it relies solely on the brain's responses to certain trigger questions/images, etc thereby improving accuracy

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[24] Gáspár Lukács, *Item Roles Explored in a Modified P300-Based CTP Concealed Information Test*, APPLIED PSYCHOPHYSIOLOGY AND BIOFEEDBACK 15 (2019).

[25] Melissa M. Littlefield et al., *Contextualizing neuro-collaborations: reflections on a transdisciplinary fMRI lie detection experiment*, 8 FRONT. HUM. NEUROSCI. (2014).

[26] Daniel D Langleben & Jane Campbell Moriarty, *Using Brain Imaging for Lie Detection: Where Science, Law and Research Policy Collide* 23 (2014).

[27] Supra, see note 24.

[28] Robin Palmer, *Time to Take Brain-Fingerprinting Seriously? A Consideration of International Developments in Forensic Brainwave Analysis (Fba),1 In the Context of The Need for Independent Verification of Fba's Scientific Validity, And the Potential Legal Implications of Its Use in New Zealand.* 27.

standards. There have been successful applications of fMRI tests in some of the cases[29] in the United States which led to confessions according to Palmer[30]. Further development in this technique like BEOS system etc has led to many corporations investing money in further research and Palmer further states that critiques of this technique concede that fMRI is showing promise but there are additional things that need to be worked upon[31]. The question remains whether 'showing promise' is something that courts should take into consideration and incorporate. I would argue no, it would be a substandard position that can create havoc if a certain decision is based on these techniques but later discovered erroneous due to the problem of accuracy.

1.6 Analysis of Recent Developments in accordance with Law: -

All these papers and other articles reflect and place reliance on the fact that accuracy standards are increasing with further research and analysis. The papers mentioned above place the accuracy standards of these tests between 85-95 percent. Based on that some important questions must be kept in mind while reviewing these standards like whether this accuracy can be replicated in practical world scenarios or whether they can maintain the quality and uniform standards. One can argue that developing accuracy is a sign that these methods could potentially be used within the court of law. Maybe not blindly but in a controlled manner with a system of checks and balances as replicated in the case of Lee vs Martinez[32]. In this case, the case of the Supreme Court of Mexico ruled based on increasing accuracy decided to admit them. It is observed that they are one of the first countries in the world to introduce these tests within the court of law. They also developed certain principles and measures to maintain the quality standards of lie detection measures.

Based on this one could possibly argue that the Supreme Court of India failed to consider this while evaluating the question related to the admissibility of the lie detection technique. But I would say that there are certain things the Supreme Court of Mexico erred in their findings. The hypothesis of lie-detection tests and their validity in the practical world wasn't weighed by the Supreme Court of Mexico. 5 important questions must be weighed in when considering the admissibility of lie detection technique in the courtroom, firstly physiological responses and the changes apply to all classes of people, secondly, deception is what leads to physiological responses and not fear anxiety and nervousness, etc, thirdly whether countermeasures are really effective and they can be learned

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[29] Terry Harington case, JB Grinder case etc.
[30] Supra Note 26
[31] Supra 26
[32] 136 N.M. 166, 96 P.3d 291, 310-311 (N.M.2004)

and applied in a uniform manner or in a manner that can actually lead to increased standards of accuracy, fourthly the role of examiner's belief and personal biases could skew the results, fifthly how wording and presentation of questions can skew and affect the results in may be positive and negative manner[33]. These questions have not been tested in great detail and these minute questions are not subjected to adequate research to form a conclusive opinion. The scientific community is still developing various methods and techniques which lead to reducing the potential rate of error, but these are within a lab-controlled environment and real problems start when these tests are used in real-world scenarios. These are some important concerns that require a deeper understanding. In Lee vs Martinez, the court themselves admitted that out of 194 studies that the NRC went into only 57 met the adequate levels of accuracy[34]. Palmer in his paper projected that fMRI also sometimes drops to 60 percent standards when applied in a practical world which indicates further work/breakthrough is required[35]. This shows that during those times the standards of accuracy were not up to the mark and the same case is now. Lab testing predicting/reflecting greater levels of accuracy shouldn't create a situation of hastening the process of admitting these tests within the courtroom.

Another possible argument that could be made is, that many studies have commented on the non-inclusion of these tests in the courtroom is taking America as an example where the prevalence of jury trial is seen. The jury seems to have an inherent problem with relying on these tests since their nature is scientific. Many studies have concluded this fact[36]. This is absent in the case of Mexico and India, which opens the possibility of using these tests to their advantage since judges are in a better position to scrutinize this type of evidence. This argument can be strengthened by the point of the Mexican Supreme Court wherein they said the reliability of evidence can be questioned through heavy cross-examination etc[37]. Certain pertinent questions like what happens to the probative value of these tests if there is a hypothetical question of zero cross-examination or non-effective cross-examination or ineffective counsel is there? With regard to Jury vs Judge argument, a pertinent question could be whether discretionary nature is the most appropriate way forward especially considering their shaky standards of accuracy which differ from scenario to scenario. This

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[33] Jodi Meyers, *LEE v. MARTINEZ: DOES POLYGRAPH EVIDENCE REALLY SATISFY DAUBERT?* 17 (2020).

[34] Supra 28

[35] Supra 26

[36] Bryan Myers, Rachel Latter & M. Kathrine Abdollahi-Arena, *The Court of Public Opinion: Lay Perceptions of Polygraph Testing*, 30 LAW AND HUMAN BEHAVIOR 509–523 (2006). See also; Ann Cavoukian & Ronald J. Heslegrave, *The admissibility of polygraph evidence in court: Some empirical findings.*, 4 LAW AND HUMAN BEHAVIOR 117–131 (1980).

[37] Supra 28

becomes important because there can be a situation wherein some judges rely more on these tests while others don't which can cause serious repercussions in the long run. Hence a better way would be to closely monitor development and wait for further breakthroughs that can maintain consistent accuracy standards. At that point in time, it will be the best time to incorporate these tests within the court of law.

Conclusion: -

Even though major breakthroughs and developments have taken place in the realm of lie detection techniques since the passing of the judgment of Selvi vs the State of Karnataka[38], the opinion remains largely the same. We should wait and not be in hurry to admit these tests within the court of law and let the scientific community do their intelligence gathering/research to further develop these techniques so that they can be appropriately used within the courtroom. Increasing accuracy on the face of it shouldn't be taken as a sign to incorporate these tests within the legal sphere. There are a lot of other factors at play. I would opine that many private corporations have funded the project of testing the practicality of the fMRI technique. This move has been done so as to develop the technique further to bring it to the standards of the Daubert test. These breakthroughs are inspiring and fascinating at the same time. It won't be long when these new lie detection techniques could not only be ready for use in the courtroom but also be ready to create a scientific consensus all across the world. At that moment, the question of reconsideration of incorporating these techniques should be taken seriously but it would be my suggestion that the debates and courtroom consensus should be done and dusted. The judicial and academic domains should endeavour to monitor the changes and developments that have taken place within this sphere. Once they feel that developments are positive, they should reconsider and incorporate them immediately to maximize the gains/advantage they may bring about.

Disclaimer: A preliminary version of this paper has been submitted to Prof. Khagesh Gautam, Jindal Global Law School, O.P Jindal Global University, Sonipat as part of credit requirement for the course on Evidence Law.

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[38] Supra 16.

APPENDIX

TABLE 1 Physiologic Measurements Taken by Polygraph

Physiologic Measures	Related Regulatory Autonomic Components	Effector Neurotransmitters	Conditions Possibly Affecting Results
Blood pressure	Sympathetic noradrenergic system, sympathetic adrenergic system	Norepinephrine, epinephrine	Essential hypertension, heart failure, diabetes mellitus
Heart rate	Parasympathetic nervous system, sympathetic noradrenergic system, sympathetic adrenergic system	Acetylcholine, norepinephrine, epinephrine	Heart failure, athletic conditioning, diabetes mellitus, anxiety disorders
Perspiration (skin electrical conductance)	Sympathetic cholinergic system	Acetylcholine	Autonomic neuropathies, α synucleopathies (eg, dementia with Lewy bodies, multiple system atrophy)
Respiration	Medullary respiratory control center	Acetylcholine	Pulmonary conditions, neuromuscular weakness, neurodegenerative diseases

Source: LCDR Glen Cook & LT Charles Mitschow, *Beyond the Polygraph: Deception Detection and the Autonomic Nervous System*, 36 FED PRACT 316–321 (2019), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6654171/.

BIBLIOGRAPHY

1. Indian Evidence Act, 1872- Section 45.

2. Daubert v. Merrel Dow Pharmaceuticals, 509 U.S. 579 (1993).

3. The United States v. Scheffer, 523 U.S. 303 (1998).

4. Selvi v. State of Karnataka (2010) 7 SCC 263

5. John Synnott, David Dietzel & Maria Ioannou, *A review of the polygraph: history, methodology and current status*, 1 CRIME PSYCHOLOGY REVIEW 59–83 (2015), http://www.tandfonline.com/doi/full/10.1080/23744006.2015.1060080.

6. Benjamin Kleinmuntz & Julian J. Szucko, *On the Fallibility of Lie Detection*, 17 LAW & SOCIETY REVIEW 85 (1982), https://www.jstor.org/stable/3053533?origin=crossref.

7. LCDR Glen Cook & LT Charles Mitschow, *Beyond the Polygraph: Deception Detection and the Autonomic Nervous System*, 36 FED PRACT 316–321 (2019), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6654171/.

8. A.S. Dalal & Arunava Mukherjee, *CONSTITUTIONAL AND EVIDENTIARY VALIDITY OF NEW SCIENTIFIC TESTS*, 49 JOURNAL OF THE INDIAN LAW INSTITUTE 529–542 (2007), https://www.jstor.org/stable/43952091.

9. Gowsia Farooq Khan, *Narco analysis test: A blessing to the criminal justice system, its reliability, and admissibility in light of various Judgements* 7.

10. The Emergence of the Polygraph at Trial, 73 COLUMBIA LAW REVIEW 1120–1144 (1973), https://www.jstor.org/stable/1121713.

11. Stephen E Fienberg, *TO TELL THE TRUTH: ON THE PROBATIVE VALUE OF POLYGRAPH SEARCH EVIDENCE* 11 (2020).

12. Elena Rusconi & Timothy Mitchener-Nissen, *Prospects of functional magnetic resonance imaging as a lie detector*, 7 FRONT. HUM. NEUROSCI. (2013), http://journal.frontiersin.org/article/10.3389/fnhum.2013.00594/abstract.

13. Martina Vicianova, *Historical Techniques of Lie Detection*, 11 EUR. J. PSYCHOL. 522–534 (2015), http://ejop.psychopen.eu/article/view/919.

14. Daniel D Langleben & Jane Campbell Moriarty, *Using Brain Imaging for Lie Detection: Where Science, Law and Research Policy Collide* 23 (2014).

15. Junfeng Gao et al., *A Novel Algorithm to Enhance P300 in Single Trials: Application to Lie Detection Using F-Score and SVM*, 9 PLoS ONE e109700 (2014), https://dx.plos.org/10.1371/journal.pone.0109700.

16. Junfeng Gao et al., *A Novel Approach for Lie Detection Based on F-Score and Extreme Learning Machine*, 8 PLoS ONE e64704 (2013), https://dx.plos.org/10.1371/journal.pone.0064704.

17. Lawrence A. Farwell et al., *Brain fingerprinting classification concealed information test detects US Navy military medical information with P300*, 8 FRONT. NEUROSCI. (2014), http://journal.frontiersin.org/article/10.3389/fnins.2014.00410/abstract.

18. Syed Kamran Haider et al., *Evaluation of P300 based Lie Detection Algorithm*, 7 ELECTRICAL AND ELECTRONICS ENGINEERING 69–76 (2017).

19. M. Raheel Bhutta et al., *Single-trial lie detection using a combined fNIRS-polygraph system*, 6 FRONT. PSYCHOL. (2015), http://journal.frontiersin.org/Article/10.3389/fpsyg.2015.00709/abstract.

20. Gáspár Lukács, *Item Roles Explored in a Modified P300-Based CTP Concealed Information Test*, APPLIED PSYCHOPHYSIOLOGY, AND BIOFEEDBACK 15 (2019).

21. Melissa M. Littlefield et al., *Contextualizing neuro-collaborations: reflections on a transdisciplinary fMRI lie detection experiment*, 8 FRONT. HUM. NEUROSCI. (2014), http://journal.frontiersin.org/article/10.3389/fnhum.2014.00149/abstract.

22. Robin Palmer, *TIME TO TAKE BRAIN-FINGERPRINTING SERIOUSLY? A CONSIDERATION OF INTERNATIONAL DEVELOPMENTS IN FORENSIC BRAINWAVE ANALYSIS (FBA),1 IN THE CONTEXT OF THE NEED FOR INDEPENDENT VERIFICATION OF FBA'S SCIENTIFIC VALIDITY, AND THE POTENTIAL LEGAL IMPLICATIONS OF ITS USE IN NEW ZEALAND.* 27.

23. Lee v. Martinez, 136 N.M. 166, 96 P.3d 291, 310-311 (N.M.2004)

24. Jodi Meyers, *LEE v. MARTINEZ: DOES POLYGRAPH EVIDENCE REALLY SATISFY DAUBERT?* 17 (2020).

25. Bryan Myers, Rachel Latter & M. Kathrine Abdollahi-Arena, *The Court of Public Opinion: Lay Perceptions of Polygraph Testing*, 30 LAW AND HUMAN BEHAVIOR 509–523 (2006), http://www.jstor.org/stable/4499489.

26. Ann Cavoukian & Ronald J. Heslegrave, *The admissibility of polygraph evidence in court: Some empirical findings.*, 4 LAW AND HUMAN BEHAVIOR 117–131 (1980), http://doi.apa.org/getdoi.cfm?doi=10.1007/BF01040487.