MEDWIN PUBLISHERS
Committed to Create Value for Researchers

International Journal of Forensic Sciences
ISSN: 2573-1734

Understanding the Differences between Brain Finger Printing and Brain Electrical Oscillations Signature (BEOS) Profiling Systems used for Forensic Psychological Investigation

Kacker P*

School of Forensic Psychology, National Forensic Sciences University, India

***Corresponding author:** Priyanka Kacker, Senior Assistant Professor, School of Forensic Psychology, National Forensic Sciences University, Gandhinagar, Gujarat, India, Email: priyanka.kacker@nfsu.ac.in

Mini Review

Volume 7 Issue 1

Received Date: January 07, 2022

Published Date: January 26, 2022

DOI: 10.23880/ijfsc-16000249

Abstract

It has been quite a matter of concern and discussion from past many years to understand the difference between Brain Fingerprinting technique (BFT) and Brain Electrical Oscillation (BEOS) Profiling technique to understand there usage and significance in forensic psychological investigation. BFT and BEOS terms are used interchangeable and sometimes termed as brain mapping too. But, technically the Brain Fingerprinting and Brain Electrical Oscillations Signature Profiling System (BEOS) are two different technologies for measuring two different parameters of the brain activation. Brain Fingerprinting detects P300; whether the suspect has recognized the stimulus (the image presentation of weapon, missing person, victim, and/or perpetrator) somewhat similar to Polygraph results. BEOS detects the involvement of the suspect in the criminal case under investigation as an Eye-witness/victim/perpetrator. BEOS can further distinguish whether the perpetrator is the conspirer/primary offender/helped the perpetrator to commit the crime. This paper talks about the differences between the two systems in depth.

Keywords: Brain Fingerprinting (BFT); Brain Electrical Oscillations Signature (BEOS) profiling; Forensic Psychological Investigation Techniques

Abbreviations: BFT: Brain Fingerprinting Technique; BEOS: Brain Electrical Oscillation; BFP: Brain Fingerprinting; EEG: Electro Encephalogram.

It's been years that a debate is going on about the significance and superiority of techniques called Brain Fingerprinting (BFT) and Brain Electrical Oscillations Signature (BEOS) profiling. The BFT and BEOS are loosely termed as Brain mapping however, they both are neither Brain mapping nor brain imaging techniques. BFT was developed by Lawrence A. Farwell which is based on P300 Event Related Potential on Brain. BEOS was developed by Mukundan C.R. which is based on Experiential Knowledge of an individual through remembrance of an event in the brain. The two technologies are different in its approach to administration, analysis and reporting. The only common aspect is that both the technologies records brain signals for analysis [1,2].

The Differences between Brain Fingerprinting (BFP) and Brain Electrical Oscillations Signature Profiling System (BEOS) based upon the Review of BFP and BEOS based Scientific Research Publications are

i. Brain Fingerprinting (BFP) Measures P300 which is a positive event related potential occurring around 300 milliseconds after the detection of a stimulus. The positivity is an indication of recognition of the stimulus, which could happen only if the person has had an earlier exposure with the content of the stimulus. P300 is an indication of frontal activation associated with recognition. The stimulus is presented for 200 – 300 milliseconds for recognition and the P300 occurs within 300 – maximum 500 milliseconds [3-6].

ii. P300 indicates recognition of familiarity or even recognition of any difference in the pattern of same stimulus repeatedly presented, when a different stimulus is presented along with other familiar stimuli to the subject. This could be easily demonstrated in laboratory experiments using any ERP instrument. By presenting a stimulus related to a crime scene, along with other familiar stimuli, the subject may show a higher P300 while recognizing the crime specific stimulus, compared to other stimuli. P300 is essentially a sensory event taking place in the brain, while the brain recognizes a difference in the sensory inputs. It does not go beyond recognizing a stimulus which might be related to any random event of life and not specifically be related to a crime scene [7].

iii. While BEOS is Brain Electrical Oscillation Signature changes occurring with various neurocognitive steps that occur in the brain, during remembrance of description of neurocognitive event, including motor events in the brain. Thus it starts with the recognition of the sensory input and its cognitive judgments, and remembrance of similar past sensory-motor events, including recognition of new sensory-motor events in the brain [8].

iv. P300 is measured in "BFP" using repeat visual presentations of a visual stimulus with occasional presentations of a different stimulus. P300 is generated while recognizing the different stimulus. On the other hand BEOS consists of several neurocognitive processing steps starting with attention, recognition, semantic processing - encoding, and remembrance from the past, and sensory interpretations of the input stimuli. BEOS uses presentation of short sentences in auditory mode, and the subject merely listens to them without giving any response. The subject is expected to remember and recall them at the end of the experiment. The auditory presentations are sequential presentations of a previous experience. Sensory-motor events or experiences, which the subject is suspected to have had are presented using short sentences in a sequential manner [9,10].

v. The auditory inputs for BEOS are short sentences, each lasting maximum 3 seconds. Each is composed of 3 or 4 words, which describe the presence of a sensory-motor activity engaged by the person, or what the subject has had experienced. The subject is informed that he would have to recall all those presentations at the end of the BEOS test and hence must listen to them carefully. The subject remains with the eyes closed, while the EEG is collected [11-16].

vi. The analysis duration of each BEOS auditory input is 10 seconds. The system records 10 seconds of 32 channels of EEG. The auditory presentations are prerecorded and they are presented to the subject by the system. After presentation of 60 to 100 or more probes, the system would carry out all analyses including statistical comparisons are automatically carried out [17,18].

vii. The initiation analysis is for detection of the auditory stimuli by the subject, followed by detection of the semantic analysis of the words heard. This still be followed by detection of presence of remembrance, as the auditory inputs may refer to a past experience, which the subject is considered to have had. These are carried out by multiple channels and the results are obtained after statistical analyses of each channel EEG. 10 seconds of EEG inputs are sequentially analyzed and the results are stored in the system. These analyses would take place over the next 6 – 7 seconds, which would make the total duration of analysis of each probe, as 10 seconds. The system carries out all statistical analyses of various parameters (total 15 variables) and their results would be stored [19].

viii. Any of the analyzed data is considered significant only if it refers to remembrance of a past experience, which the subject needs to explain, in post analyses examination [20-25].

ix. The Examiner has the responsibility to search the past events and find supportive evidences to show that the subject has had a specific experience related to sensory-motor acts, one of which may be a criminal action. He or she needs to explain the experience after the BEOS test. The post test interrogation is thus very important as it allows the emergence of the presentation of earlier experiences or actions [26-28].

x. The main cognitive task that we look for in BEOS examination is the understanding of past experiences through related remembrance of the event. The subject remains silent without providing any explanation of the remembered event, through the neurocognitive task of remembrance produces electrophysiological changes, which are acquired by the system. The response pattern would only tell that remembrance has taken place. It has

to be explained by the subject [29-33].

xi. EEG analyses are carried out in each channel during the 10 secs and they are arranged topographically so that each section would represent specific neurocognitive processing in the individual [34,35].

xii. Based on the significant findings from BEOS test, further investigations of the case could be carried out to determine, if the suspect has had a specific experience. This is done by the investigators independently and they could make use of such investigations for further understanding of the case, and to hold specific individual responsible for the actions committed [36].

xiii. There is no way a P300 examination result could be compared with the BEOS results, as recognition is only one of the several neurocognitive processes carried out by the BEOS test [37].

Sr. No.	Features	Brain Fingerprinting (BFT)	Brain Electrical Oscillations Signature (BEOS)
1.	Device Based on	Event Related Potential (ERP)	Electro Encephalogram (EEG)
2.	Measures	Recognition (P300) of a Familiar stimuli at lower latency and frequency of brain activation	Remembrance of an Event at higher latency and frequency of brain activation
3.	Detects	Guilty knowledge (Detects whether the suspect Possess information about the Crime or not) similar to Polygraph	Experiential Knowledge (Detects whether the suspect is Involved in the act of Crime or not)
4.	Differentiate between Eye-witness, Victim & Perpetrator	Cannot differentiate	Differentiate well
5.	Detailed Information about the Brain for analysis and interpretation	**NO**. It records only two areas of the brain using 2 electrodes which gives limited information.	**YES**. It records the activation of entire brain using 32 electrodes which gives broader and detailed information.
6.	Level of Investigation	For Screening of suspect (To screen out whether the suspect is familiar with the stimulus presented or not)	For in-depth Forensic psychological investigation and to detect the level of involvement of the suspect in the Crime under investigation
7.	Presentation of	Visual & Text stimulus	Auditory Probes
8.	Mode of presentation	Series of Pictures/images are presented for which the suspect has to press button	Auditory probes of small and simple statements are presented. No verbal/physical responses are required for recording.
9.	Display results	P300 i.e. Recognition	Experiential Knowledge (EK), Encoding of Information at level 1 & 2 (EN & EN++), Primary processing of the information (PP), Inattention shown by the suspect during the recording (IA) and attempt of hiding information through Activation Suppression (AS)
10.	Information required for recording	Physical evidences are required for preparation stimulus for presentation	Investigation can be done in absence of physical evidences too

Table 1: Tabular Representation of Differences between Brain Fingerprinting (BFP) and Brain Electrical Oscillations Signature (BEOS) Profiling.

Conclusion

The technologies Brain Fingerprinting (BFT) & Brain Electrical Oscillations Signature (BEOS) profiling systems which are used for forensic psychological investigations are different from each in its objectives, administration, analysis, its interpretation and reporting. So, the technologies cannot be compared with each other and cannot replace each other in terms of investigation of a criminal case [38].

References

1. Deepti P, Priscilla P, Mukundan CR, Gautam G (2020) Eliciting Experiential Knowledge of Autobiographical Episodes using Brain Electrical Oscillation Signature Profiling. Special Issue for Research Scholars. Indian Journal of Psychology, Punjab University, pp: 14-17.

2. Isai C, Kacker P (2020) Effect of Repeated Probes on Creating Experiential Knowledge. GAP iNTERDISCIPLINARITIES, A Global Journal of Interdisciplinary Studies 3(3): 17-29.

3. Kacker P, Ajitprasad A (2020) Experiential Knowledge on Confabulated and Real Experiences Using Neuro-Signature System: A Pathway to Criminal Justice. GAP iNTERDISCIPLINARITIES, A Global Journal of Interdisciplinary Studies 3(3): 30-36.

4. Khemchandani R, Kacker P (2020) The Experience of Post-Traumatic Stress Disorder And Domestic Violence. GAP Indian Journal of Forensics and Behavioural Sciences 1(1): 1-4.

5. Grandhi SR, Kacker P (2020) Cyber Crime Investigation Through BEOS Profiling. GAP iNTERDISCIPLINARITIES, A Global Journal of Interdisciplinary Studies 3(2): 67-72.

6. Pendse A, Kacker P (2020) Remembrance of Recent Vs. Remote Memory of an Event: A Key to Investigation of Cold Cases. The Indian Police Journal 67: 89-95.

7. Kacker P (2020) Forensic Psychological Investigation During and After the Pandemic 2020: A Technology – Based Futuristic Approach. Encyclopedia of Covid. Gurudutta Japee, Preeti Oza (Eds), Aple Books Publishers and Distributors, pp: 219-230.

8. Mukundan CR, Sumit S, Chetan SM (2019) Neurocognitive Processes of Recognition and Remembrance. Psychology and Behavioral Science -International Journal 10(3): 555795.

9. Mukundan CR, Sumit S, Chetan SM (2018) Neurocognitive Processes of Recognition and Remembrance. Psychology and Behavioral Science -International Journal 10(3): 134-141.

10. Kacker P (2018) Experiential knowledge of positive and negative experiences on remembrance and neural response using neuro signature system. Journal of Clinical Psychiatry Cognitive Psychology 2(1): 19-25.

11. Keshav K, Vyas JM, Kacker P (2018) Forensic Psychological Investigative Techniques Eliciting cues to deception and truth in Crime Investigation. Indian scenario, Research Journal of Social and Life Sciences.

12. Mukundan CR, Sumit S, Chetan SM (2017) Brain Electrical Oscillations Signature Profiling (BEOS) for Measuring the Process of Remembrance. EC Neurology 8(6): 217-230.

13. Vishal KP, Mukundan CR (2017) Brain Electrical Oscillation Signature Profiling (BEOS). International Journal of Computers in Clinical Practice 2(1): 1-23.

14. Nandini N, Kacker P (2017) Paranormal Movie Based "Experiential Knowledge" using Brain Electrical Oscillations Signature (BEOS) Profiling. Indian Journal of Health and Wellbeing 8(11): 1285-1290.

15. Mukundan CR (2017) Modern Methods of Psychological Investigations. In: Proceedings of International Conference of Forensic Sciences, Gujarat Forensic Sciences University, Gandhinagar.

16. Mukundan CR (2017) Emotion – The Driving Force. Red Shine Publication.

17. Mukundan CR (2016) Neurocognitive Processing Steps during Remembrance. J Psychology & Clinical Psychiatry 6(6): 00387.

18. Mukundan CR (2015) Brain at Work: Neuroexperiential Perspectives. Atlantic Publishers.

19. Mukundan CR (2014) Neuroscience Techniques for Forensic Examination of Suspects. In: Nagle YK, Srivastava K, Gupta A (Eds.), Handbook of Forensic Psychology. Author House, UK, pp: 137-167.

20. Puranik DA, Mavle RR, Daundkar BB, Malve MK (2014) Brain electrical oscillations signature profiling –a forensic psychological tool for investigation. International of Psychosocial Research 3(2): 14.

21. Puranik DA, Priscilla Paul (2014) Forensic psychological tools and its evidentiary value in Indian courts. Journal of Contemporary Psychology.

22. Vaya SL (2013) National Resource Center for Forensic Psychology. 2nd (Edn.), Directorate of Forensic Science. Gandhinagar.

23. Mukundan CR (2010) Reading from memory: a paradigm shift for deception detection in investigative psychology. Amity Journal of Applied Psychology 1(1): 24-34.

24. Mukundan CR (2009) Neural Correlates of Experience. In: Surila A, Ira Das, et al. (Eds.), Health Psychology. Allied Publishers, New Delhi, pp: 46-58.

25. Puranik DA, Joseph SK, Daundkar BB, Garad MV (2009) Brain Signature profiling in India. It's status as an aid in investigation and as corroborative evidence – as seen from judgments. Proceedings of XX All India Forensic Science Conference, pp: 815-822.

26. Sunny J, Puranik DA, Daundkar BB, Garad MV (2009) Presence of Experiential Knowledge in suspected vs. control subjects. An evaluation of Brain Electrical Oscillations Signature Profiling. Proceedings of XX All India Forensic Science Conference, pp: 803-813.

27. Sunny J, Mukundan CR, Puranik DA, Daundkar BB, Garad MV (2009) Eliciting Experiential Knowledge – Some theoretical and practical considerations in designing probes for Brain Signature Profiling. Proceedings of XX All India Forensic Science Conference, pp: 823-834.

28. Khopkar NM, Shukla AD, Shah DG, Vaya SL. Significance of isolated Experiential Knowledge in interpreting Brain Electrical Oscillations Signature Profile. Proceedings of XX All India Forensic Science Conference, pp: 787-794.

29. Wagh NB, Vaya SL, Vyas JM, Asawa TL, Khandwala SU, et al. (2009) Sensitivity and Specificity of Brain Electrical Oscillations Signature Profiling. Abstract in Proceedings of XIX All India Forensic Science Conference, pp: 112.

30. Vaya SL, Vyas JM, Khopkar NM, Wagh NB, Rever JM, et al. (2009a) Scenario wise analysis of experiential knowledge in brain electrical oscillation signature profiling. Abstract in Proceedings of XIX All India Forensic Science Conference, pp: 113.

31. Vaya SL, Vyas JM, Khopkar NM, Wagh NB, Rever JM, et al. (2009b) Presence of Experiential Knowledge in sequence in BEOS profiling: Implications for forensic formulations. Abstract in Proceedingsof XIX All India Forensic Science Conference, pp: 114.

32. Vaya SL, Khopkar NM, Shukla AD, Patel VH, Shah DG (2009c) Brain Electrical Osicllations Signature profiling technique to verify the truthfulness of confessions (2009). Abstract in Proceedings, XIX All India Forensic Science Conference, pp: 115.

33. Anjali Y, Rao MS, Ravikumar KV (2009) Brain Electrical OSicllations Signature profiling: An emerging tool in crime investigation. Proceedings, pp: 117-123, XIX All India Forensic Science Conference.

34. Mukundan CR (2008) Brain Electrical Oscillations Signature Profiling for Crime Investigation. In: Veeraraghavan V (Ed.), Handbook of Forensic Psychology. Selective & Scientific Books, New Delhi, pp: 123-46.

35. Tifac-DFS-Project-Final-Report (2008) Normative Data for Brain Electrical Activation Profiling. Research project by DFS, Gandhinagar and Funded by Technology Information Forecasting & Assessment Council (TIFAC), New Delhi.

36. Mukundan CR (2007) Brain Signature Profiling for Crime Detection. In: Kiran Rao, Indira Jai Prakas, Srinivasan K (Eds.), Mindscapes: Global Perspectives on Psychology in Mental Health. NIMHANS Publication, pp: 282-297.

37. Mukundan CR (2007) Brain Experience: Neuroexperiential Perspectives of Brain-Mind. Atlantic Publishers, New Delhi.

38. Mukundan CR, Vaya SL (2004) Brain electrical activation fingerprinting. CBI Bulletin 12(10): 29-37.