

# EXPERIENTIAL KNOWLEDGE ON CONFABULATED AND REAL EXPERIENCES USING NEURO-SIGNATURE SYSTEM: A PATHWAY TO CRIMINAL JUSTICE

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## Abstract

*Presumption of innocence is a legal principle that one is innocent until proven guilty. Justice is served to the victim, when the guilty is convicted. It, not just, prevents perpetrator from offending further, but also, safeguards the potential victims. The guilty is convicted with the help of thorough and accurate forensic investigations. Forensic investigations are supposed to provide reliable evidence to the court, and subjecting such investigative evidence to conventional scientific tests will enhance the perceived reliability of evidence. The Brain Electrical Oscillations Signature Profiling, the BEOS, is one such investigative conventional technique that determines the involvement of the individual's actions in an actual event. It involves extracting information from the person's memory, without having the individual respond to the probes. The validity of eyewitness testimony, statements given by the victims, statements by witnesses and statements by suspects may be dependent on a variety of factors, mainly the fallibility of human memory. This study was conducted to examine the authenticity of such memories using the Neuro Signature System or the BEOS. The research design was prepared on the basis of increasing incidents of exonerations in the past due to verdicts based on false or confabulated memory. The findings of this study have suggested that BEOS, as a forensic investigative technique, could distinguish false memories from real memories.*

**Keywords:** Justice, Court, Forensic investigations, Validity, False memory, Real experiences, Exonerations

## INTRODUCTION

The word 'forensics' is derived from the Latin term 'Forensis', which means "of the forum". The forum is famous law court of ancient Rome. Forensic Psychology has been around since the turn of the 20<sup>th</sup> century. The first Forensic Scientist is Hugo Munsterberg, who published "On the Witness Stand" in 1908. Forensic Psychology is the intersection between psychology and the criminal justice system. It involves understanding criminal law in the relevant jurisdiction in order to be able to interact appropriately with judges, attorneys and other legal professionals (Munsterberg, 1908).

The most common roles performed by psychologists and psychiatrists consulting criminal courts include competency evaluations, assessment of mental state at the time of offense (sanity evaluations), pre-sentencing evaluations.

Investigation of a crime offers a multitude of both research and practical activities for a forensic psychologist. Some of these activities directly relate to identifying the perpetrator, while others relate to the methods police use after apprehending a suspect or suspects. One such method is interviewing. Interviewing is all about getting an accurate account of an event. However, there are a number of factors that influence the responses of the witnesses, victims and the suspects. Responses to the questions during investigations may confabulate the memory one had created about the event. Remembrance of experiences that was more than a few moments ago means reconstruction of past events. The more the event follows our day-to-day expectations, the more we reconstruct what we think happened rather than any direct memory of what really did happen. The result is that we may inadvertently alter the facts and miss some out or forget.

The main purpose of an interview with a witness, victim or suspect is to get a description of who did what, where and when. False memories occur when one remembers something that did not in fact happen. In a forensic investigation, one of the most direct ways in which false memories occur is when a witness offered an answer, which may, in fact, be implied by the phrasing of the questions at the time of forensic interrogations (Canter, 2019).

Bringing a false allegation against a person is a particularly insidious form of deception, especially when someone is accusing a person of a heinous crime such as sexual abuse or rape. Some evidence shows that false accusations of rape may occur in at least one out of every ten allegations (Canter, 2019).

Witnesses are generally in the habit of trying to tell the truth as they understand it when being interviewed. However, a similar assumption cannot be made when interviewing suspects. Interviewing procedures are established in some places that make it easier to find out if the suspect is telling the truth. However, you need to keep in mind that such interviewing procedures can be fraught with problems.

Any lie-detection procedure takes into account the intellectual and emotional demands that lying requires. The nitty-gritty of detecting a lie is in testing the plausibility of the claims the suspect is making. But if a liar truly believes he is telling the truth none of the intellectual or emotional aspects of lying exist and usual procedures for detecting deception are unlikely to work.

This study focuses on such a forensic investigative technique that will aid in determining the validity of the statements made by the victims, witnesses or the suspect, helping in detecting a false confession, false allegations or confabulated memories.

Forensic Psychological investigative methods include Narcoanalysis, suspect detection test, Statement Analysis, Polygraph and BEOS. These are to be used as corroborative evidence and not as sole evidences. Polygraph test, popularly known as Lie-Detection test, infers whether a person is telling the truth or is he lying. The scientific basis on which this instrument works is that a suspect will produce a defensive reaction in the form of psychological and physiological changes when the guilt feelings were consciously held. The underlying theory of the polygraph is that when people lie they also get measurably nervous about lying. The heartbeat increases, blood pressure goes up, breathing rhythms change, perspiration increases, etc. A baseline for these physiological characteristics is established by asking the subject questions whose answers the investigator knows. Any deviation from the baseline for truthfulness is taken as a sign of lying.

BEOS is an investigative method that has been found to be more accurate than polygraph since it measures the electrophysiological signatures. Memory confabulation using polygraph has not been studied much. The reason to have chosen BEOS to study memory confabulation and false memories is also to study the brain oscillations and their electrophysiological signatures when under the remembrance of an experience that actually did not happen.

A number of studies have demonstrated how brain distinguishes false memories from real memories. One such study was conducted by Michael Kahana, a professor of psychology in Penn's School of Arts and Sciences and lead investigator. The study results indicated that there is a difference in brain activity just prior to remembering something that had and had not actually happened.

Lawrence Farwell developed an approach on brain fingerprinting to understand the brain activity. According to Farewell, the brain is central to all human acts. In a criminal act, evidence in the form of information may be there or may not be there. Brain of the perpetrator is always there- planning, executing and recording the crime. Perpetrator, having committed the crime has details of the crime stored in the brain (Farwell, 1995).

Farewell's Brain fingerprinting measures P300 which is a measure of familiarity than that of a change. P300 could be used as a potential lie-detection measure, if words representing guilt knowledge could be infrequently presented. P300 indeed has a high sensitivity and poor specificity required for forensic application, for discrimination of a perpetrator from innocent. However P300 denotes recognition and not measuring experience which is the major limitation of the system due to which it cannot be used for forensic investigation. Due to this reason even the developer of the instrument Farwell (2001) has declared that it shall not be used for forensic investigation. Based on the report of US General Accounting Office (2001), CIA officials concluded that brain fingerprinting had limited application to CIA's operations.

Prof C. R. Mukundan developed a forensic investigative tool, BEOS (Brain Electrical Oscillation Signature) Profile. It is a computer-based technology to identify the presence of "Experiential Knowledge" in the perpetrator of the crime. The person tested is made to sit comfortably with the electro-cap on his head. He remains silent with eyes closed during auditory presentations. He is not expected to offer any type of response while the probes are presented. This technique is used for extracting a signature of electrical oscillations from the background electrical activity of the brain of a subject by presenting probes. The signature contains reference to an "Experiential Knowledge" (EK) in the subject to an act committed by the person, and which is elicited by the probe. The probe makes the subject become aware of the experience or the action, if he or she has committed the same. During recall of the EK the subject recalls the autobiographical information related to the occurrence of the event and subject's participation in the act. The signature is measured as frequency-time domain activity during or immediately after the presentation of the probe. The electrical oscillation pattern is evoked by remembrance of the experience reflected in the 'nestled' probes. Absence of experience is associated with absence of remembrance and absence of corresponding electrical signature (Mukundan, 1998).

A human brain stores information in the form of signals in different sensory modalities. These signals are classified in terms of their relationships perceived as function of experience and existing knowledge, as well as new relationship produced through sequential processing. The process is called encoding which is primary, if the individual has directly participated or experienced. It is considered secondary when the information is

obtained from secondary sources such as watching, listening etc. Primary encoding is deep seated as the individual has directly participated in the experience, act or event. The brain of the subject who has participated in such event, will respond different from the person who has not participated in such event or received the information from any secondary source. BEOS is such a technique that will possibly help to identify the individual who has perpetrated the crime and can be differentiate from those acquiring information from the secondary sources. The individuals who have encoded information through primary sources will show the characteristic brain responses that are indicative of the possession of first-hand knowledge- personally acquired information- of the event (Mukundan, 1998).

A study on BEOS, BEOS profile of experiential knowledge was conducted to compare two groups. The results showed that the remembrance for experiences and remembrance for recognition of an event can be differentiated by using BEOS profiling. It can also differentiate the role-played by the suspect or the participant in the event or crime (Mukundan et al. 2009).

A study was conducted by Patel A N (2015) to verify the principles of BEOS. The study demonstrated that the subjects were able to differentiate between relevant, control and neutral probes.

A number of studies have demonstrated how brain distinguishes false memories from real memories. One such study (Kahana, 2007) indicated that there is a difference in brain activity just prior to remembering something that had and had not actually happened.

## RATIONALE

The rationale of this study is the need to validate the statements made by the witnesses, victims, and the suspects to furnish assistance in the forensic investigative processes. Considering the flaws of our memory and the influence of internal and external factors in creating a memory of what we know and what we have done, when these memories are attended to the electrical activity pattern generated by the NSS system will help differentiating the source of the memory, whether participated, witnessed or heard about the event.

## HYPOTHESES

1. The number of EKs generated for a real experience is greater than the number of EKs generated on Imagined experiences and Confabulated experiences.
2. The number of EKs generated in Phase 1 will be the highest followed by Phase 3 and the least in Phase 2.
3. The number of EKs on AR (Action recall) is higher than VR on the probes of real experience.
4. The number of EKs on VR (Visual recall) is higher that AR on the probes of imagined experience.

## METHODOLOGY

### Objective of the study

To study the Experiential Knowledge of people at three different Phases i.e.

Phase 1: Real Experiences

Phase 2: Confabulated Experiences

Phase 3: Imagined Experiences

### Sample

Subjects for the study were collected through purposive sampling from Gujarat Forensic Sciences University, Gandhinagar, Gujarat. The approval for the data collection was sought and obtained by the institute. Age group was between 21 to 29 years. Total sample comprised of 10 subjects. Informed consent was taken from the subjects. All the subjects were ensured confidentiality. The subjects were well educated. All the subjects were post graduate students. They were briefed about the study and willingly agreed to write down a real vivid experience and a real and not very vivid experience. They were given time for the third experience since it required imagination and concrete, believable situation. All the subjects were cooperative.

### Tools and Instruments

*Semi-structured Interview Questionnaire for eliciting subjects' experiences*

The subjects' consent is taken and the biographical details are noted down after the subject agreed for participating in the study. The subjects were instructed to write down their personal experiences. They were told that experiences could be emotional, pleasant, unpleasant, vivid or faded. They were asked to produce two real experiences. The First Phase included the real experience of the subject. The Second Phase also consists of the subjects' real experience. The Third Phase consists of the experimental condition where a false memory has to be created. The Subjects are provided with a script that they were to visually participate while memorizing at three different intervals and after a period of 15 days called for the recording.

### **BEOS- Brain Electrical Oscillations Signature Profile**

The BEOS Profiling was carried out for this study. There are two systems involved, VASP and NSS. The VASP system is the Visual and Auditory Stimulus Programming system where the probes are designed, uploaded and recorded. The NSS system is where the probes are presented (auditory or visual) and the electrical activity of the subjects are recorded. The subject room consists of the subject chair, head cap with 32 channels, amplifier and a monitor with two webcams.

Items provided for subject preparation include EEG head cap, adaptor with a Reference Ear Electrodes and Mastoid electrode, EEG Gel, Blunt Needle and a Gel Syringes.

Instructions include asking the subject to place the feet on a rubber mat or a wooden stool. This is for grounding to isolate the subject from ambient electrical noise and activity. The subject's feet should be flat on the ground and not crossed. This is to reduce muscle artifact. The subject should be instructed to avoid movement as far as possible and to reduce eye blinks as well as for eyes open session.

### **Procedure**

This was the first kind of study which was conducted to study significance or the result of confabulation or imagination using BEOS instrument. The research was divided into various stages: Stage 1: Planning and Formulation of the objective of the study; Stage 2: Sampling; Stage 3: Set the tools and instruments ready for the study; Stage 4: Following the procedure in conducting the study (1) Phase I – Data collection (2) Phase II – Designing and Audio recording of the probes (3) Phase III – BEOS Recording (4) Phase IV – Data Analysis

### **Phase-I: Data Collection**

The subjects had to write life experiences in detail. The experiences were divided into three phases. The first phase consisted of their real, vivid memory of their experience. The second phase was their real experience merged with few false statements and finally the third phase had an experience that was visually or imaginatively created. The third phase experience was made to be imagined by the subject at three different times with a motive to create a false memory. The second phase also had real experiences of the subjects and the examiner confabulated the experiences by adding false believable details. Phase 3 consisted of an experience created by the subject by imagining it or they were also given a script and were asked to imagine the experience and embed with their original or real experience of an event.

### **Phase-II: Designing and recording of probes**

Once the forms were being collected, a set of probes were designed. It consisted of 70 minimum and 228 maximum probes of each subjects and recording were designed in sequence along with respective event markers. Then auditory probes were recorded in the voice of the same gender as the participant.

### **Phase-III: BEOS recording**

After almost 15 days the subjects was being brought to the BEOS lab for recording, according to the convenience of the subject. The baseline session is recorded as control for 2-3 minutes before recording the BEOS recording.

## **RESULT AND ANALYSIS**

The objectives of the study was to find whether the percentage of EK was highest on real experiences, followed by imagined experiences and least on confabulated experiences. In order to study this objective, the data was collected. The statistical analysis was done finding the percentage of number of EK in each Phase.

Below are the tables showing encoding++ and experiential knowledge of the participants.

- Encoding++: Activity related to higher order of processing
- Experiential knowledge: Activity related to remembrance of the experience triggered by the probe present.

The first phase has the real experience of the subjects. The second phase is the real, faded memory merged with certain false statements. The third phase was either created entirely by the subjects or a false event embedded into their real experience. In the third phase the subject was subject to repeated imagination and visualization of the entire experience with intent to develop a false memory of it. According to the hypothesis the number of EK should be either nil or minimal. The subject should not generate an EK for a falsely created experience.

### **Summary Analysis**

**Table 3.1:** The table shows the number of encoding++ (En++), experiential knowledge (EK) and the percentage of EK generated on confabulated, imagined experiences and the real experiences of all the phases and the ratios of the EK (Phase1, Phase 2 and Phase 3) (summary).

Subject	Phase 1			Phase 2			Phase 3		
	En++	EK	Percentage of EK	En++	EK	Percentage of EK	En++	EK	Percentage of EK
1	28	19	24%	19	6	10%	42	10	10%
2	22	12	19%	13	10	13%	34	18	16%
3	59	10	20%	17	10	13%	35	14	9%
4	37	11	10%	21	5	6%	12	5	6%
5	45	12	13%	33	10	10%	44	21	13%
6	10	5	16%	8	5	9%	54	12	8%
7	39	14	23%	23	8	9%	29	19	11%
8	61	9	15%	50	19	11%	43	10	1%
9	8	5	21%	14	5	9%	7	3	8%
10	27	16	17%	58	17	10%	61	14	8%

**Table 3.2:** This table shows the number encoding++ (En++) and experiential knowledge (EK) and the percentage of EK generated on confabulated and imagined experiences (Phase 2 and Phase 3).

Subject	Phase 2			Phase 3		
	En++	EK	Percentage of EK	En++	EK	Percentage of EK
Subject 1	0	0	0	22	6	6%
Subject 2	1	5	6%	17	12	11%
Subject 3	1	3	4%	10	2	1%
Subject 4	3	1	1%	12	5	6%
Subject 5	6	4	4%	5	3	2%
Subject 6	2	0	0	24	6	4%
Subject 7	0	0	0	14	11	6%
Subject 8	5	4	2%	18	3	3%
Subject 9	3	3	7%	5	3	8%
Subject 10	0	0	0	16	4	0.5%

The percentage of En++ and EK is found to be more on imagined experiences as compared to the confabulated experiences.

With reference to Table 3.11 it was found that the percentages of EK scores are higher in Phase1 as compared to the other two phases i.e. Phase 2 and Phase 3. Also the percentage of EK in Phase 3 is higher than in Phase 2.

The number of EK on real experiences was found to be higher than the percentage of EK on confabulated experiences in Phase 2. And the number of EK generated on real experiences was more than the number of EKs generated on imagined experiences in Phase 3.

However with reference to Table 3.2, it was found that the percentage of EK scores on real experiences was higher as compared to the percentage of EK scores on confabulated experiences.

Further analysis showed that on imagined experiences the percentage of EK on Visual Recall (VR) probes was higher compared to the percentage of EK on Action Recall (AR) for imagined experiences. Conversely, the percentage of EK on Action Recall (AR) was higher compared to EK on Visual Recall (VR) of real experiences.

## DISCUSSION

When a crime is committed the police investigate to find the culprit. In the process the police or the investigation team produce suspects and conduct interrogation to find the real culprit behind the crime. A number of studies have demonstrated the mechanism and processes of memories and how certain strategies may be implemented to strengthen one's retrieval of memory. The seven sins of memory is what intrigued in conducting this study. When a crime is committed there are a number of people involved including the suspect or perpetrator, victim, witnesses and others who may be directly or indirectly involved. During the investigation, the suspects' version may be a real experience or a fabricated experience of the original event. Undergoing multiple interrogations may lead to the development of an entirely new memory that is confabulated. Similarly investigator's version may include details elicited from the suspects, victims, witness and others which may be fabricated. The victim's version may imagine experiences due to past traumatic experiences or irrational thoughts and may represent a fabricated memory of an event. This study was conducted to examine the authenticity of such memories using the Neuro Signature System.

Forensic evaluation of the suspect becomes relevant only when the role of the suspect is linked to the crime that is under investigation. Techniques like forensic psychological assessment, forensic hypnosis, Narcoanalysis, BEOS and polygraph examination are used as scientific aids to interrogation. Comprehensive

forensic evaluation is important to understand the behaviour of the perpetrator with reference to the crime scene as a whole.

To undergo BEOS there are two versions of the statement. One is the suspect's version, the other is the investigator's version of the statement. Investigators' version is based on the information elicited by the suspect, victim, witnesses and the other people who may be relevant in the case.

The conditions in this study represents the above two phases. The investigator's version serves the Phase 2 condition consisting of the confabulated experiences. The interrogator collects the information from number of people known and unknown to the suspect based on the witnesses' report, victims allegations and writes a statement. The produced statement may or may not have fabricated and confabulated details. The suspect's version serves the Phase 1 and 2 conditions consisting of the real actual experiences and confabulated experiences. The suspect undergoes multiple interrogations and may have a fabricated memory of that event that is far different from his or her original memory. The case may be the same with the witnesses' memory. Many studies show that an individual's memory is recreated by the knowledge one has and the knowledge one is been exposed to giving a new memory of that event. Phase 3 condition consists of imagined experiences. Phase 3 condition may represent the version of the victim where they may imagine or visualize the act or event happening or occurring a number of times developing a belief that it actually occurred.

This study purports to explore the "signatures" of the experiences that are real, confabulated and imagined. According to the hypothesis, EK should be generated in Phase 1 the most, followed by Phase 2 and least generated in Phase 3. The results showed that percentage of EK is higher for Phase 1 in most subjects. The percentage is higher in Phase 2 and 3 for those probes that were part of the real experiences. The subjects generated experiential knowledge for the experiences they had actively participated. The Phase 2 consisted of confabulated experiences where the probes were unlikely to generate an EK. The researcher added the probes at the time of designing those that are not known to the subject. However, there is a possibility that the participant has evoked an EK. Considering the possibility that the past experiences may be associated evoking an EK for the fabricated probes. The third Phase is the imagined experience, by which the researcher tried to induce a false memory.

The results are consistent with the objectives of the study that experiential knowledge scores were evoked more on the individual's personal experiences and not on the confabulated experiences.

However, it is discussed later in this section that the memories that were confabulated and memories that were falsely created have different implications. The memory confabulation occurs with or without the individual's knowledge and due to the errors of memory. The imagination inflation occurs due to the individual's active participation in the imagination of the experience. Memories that are not relevant to an individual's experience are unlikely to evoke an EK. Memory confabulations may be entirely irrelevant or may have certain similarity or familiarity. In that case, EK is not provoked as desired. The imagination inflation leads to strong false beliefs that are developed and held by the subjects, such that there may be a possibility that EK was generated which will need further probing and elaboration. That has what been found in this study.

The study showed that the percentage of EK generated on Imagined experiences is higher than the ratios on the confabulated experiences. This indicates that Imagination involves visual participation and evokes more EK scores as compared to confabulation which is not associated to the subject's experiences or past experiences explaining the imagination inflation studies.

Phase 3 was further divided to find the number of EK generated on the real part of the experiences and on the imagined part of the experiences. It was observed that the number of EK was evoked more on the real experiences compared to the number of EK elicited on Imagined experiences indicating that experiential knowledge is generated for real experiences because the system detects the individual's active participation in the experience or event.

Phase 3 divisions of two event markers was further analysed to see whether event markers played significance in the generation of experiential knowledge on imagined experiences. The results indicated that the participants evoked more EK on Action Recall compared to Visual Recall on real experiences and more EK on Visual Recall compared to Action Recall on Imagined experiences. This could explain the higher number of EKs on imagined experiences due to subject's active participation visually.

An interesting finding of this study was that a subject generated EK on a strong urge. When further probed it was found that the subject not only recreated the false experience but also with a strong of wishing the experience in real. Another interview was done where the subject was asked to elaborate the scenario that was a real experience and the session was re-recorded to the effect of strong urge.

The Nithari case in 2006 is an example of this result. Nithari was a serial murderer and seem to have shown EK on the probes that were is strong urges to execute or act.

## CONCLUSION

It was found that in few of the experiences imagined by the subjects, the more relevance the probes had in the subjects' lives the greater was the possibility that those probes evoked an EK when the subject was asked to

imagine the experience out of context. This occurs due to the associations the individual forms in the brain when the networks are activated.

The study showed that BEOS differentiates false and confabulated memory from real experiences with crucial analysis and that those experiences imagined will generate more number EKs on visual probes probably because they have visually participated in the experiences.

The number EK generated on imagined recall has to be probed further and elaborated. An interesting finding observed during the process of the study was that strong urges were possible enough to generate an EK in an individual which requires further contemplation and exploration.

This study furnishes our knowledge in understanding BEOS as an investigative forensic tool that can be used to aid the forensic investigations. Such corroborative evidence is more likely to reach the court and have a positive effect on juries' decisions to convict.

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