

## When Brain Tells the Deception: A Literature Review on Brain Electrical Oscillation Signature Profiling

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*Deception is all around us and lies are the basic form of deception. Deception ranges from the innocent lies of kids to terror-creating community lies. Deception is a common aspect of planet life. Deception can save a life from predators, for winning a mate, in securing meals, and to combat competitors. Deception is part of biological life. Deception can be found in birds, animals, and microbes. But, in humans, deception is not a part of biological activities. Human deception can be for survival or for escaping from the punishment of wrongdoing of them. Anyway, human deception is a trending topic in the science world. There are various techniques in the forensic psychology field to detect human deception. Polygraph, layered voice analyser, forensic Narcoanalysis, and brain electrical oscillation signature profiling, brain fingerprinting are the major deception detection techniques. This review article focuses on the theoretical perspectives and background of Brain Electrical Oscillation Signature Profiling. BEOS is an Indian lie detection tool, developed by Dr. C.R. Mukundan. BEOS is working on the principle of Autobiographical memory and semantic memory.*

**Keywords:** BEOS, Brain Electrical Oscillation Signature Profiling, deception

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Deception is all around us and lies are the basic form of deception. Deception ranges from the innocent lies of kids to terror-creating community lies. Lie detection has moral, methodological, clinical, and legal implications. Deception is a common aspect of planet life. Deception can save a life from predators, for winning a mate, in securing meals, and to combat competitors. Deception is part of biological life. Deception can be found in birds, animals, and microbes. But, in humans, deception is not a part of biological activities. Human deception can be

for survival or for escaping from the punishment of wrongdoing of them. Anyway, human deception is a trending topic in the science world. It's been 34 years, human deception became a core research interest of the cognitive neuroscience field (Rosenfeld, 1992; Rosenfeld, 1999)

There are various techniques in the forensic psychology field to detect human deception. Polygraph, layered voice analyzer, forensic narcoanalysis, and brain electrical oscillation signature profiling, brain fingerprinting are the

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major deception detection techniques. Criminal Justice System utilizes these techniques to find out the culprits.

The modern advanced technology is brain lie detection instruments such as brain fingerprinting and brain electrical oscillation signature profiling. In India Brain Electrical oscillation Signature Profiling is the most used technique. It is also called BEOS or BEOSP. BEOS is not detecting lies rather than it is detecting memory related to the crime. BEOS is working on the principle of Autobiographical memory and semantic memory. What we encountered in our life will make a trace on autobiographical memory. It is called experiential knowledge. BEOS has been using in Indian crime investigations since 2003. (*Puranik et al 2009*).

### **METHODOLOGY**

This study tries to review and analyse research articles, empirical studies published online. To get information online search was conducted on Cochrane library, Research gate, PsycINFO, GAP Journal, Semantic Scholar, Google Scholar etc. using certain keywords related to the topic. Total 14 research papers were reviewed in this review study. Each data Combined and analysed qualitatively. Guidelines of Centre for Review and Dissemination (2009) and PRISMA guidelines were used to extract data from online with exclusion and inclusion criteria.

### **I. Brain Electrical Oscillation Signature Profiling**

BEOS is a technique which had been developed in the year 2003 by Prof. Dr. C.R. Mukundan; father of Indian Neuropsychology. It is a computer – EEG based techniques used to detect the presence of experiential knowledge in suspect of the crime. BEOS extracting electrical oscillation signature from the brain by presenting probes. While recalling experiential knowledge, the examinee could recollect the autobiographical information encoded in

autobiographical memory related to the happening of the crime or engagement in the crime. (*Mukundan CR, 2005*)

BEOS using 32 channel electrode head cap. Head cap can be fitted in scalp and conducting gel injected on discs of electrodes. Subject will be monitored by webcams.

BEOS is based on the human memory system, so it is a memory- based test and not a deception detection test. BEOS is constructed on the assessment of two memory systems.

**Knowing** – It is based on the semantic memory of the subject. By sharing knowledge with others, a person will get semantic information. Knowing is associated with activation from the dorso-frontal cortex.

**Remembrance** – Remembrance is the autobiographical information which is encountered in our life. In other words, the events which are faced by the subject is called Remembrance or experiential knowledge. Activation of the ventral brain, anterior cingulate cortex, orbitofrontal cortex, medial temporal cortex is associated with remembrance.

The meaning behind the name – Brain electrical oscillation signature profile: brain oscillation which elucidates electrical activity of the brain produced during cognitive processing. A signature means a specific pattern of electrical activity while marking the remembrance or experiential knowledge. (*Mukundan CR., et al. 2017*)

### **Type of Probes used in BEOS**

BEOS is based on autobiographical memory and semantic memory. Assesses knowing and remembrance of the subject about participation/ occurrence of the crime. There are statements called probes. Probe is categorized into four kinds of probes.

- Neutral probes are short linguistic sentences that will not have personal references.
- Control probes, which are capable to elicit experiential knowledge about autobiographical information.

- Target A probes: The investigation officer will provide information about the activity of suspects, Target A probes are designed against the suspect or it can be denoted as investigation officer's version of probes.

- The Target B probes contain the information given by the suspect, in which she/he believes that their innocence will be proven.

## II. Novel studies in BEOS

A study on the effect of repeated probes on creating experiential knowledge, which study brought out that Experiential Knowledge of an individual can be elicited only when the incident is episodic memory-based which the individual has experienced (Episodic Memory) himself. Memorizing an event multiple times or listening about an incident multiple times cannot create experience-based signatures in the individual's brain. (Isai, C. & Kacker 2020). Human memory is connected to emotion. Positive emotions and negative emotions are capable to make deep impacts on memory. These experiences will produce experiential knowledge of the suspect's memory. In 2018, researchers came across both negative emotion and positive emotion almost equally produces experiential knowledge about the events which made them happy or sad. It was a BEOS based study and 20 participants participated. (Kacker, 2018). Investigators established the significant role of BEOS in the cyber-crime investigation through their research on cyber-crime investigation through BEOS profiling. They conducted study between amateur hackers and professional hackers. Investigators established

positivity for the use of BEOS in cyber-crime investigation. (Kacker and Roy, S 2020).

Kacker & Amrita, A. (2020) found that experiential knowledge cannot be manipulated with confabulated memory of suspects in BEOS system. Results found that in BEOS real memories cannot be influenced by false memories. In a study, named "Remembrance of Recent vs. Remote Memory of an Event: A Key to Investigation of Cold Cases" (Pendse, A. & Kacker, P. 2020) discovered that BEOS can be used for investigating cold cases. It was a quasi-experimental study and the number of EKs elicited in recent memory and remote memory was studied and statistically analysed.

## CONCLUSION

BEOS is a technique which had been developed in the year 2003 by Prof. Dr. C.R. Mukundan; father of Indian Neuropsychology. It is a computer – EEG based techniques used to detect the presence of experiential knowledge in suspect of the crime. BEOS is based on the human memory system, so it is a memory-based test and not a deception detection test. BEOS is constructed on the assessment of two memory systems - Autobiographical memory and semantic memory. What we encountered in our life that will make a trace on autobiographical memory. From the birth of BEOS, so many offenders got convicted by the criminal justice system. A lot of innocent people got their normal life back. BEOS is based on the human memory system, so it is a memory-based test and not a deception detection test. BEOS can be applied in cold crime investigation, cybercrime investigation.

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