

EFFECT OF REPEATED PROBES ON CREATING EXPERIENTIAL KNOWLEDGE

Pravesh Charan Isai, Dr. Priyanka Kacker

Institute of Behavioral Science, GFSU,
Gandhinagar, Gujarat
pcharan273@gmail.com

Assistant Professor, Institute of Behavioral Science, GFSU,
Gandhinagar, Gujarat
drpiyankakacker@gmail.com

Abstract

In recent years, there has been a gradual increase in the crime rate in our country. With the increasing number of crimes, physical evidence left on the crime scene is negligible and thus it becomes relatively difficult for the investigating agencies to gather pieces of evidence that will lead them to the perpetrator of a particular crime. Further, although the investigating agency may reach a particular suspect in a crime, it has to be proved in the court of law by the prosecution that the suspect is involved in the crime. For this purpose, the legal system has emphasized oral or documentary pieces of evidence, to convict an individual of a particular crime. Recently, there is a lot of dependencies on newer scientific techniques that are used as an aid to an investigation process. One of the major reasons is that the witness manipulates his/her statement in the court due to which the case gets more complicated. So there is the need of the study through which we may able to find out whether the particular individual is actually able to remember the entire scenario that has happened or else it just the imaginary incident that he is making also creates the impact of leading question & false statement and also the false testimony which ultimately leads to the extension of so many years in the court of the particular case is well. The statement of the subject gets affected by the repetition of the information given by investigating officer, lawyer, and the repeated trials he has undergone. Mostly eyewitness affected with such repetition of information due to which they change their statement trials after make case complicated and reduces the reliability of the statements given by eyewitness this leads to delay in justice and complexity of the case. One such technique is Brain Electrical Oscillation Signature (BEOS) which has received a lot of public attention. BEOS profiling is a scientific tool, which is used to identify individuals with Experience of participating in a crime.

Keywords: Episodic Memory, Repetitive Memory, Eyewitness Testimony, Brain Electrical Oscillation Signature Profiling, Experiential Knowledge.

INTRODUCTION

Remembrance has become popular in the recent day's discipline of research. It is playing a major role in discussions of crime in every scenario and offering suggestions as to how to deal with the underlying factors of crime-related scenario. Understanding why crime occurs requires an understanding of the complexity of human experiential knowledge. Detection of the crime and eliciting the truth and involvement in a criminal act has always been a most difficult investigative task, as individuals invariably hide the truth and try to implicate others as responsible for the criminal activity. Detection of significant remembrance responsible generally present when a person makes an untrue revelation has been the commonly used Polytrophic method of lie detection. However, knowing that one may be telling a lie may only party help in the process of crime investigation. After more than a century of research on Episodic Memory, there is still an argument that underlies the mechanism of the repetition of memory. Factors such as age, coping skills, personality, level of social and financial support, and the ability to hold on to their own cognitive and the episodic memory can be equated to an individual's context of criminal behavior. Thus, both individual's remembrance and current living factors are essential in explaining current behavior and to predict the experiential knowledge. An important forensic task has always been a elicit the truth from an individual who may be taken in as suspect with someone specific involvement in a crime already committed it is a general phenomenon that the person who has already committed a criminal act may want to hide his or her involvement in the criminal activity and pretend to be innocent. In most cases, a crime is reported within a short period after its occurrence. But it has also been seen that some crimes may be reported quite late, such as rape cases. In some situations, a case is reported and is under investigation, but due to various reasons, the entire investigation takes a long time.

When cases are brought to Forensic Laboratories for testing, usually a considerable amount of time has already been spent by the investigative agencies for the investigation. If a fresh avenue of investigation opens up due to new information obtained by the police, it may lead the police to new suspects. There is no estimation as to how long an investigation can go on for. When the police have to prove the involvement of an individual in crime in the absence of any physical evidence, they may get court orders to conduct various forensic psychological tests on the suspect. Investigative agencies turn towards forensic laboratories to conduct these tests on the suspect to gain new leads in an investigation or to ascertain the role of the suspect in the said crime, or to determine the extent of his/her role. A factor that might play a role in the effectiveness of psychological testing of suspects is the time interval between the occurrence of the crime and the testing of the suspect. In cases where BEOS profiling is deemed necessary, it has been observed that there might not be any fresh leads available, and any possible leads may only be obtained from the suspect that is presented for testing. BEOS profiling is often done in cases of serious crimes such as rape, murder, kidnapping, and sexual harassment of a child (POCSO cases). The memory of the suspect undergoes the normal phenomenon of forgetting as time goes by. When the Investigative officer/Lawyer has to prove the involvement of an individual in crime in the absence of any physical evidence, they may get court orders to conduct various forensic psychological tests including BEOS profiling. Investigative agencies turn towards forensic laboratories to conduct these tests on the suspect to gain new leads in an investigation or to ascertain the role of a suspect in the crime. A factor that is effective in psychological testing of suspects is the time interval between the occurrence of the crime and the testing of the suspect. In cases where BEOS profiling is deemed necessary, it has been observed that there might not be any fresh leads available, and any possible leads may only be obtained from the suspect that is presented for testing. Therefore, the need to study whether the effect of time can affect the results produced by BEOS was felt. The findings of this study are supported by the study of Maguire and Mummrey (1999) suggested that memory may be classified as personally relevant or not instead of episodic and semantic. Information with personal relevance may also have temporal specificity. Relevant time-specific memory recall with the personal relevance was associated with the increased inactivation of the left hippocampus whereas pure personal information without time reference produced an increase in activation of bilateral tempo parietal junctions. Prof C.R. Mukundan developed a forensic investigative tool. BEOS (Brain Electrical Oscillations Signature) Profile. It is a computer-based technology to identify the presence of "Experiential Knowledge" in the perpetrator of the crime. This technique is used for extracting a signature of electrical oscillations from the background electrical activity of the brain of a subject by presenting a probe. The signature contains a reference to an "Experiential Knowledge" (EK) in the subject to an act committed by the person, and which is elicited by the probe using the method of Probing. The probe makes the subject aware of the experience of the action if he or she has committed the same. During the recall of the EK, the subject recalls the autobiographical information related to the occurrence of the event and the subject's participation in the act [7]. The primal difference between the perpetrator of a crime and an innocent person is that the perpetrator, having committed the crime, has the details of the crime stored in his memory as signatures, and the innocent suspect does not. This is what Brain Fingerprinting testing detects scientifically, the presence or absence of specific information [8]. In a forensic psychological perspective, it is seen that when some cases have to be tested, there is no limit on how old the case is. Nevertheless, proper testing of all subjects involved in the case, as directed by the court has to be conducted. In these cases, there is a possibility that the subject may not entirely recollect the details of the incident or may claim to know certain details, which may be a confabulated memory or may even be fabrications. The effect of the passage of time on memory can be tested with Brain Electrical Oscillation Signature Profiling System or BEOS. True remembrance as well as experiential knowledge can be ascertained by the use of BEOS.

BRAIN ELECTRICAL OSCILLATION SIGNATURE PROFILING (BEOS)

BEOS is usually a memory-based test not a detection-deception test and its scientific base is derived from the differences between the two memory systems, one responsible for 'knowing' and the other for 'remembrance'. Knowing is a process of acquisition or sharing knowledge or information with others. On the other hand, remembrance is that of autobiographic episodes, and episodes are encountered in life by each, which is called experience. Remembering is associated with extensive activation of the ventral brain, anterior cingulate cortex, orbitofrontal cortex, and medial temporal cortex. Knowing requires brain engagement mainly from the dorso-frontal cortex, which is a much smaller engagement of the brain for knowing and retrieving information. This may involve mainly the process of recognition of the external signals or proprioceptive sensations, and their later retrieval for recognition of the same signal. The term Brain Electrical Oscillation is a commonly used reference to the electrical activity of the brain produced during cognitive processing in cognitive neuroscience. The word "signature" is used to refer to a specific pattern in the electrical activity recorded from the brain and is the marker of the process of remembrance of autobiographical episodes or personal experiences when provoked by the probes presented to a subject. The signature is detected as a group of changes in the electrical activity patterns when provoked by the probe and is measured in comparison with a pre-probe baseline activity (Mukundan ,2005). The human brain stores information in the form of signals in different sensory

modalities all through the waking periods. These signals are classified in terms of their relationships perceived as a function of experience and existing knowledge, as well as new relationships produced through sequential processing. The process is called primary encoding 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 himself/herself will have shared or participated in the experience, act, or event. Such encoded information can be found when the brain is activated by using a part of the information in relevance to the event or activity that forms the part of the event. The brain of the subject who has participated in such an event will respond differently from the person who has not participated in such an event or received the information from any secondary source. By using this technique, it is possible to identify the precise individual who has perpetrated the crime and can be differentiated 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 possession of first-hand knowledge (personally acquired information) of the event (Mukundan, 1998). BEOS is a technique that detects Experiential Knowledge (EK) in an individual. EK can be obtained only when an individual participates in an activity or witnesses an activity (Mukundan, et al.; Mukundan, 2007; Mukundan, 2008; Kacker, 2018). This system is manufactured and developed by Axxonet systems, and its formal name is Neuro Signature System. The forensic application of this system is the detection of EK in an individual who is suspected of being a participant in a crime. The subject is presented with auditory stimuli called 'probes' which are regarding the actions of the subject. The subject is not supposed to verbally or physically respond to the stimuli, but instead, the response of the subject to these probes is recorded by NSS through gel electrodes that are placed on the scalp of the subject. The NSS analyses the electrical activity obtained through EEG and generates a graph that provides details about the EK of the subject. BEOS profiling is used to aid the investigations, and to find the nature and extent of involvement of an individual (suspect or accused) in the crime under investigation (Mukundan, et al.; Mukundan, 2007; Mukundan, 2008, TIIFAC-DFS Project report, 2008).

Remembrance is triggered in BEOS by presenting cues to a subject in the form of short verbal statements called the probes. The electrophysiological changes taking place when retrieval is triggered by the cue are measured from the multiple channels of electrical oscillations of the brain. Multiple channels of EEG are analyzed to extract the significant changes that occur in the brain EEG while listening to each probe. As the subject is not expected to give any response to the probe head, only change evoked by listening to a probe is recorded as a remembrance. Remembrance of experience may be triggered by a probe only if the person has personally acquired the experience and stored the information. The analysis program looks for changes in the electrical activity, which indicates remembrance of autobiographical episodes or experiential knowledge. The EEG frequency and the time domain changes associated with different stages of cognitive processing in remembrances such as semantic processing of the probe, a shift in attention, episodic memory, and neutral binding effects [23,24] are extracted if present and the significant changes are interpreted by the program. BEOS profiling is carried by using EEG with 30cephalic channels and 2 eye movement channels. The hardware and the software for data acquisition and analyses were developed by Axxonet System Technologies.

Now understanding the probes is necessary for the BEOS interpretation which is the crux for the experiential knowledge. At the very onset, the major events of the crime are classified into separate Scenarios. Probes are designed for cueing the remembrance of specific possible experiences as derived from the information of the case acquired from investigators and interviews of concerned persons. Each scenario depicts a specific formulation of happening when the suspect could have carried out a specific activity. The probes are arranged sequentially and systematically. No value-based or judgmental words are used. Probes differ in their length in terms of the number of words. Designing of the probes is based on some set criteria i.e., they should be arranged within the time limit of 3.4 sec. There are a total of four types of probes. The first set of probes are called Neutral probes which are essentially short semantic processing sentences without any personal references and are used to measure and compensate the encoding process and its topographic distribution compared to the pre-probe baseline epoch of 3 sec. The next set of probes are control probes referring to verified autobiographic episodes in the life of the subject tested, which are expected to produce expected remembrance and associated electrophysiological changes. Positive findings in the analysis using the control probes are considered a process of self-validation of the procedure, which the examiner can share with the subject for generating confidence in the test protocol and later during the post-test interview. The third set of probes is called Target "A" probes. These lists of probes are designed in different scenarios that form the activities of the suspect/subject before, during, and following the crime investigated. The last set probes are Target "B" probes, which refer to the version of activities and participation as claimed by the suspect, which he may believe would prove his or her innocence. Once the probes are designed along with respective event markers, indicating the beginning of the pre-probe baseline and beginning of probe epoch, the release of the probe, and the end of the probe epoch. The probes are recorded using Visual and Auditory Stimulus programming (VASP) on the computer. And after the probes are being recorded, the next step to follow is trimming to check if there is an error while recording. Once this checking is completed the subject is ready to be called for the recording.

BASIC PRINCIPLES

This technique is based on the principles of encoding, storage, and retrieval of memory from the brain. The information of action is encoded in the brain during the participation or its execution. Its recall at a later point in time may depend upon a voluntary and intentional effort to recall, or the presence of an external event or information, which could be triggered its remembrance. The externally presented information could both prime as well as trigger the remembrance of the experience. The presentation of this triggering or provoking information has been termed as a probe in a BEOS paradigm. In context with the Neurocognition, the probe must help the subject to access the long term episodic memory system and retrieved the linked information. The awareness related to the retrieval is generally called its remembrance. Remembrance may constitute a series of processes of recreation of the associated mental imaginaries and emotions associated with the original experience, and it may be considered as an indication of evidence of the presence of the original experience in the person. The entire process of interrogation of a suspect involves the direct method of provoking the subject to remember and report personal involvement and experiences of participation in the crime investigated. Remembrance is the only way one retrieves from memory information related to past events to the present. Such reporting by a person, in the routine judicial system, is called “Confession”, though it would still require physical corroboration for the acceptance as evidence. Unlike remembrance, knowing or recognition does not need to access personal experiential memory repertoire or autobiographical memory. BEOS has mainly been used as a forensic investigation tool from extracting the information from suspects who are believed to have given an adequate and accurate narration of their involvement in a crime. As BEOS does not require any question to be put to the suspect as well as no responses as expected from the subject, only minimal active cooperation is required for its administration. The suspect is not threatened by the prospect answering question which can implicate him or her in the crime investigated. BEOS also allows hypothesizing and testing different possibilities of action that could have been committed by a suspect. Further, BEOS test measures the presence of knowledge acquired through experience or actions committed by a person, it is an indicator for the involvement of a subject, rather than a measure of the knowledge which could have been acquired through a third party, media, or other communication channels. As the aim of most of the forensic investigation related to crime is to identify a perpetrator, which has to be done either by fixing the responsibility of one suspect or differentiating one from the others. However, there are factors in an individual, which can influence the ability to remember or retrieve information. These factors may range from diseases of the brain, mental illness, intoxicated conditions at the time of participation of the actions and their recall, to an intense emotionally disturbed state of the person required to retrieve the experience. Neuropsychological studies that have investigated the effect of age, education, and similar factors on memory functions, have already shown its effect of these variables on cognitive processing. However, remembrance of experience is different from the immediate and delayed recall tests used in cognitive assessments.

STAGES IN BEOS PROFILING

- Stay calm with eyes closed.
- No need to respond to the probes.
- Remain alert and listen to the probes as the suspect will be asked to recall them later on.
- Inform examiner if the test needs to be paused.
- Instructions regarding posture.

Electrical Oscillations from the brain are picked up by using electrodes placed at a standard position such as FP1, FP2, AF3, AF4, F7, F3, F8, F4, FT7, FT8, FC3, FCC4, T3, T4, C3, C4, TP7, CP3, TP8, CP4, T5, T6, P3, P4, O1, O2, Fz, Cz, AND CPz respectively. The changes in the power spectrum profile in specific frequency ranges are classified into indicate the presence of remembrance EK (Experiential Knowledge), EM (Emotional) Response, NE (Negative) Response, Encoding present, and/or Primary Processing alone present. All probes are processed unless the subject has not attended any of them. Changes in the different frequency bands have a different meaning in terms of cognitive processing. The software generates the result in the following category for the interpretation from the forensic angle.

LEGAL STATUS OF BEOS IN INDIA

According to the Indian Evidence Act of 1872, Evidence means and includes all statements which the Court permits or requires to be made before it by witnesses, concerning matters of fact under inquiry; such statements are called ‘Oral’ evidence as well as all documents produced for the inspection of the Court; such documents are called ‘Documentary’ evidence. Evidence may be given of facts in issue and relevant facts. Evidence may be given in any suit or proceeding of the existence of the nonexistence of every fact in issue and such other facts as are hereinafter declared to be relevant and of no others. Law of Evidence governs the use of testimony (e.g. oral or written statements) and exhibits (e.g. physical objects) or other documentary material which is admissible (i.e. allowed to be considered by the trier of fact, such as jury). The development of Brain

Mapping technology has revolutionized the causes of crime investigation in the country and has obtained laurels and recognitions by the Judiciary and Investigating agencies. Further, Brain mapping technology has survived a series of legal challenges under Article 20 (3) and Article 21 of the Indian Constitution (LexisNexis, 2016). Indian Evidence Act section 45 - relevancy of opinion of an expert, when the court has to form an opinion upon a point of foreign law or science or art, or as to the identity of handwriting or finger impression, the opinions upon that point of the person especially skilled in such foreign law, science or art, or in questions as to the identity of handwriting or finger impression are relevant facts, Such persons are called experts (LexisNexis, 2016).

BEOS COMPLAINT IN CONTEXT WITH LAW

- (a). For the conduction of BEOS, a court order with the expressed consent of the potential subject is necessary.
- (b). The informed consent of the subject is obtained twice. Once in court, when the subject is informed about the BEOS procedure in brief, and once more when the subject is brought to the forensic laboratory for the test. In the forensic laboratory, the procedure of the test is explained in detail. The subject is also made aware of their right to refuse consent for the test. All the concerns of the subject are addressed, and then informed consent is taken just before the test conduction.
- (c). With regards to Article 20(3) (Right against self-incrimination) of the constitution, BEOS is not in conflict with the provisions of this article, as the subject is not required to respond to any questions in any way. The subject is not supposed to respond with “Yes”, “No”, or give any replies to the stimulus presented by the BEOS system. The system records brainwave activity and detects Experiential Knowledge from the interpretation of said brainwave activity. The effective conduction of the test is reliant upon the attentiveness of the subject to the presented stimuli. Here too, the subject has free will to be inattentive and thus obstructs the test. Thus, the subject is not compelled to answer any questions.
- (d). With regards to Article 21 (Right to life& personal liberty) of the constitution, the BEOS procedure is a non-invasive technique that does not involve injecting any medicine into the subject. It is a cruelty-free procedure, where it is made sure that the subject is comfortably seated in a chair and is relaxed before beginning the test. The comfort and relaxation of the subject are of utmost importance for the proper conduction of BEOS.

USE OF MEMORY RETRIEVAL IN FORENSIC PSYCHOLOGICAL INVESTIGATION

Lacy and Stark (2013) stated that memory distortions tend to occur due to the passage of time. One possible reason for this is that with time, some memories may change form from episodic memories being very specific and highly detailed to semantic memory, being more generalized and with loss of details. This effect is not limited to general everyday memories, but it may extend to strong memories too. The time duration between witnessing a crime and testifying regarding it has also been studied, and studies suggest that while giving testimonies in court, the individual may not even be able to distinguish between true and false memories. Eyewitness testimony has also been vastly studied for this exact purpose: to study the effect of time and memory on testimonies in court (Loftus, 1979, 2019; Lipton, 1977; Buckhout, 1974; Bekerian& Bowers, 1983). With such a background, the relevance of BEOS testing is even more evident, as some scientific evidence can be submitted in court regarding the testimonies of the suspects, who are just as susceptible to the fallibility of details in memory as the witnesses. The efficiency of BEOS has been suggested in such cases and has been assumed, owing to the very nature of permanence of memory, but it had not been tested and studied until now.

EPISODIC MEMORY

The term “Episodic Memory” refers to the distinction b/w ‘knowing & remembering’. Knowing is the ‘factual recollection’ (Semantic) whereas Remembering is the feeling i.e. located in the past (Episodic). Endel Tulving et al. 1972 coined the term of the Episodic Memory which is retrieval of autobiographical events is a typical example of declarative or explicit memory. During the generation of the verbal contents, the contents are prepared through encoding or transcoding, are kept in the working memory, and later shifted to long term memory through associations. It is the collection of past personal experiences that occurred at a particular time and place. Tulving has seminally defined three key properties of episodic memory recollection. These are a subjective sense of time (or mental time travel), connection to the self, and Autonoetic consciousness refers to a special kind of consciousness that accompanies the act of remembering which enables an individual to be aware of the self in subjective time. Aside from Tulving, others named the important aspects of recollection which include visual imagery, narrative structure, retrieval of semantic information, and the feelings of familiarity. Events that are recorded into episodic memory may trigger episodic learning, i.e. a change in behavior that occurs as a result of an event. The acceptance intact or ejecting recombined pairs is thought to require recollection for the particular pairings of stimuli. The theoretical assumption that familiarity cannot support associative recognition memory arises from the view that familiarity reflects neural activation of single items (Yonelinas, 2002) that are represented in Anterior Cingulate Cortex (Norman & O’Reilly, 2003). Nadel

and Mosovitch (1997, 1998; Fuji et al. 2000) proposed a theory of brain system with multiple memory traces representing different episodic memory acquired by the individuals over the lifetime. Each episodic memory had one or more unique traces and each trace is proposed to be identified by a unique stamp of time. Each trace represents a unique facet of the memory of the episode and the time stamp indicates the time reference of when the memory was formed. The different memory trace items are created randomly and they are independent of another. Each independent trace can decay or replicate. Newly created traces can interfere with existing traces. Fink et al. (1996) investigated the neural correlates of the autobiographical memory of comparing RCBF changes while listening to own past personal experience of their subjects with the account of impersonal experiences of a person not known to them, which are presented to them once before the PET study. Listening to the personal experience, result in a relative increase of the *rcbf* on the right hemisphere specifically affecting the right temperamental, right dorsal prefrontal cortex while the subject listens to the personal ephory. Eichenbaum et al. (1994) proposed and their potentiality to be recognized again will be enhanced if it occurs more than once. Rugg et al. (1998) on the affected of presenting a word once to a subject, which gains the capability to change how the word will be used subsequently, in an implicit manner, without deliberate and conscious effort. However, the same cannot be said when a skill is learned over several attempts of practice, that the learning is outside the awareness of the individual. The individual learns the skills with conscious effort through practice. On the other hand, during recall the skill so learned may be available for the deployment without effort, without need for an effortful recall. This would mean the acquisition of information and skill recall of the same may not utilize the same process functions. Ebbesen and Rienick (1998) investigated the effect of varying retention intervals on the accuracy of memory for events with strangers and their identification. The number of correctly recalled facts of conversations with the strangers reduced over time. However, even after a single recall, there was no further decay in the later recalls over time. The errors committed in recall remained the same over time. They too find that the confidence shown by a witness in recalling was predictive of the accuracy of the recall. Most Functional Brain Imaging studies of episodic memory retrieval have used written words, and not pictures, as stimuli (Cabeza et al., 2003; Rugg & Wilding, 2000). Moreover, our task required a simple 'YES-NO' Cognition, whereas the other studies of the episodic memory retrieval employed the 'Remember - Know' procedure (Rugg & Yonelinas, 2003). Curran (2004) demonstrated that dividing attention during encoding reduces the parietal, but not the mid-frontal old/new effect. This finding supports the assumption that familiarity operates more automatically than recollection.

REPETITIVE MEMORY

Repetition creates a pattern and familiarity which gets our attention and it can also lead to understanding. We have to repeat things more than once to finally sink into our minds. Repeating over and over again improves the remembrance of an individual. It has been proven that people learn best and retain more information related to a particular scenario and people to move information into their long term memory. Repetition of memory involves the work of tying imagery to concepts, words definition, and phenomenon. Repetition can hasten and deepen the engagement of the learning process. Multiple mechanisms work to maintain stored memory, including recollection, familiarity, and priming. Once the information is remembered correctly and used with executive functions, it still needs to be reviewed regularly, but at gradually lengthening intervals. This repetition, after the first correct response, results in reinforcement of the neuronal connections along the lengths of the axons and dendrites and across the synapses. The more the neural connections are activated by the stimulation that practice brings, the more dendrites grow to strengthen the connections between the neurons. The conclusion drawn was that because practice makes the neural networks more efficient, it took less brain metabolism to carry out the same activity. The result is that there is freeing up of brain energy and areas to be used for other things (Jancke, 2000). When the brain perceives information repeated in multiple ways, there is a priming process that makes encoding of that information more efficient. That is why writing a vocabulary word in a sentence, hearing classmates read their sentences, and then following the direction to use the word in conversation during that day will result in more successful long-term memory storage and retrieval than just memorizing the definition (Koutstaal et al., 1997). This varied repetition of the information results in the consolidation of information. Consolidation of information involves using the most effective strategies to first acquire information and then practice and rehearse it. The best-remembered information is learned through multiple and varied exposures followed by authentic use of the knowledge by processing it through the executive function centers. This executive function processing of new information can be achieved by student-centered or open-ended questions, active problem solving, or connecting the information to real-world situations. To understand how memory enhancement works, it is first necessary to understand what constitutes successful remembering. According to Bartlett (1932) termed a repetition of memory as an "AN EFFORT AFTER MEANING" means memorable information is a piece of meaningful information When the information to be remembered is meaningful to the potential learner, then use can be of the meaningful structure of the material itself as a mnemonic device. Senter et al. (1965) said that Mnemotechnics are processing strategies developed specifically for remembering meaningless information. They are special techniques that impose meaning and organization on apparently meaningless material. As a consequence of

this imposed organization and meaning, the retention of nominally meaningless information is enhanced. A breakthrough in the study of optimum spacing of repetitions came with the discovery of the repetition effect which has been founded under the wide range of the conditions and also which refers to the fact that sparsely the repetition produces better performance in memory test (Melton, 1967; Hintzman, 1974; Crowder, 1976; Cuddy 1982). The robust of the repetition effect is the exception rather than the rule (Dempster, 1987). The most convincing interpretation of this fact is that as spacing increases, the initial memory traces become less and less accessible. Despite the reduced accessibility, in distributed spacing, the repetition produces an increased memory effect. However, after the repetition reaches some critical point, the memory trace becomes completely inaccessible, and the processing to be remembered item is similar to the one that takes place at the initial representation (Underwood, 1961; Melton, 1970; Rose, 1984). There are numbers of contradictory reports, many of them invalidating the importance of the encoding variability of the memory repetition effect (Bellezza, 1975; Bird, 1978). In behavioral studies using memory repetition, the length of the spaces between stimuli proved a critical variable in Long Term Memory encoding. This was examined in an ingenious study of honeybees contrasting massed and spaced learning (Menzel et al., 2001). Using spaces between stimuli of 30 sec, 3 min, and 10 min, memory retention was tested after 30 min, one day, and three days. Honeybees trained with 30-sec spaces showed the best learning after 30 min with over 80% retention, but this rapidly decreased, falling to 20% on the third day, a demonstration that only STM had been created. In contrast, honeybees trained with 10 min spaces between learning trials showed less than 80% retention after 30 min but subsequently consolidated these memories, reaching almost 100% on the third day, demonstrating long-term memories had been created. Encoding memories has been the subject of fMRI studies showing memory encoding and memory repetition processes occur in different parts of the human brain. A seminal study of encoding complex scenes of unfamiliar information demonstrated posterior temporal-lobe structures associated with declarative memories focused in the parahippocampal cortex, whereas memory repetition for successfully remembered information in the anterior temporal-lobe region focused in the subiculum (Gabrieli et al. 1997). In repetition memories time patterns are also important through time scales in recall practice are usually in weeks, months, or even years. Repetition studies by (Ebbinghaus et al., 1913) demonstrated the value of spaced practice (many short sessions) over massed practice (a single long session) in Long Term Memory. Further studies confirmed this retrieval spacing effect and led to attempts to implement the spacing paradigm in education. Although the spacing effect in retrieval has been demonstrated in many subjects and educational contexts to be effective, it has rarely been systematically implemented in education (Dempster et al., 1988; Seabrook et al., 2005). Despite the recent careful analysis of the temporal patterns demonstrating effective recall of word pairs and other tasks (Cepeda et al., 2006; Pavlik and Anderson, 2008; Cepeda et al., 2009) and despite specific programs based on the approach (Carpenter et al., 2009, 2012, Sobel et al. 2011) this remains the case. Yet the importance of time patterns in both Long Term Memory encoding (as demonstrated in neuroscience) and retrieval practice (as demonstrated in psychology) strongly suggest there are significant applications in the education of evidence-based time patterns from both research traditions. A review by the Institute of Education Sciences of spaced retrieval approaches suggested this may be because studies included few examples showing acquisition of complex bodies of structured information, or a clear educational function in critical areas of education accountability such as high-stakes testing (Pashler et al., 2007). The repetition of memory of the South Korean faces revealed activation in the Insula and Anterior Cingulate Cortex, within these regions, response during correct trials regardless of stimulus type (old or new faces) were stronger than the responses during incorrect trials and also the previous functional brain imaging studies have implicated the prefrontal cortex in memory repetition (Buckner et al., 1999) and monitoring during retrieval (Buckner & Wheeler, 2001). The idea that perceptual and conceptual processes account for dissociations between tests has recently come into question, because researchers have found some effects of perceptual variables on conceptual tests (Hunt & Toth, 1990) and conceptual effects on perceptual tests (Bassili, Smith & MacLeod, 1989; Toth & Hunt, 1990; Hirshman, Snodgrass, Mindes, & Feenan, 1990). Feustel et al (1983) confirmed the similarity between the effects of repetition on recognition and perceptual identification by presenting words that were different in meaning from previously repeated words, but highly similar in orthography (e.g. huge presented following prior repetition of a hug). Identification of these derived words was improved by a prior presentation of the words from which they were derived (an indirect priming effect); additionally, subjects made more false-positive responses to the derived words than to underived new words in a recognition memory test. The distinction between perceptual and conceptual forms of tests does not map directly onto the distinction between recall and repetition of memory tests because it is perfectly possible to develop conceptual recall tests and perceptual repetition of memory tests (Blaxton, 1989). Besides, the perceptual-conceptual contrast is best conceived as (at least) two separate dimensions, rather than as a single continuum in which the two types of operations would necessarily trade-off against one another, for reasons cited by Weldon (1991; Weldon, Roediger, & Challis, 1989). Kuchinkel et al. (2005) investigated the neural effect of the repetition scenario of the emotional meaning of the words using event-related fMRI. The subject performs visual lexical tasks between nouns and orthographically phonologically legal non-words. Positive, neutral, and negative words were compared by each subject on parameters such as frequency, orthographic features, imageability, etc. Words show chiefly left hemisphere activation known to be present in semantic processing.

EYEWITNESS TESTIMONY

Eyewitnesses can provide very compelling legal testimony, but rather than recording experiences flawlessly, their memories are susceptible to a variety of errors and biases. They (like the rest of us) can make errors in remembering specific details and can even remember whole events that did not happen. In this module, we discuss several of the common types of errors, and what they can tell us about human memory and its interactions with the legal system. Eyewitness testimony is a legal term. It refers to an account given by people of an event they have witnessed. For example, they may be required to describe a trial of a robbery or a road accident someone has seen. This includes identification of perpetrators, details of the crime scene, etc. It is a potent form of evidence for convicting the accused, but it is subject to unconscious memory distortions and biases even among the most confident of witnesses. So memory can be remarkably accurate or remarkably inaccurate. Without objective evidence, the two are indistinguishable. But there's a big problem with eyewitness testimony—it can be inaccurate. And unfortunately, it can lead to wrongful convictions. While some research says eyewitness testimony is reliable, other studies have found problems with eyewitness ability to accurately recount the facts. As per Louisell et al. (1995), trial courts are generally unavailable and only appellate decisions are taken the testimony of eyewitness particularly in civil cases may have less rare than the paucity of the documentation. According to Miller, Lower & Bleechmore, 1978 other individuals could participate if their testimony was co-ordinated by a medical authority. The resolution is greatly influenced in the trial courts which became reluctant to accept the individual's eyewitness testimony.

REPETITIVE INFORMATION ON EYEWITNESS TESTIMONY

One important application of research was the effect of repetitive information in eyewitness testimony. Eyewitness Testimony is used as evidence in criminal trials in countries all over the world. Juries tend to pay extra attention to eyewitness testimony and generally see it as very trustworthy and convincing. However, a great deal of research in cognitive psychology tells us that, in general, people's memories are fairly fallible. It examines some of the psychological factors that can affect the accuracy of EWT. It is split into two main aspects:

- (a). Reconstructive Errors.
- (b). Leading Questions.

RECONSTRUCTIVE ERRORS

Many people believe that memory works something like a videotape. Storing information is like recording and remembering is like playing back what was recorded, with information being retrieved in much the same form as it was encoded. However, memory does not work in this way. It is a feature of human memory that we do not store information exactly as it is presented to us. Rather, people extract from information the gist or underlying meaning. In other words, people store information in a way that makes the most sense to them. We make sense of information by trying to fit it into schemas, which are a way of organizing information. Schemas are general-purpose 'packets' of knowledge that correspond to frequently encountered people, objects, or situations. They allow us to make sense of what we encounter so that we can predict what is going to happen and what we should do in any given situation. Schemas are a very effective way of processing information. Besides making the world more predictable, they remove the need to store similar information more than once.

LEADING QUESTIONS

There are several possible sources. For example, witnesses might confer with each other about what they saw, thereby contaminating each others' accounts. But the most problematic source of new information is the leading questions that may be asked by police and lawyers. A leading question is a question that contains information previously unknown to the witness. For example, a police officer that asks 'how many times did Joe Bloggs hit the victim?' is not only requesting information about an assault but incidentally conveying the idea that it was Joe Bloggs that hit the victim and not Joe Blow. This information has the potential to affect the witness' understanding of the event so that, when they are later asked who carried out the assault, the understanding that it was Joe Bloggs has been implanted in their recollection of what happened, and it is unlikely that a police officer or lawyer would ask such a blatantly leading question. However, the information suggested by real leading questions can be subtle and go unnoticed by the witness. Loftus carried out several studies in which participants were shown films of car crashes. Different groups of participants were asked slightly different questions about what they had seen. Loftus and her colleagues found that the different questions caused the participants to recall the events differently. For example, Loftus & Zanni (1975) found that asking the participants if they had seen 'the' broken headlight rather than 'a' broken headlight increased the likelihood that they would report seeing one, even though there was no broken headlight in the film.

Similarly, Loftus & Palmer (1974) found that participants who were asked how fast the cars were going when they 'smashed into' each other gave higher estimates of speed than participants who were asked how fast the cars were going when they 'hit' each other. In a further study, Loftus, Miller & Burns (1978) found that they were able to get some participants to recall having seen a sign by the road, even though there had been no sign shown. This study also showed that most participants were unaware that they had been misled, which helps to reduce the possibility that results like these are simply the result of demand characteristics. Loftus' basic position on eyewitness testimony is that, frequently, witness' accounts of what they have seen are little better than guesses. This finding was highly influential in the writing of The Devlin Report, which concluded that, unless the circumstances were highly unusual, eyewitness testimony should not result in a conviction in an English court in the absence of other corroborating evidence. However, not all researchers agree with Loftus' point of view. Some research has shown that, if the circumstances are right, witness recall can be extremely accurate. For example, Yuille & Cutshall (1986) examined the recall of witnesses to a shooting in a town in Canada. A man had attempted to rob a gun shop. During the robbery, the shop owner was shot. He returned fire, killing the would-be robber. The incident occurred in broad daylight, in front of a large number of witnesses. Some months after the event, Yuille and Cutshall tracked down the witnesses and asked to interview them. Fifteen of them agreed to take part in the study. Examining their accounts, Yuille and Cutshall made several important findings:

- The witnesses were able to recall the incident in a great deal of detail.
 - There was a very high level of agreement between the accounts given by the different witnesses.
 - The witness's accounts did not alter in response to leading questions.
- These findings are contrary to those that Loftus might lead us to expect. The reconstructive memory approach would suggest first, that the witness's memory of the event would fade with time, second that the witnesses' accounts would differ according to their different interpretations of the incident and, third, that the witnesses would be susceptible to leading questions. Such findings, which are obtained from real-world witnesses and hence are high in ecological validity cast doubt on the validity of Loftus' conclusions. However, it would be unwise to dismiss Loftus' research purely based on Yuille and Cutshall's findings. The incident witnessed by their participants was shocking, highly unusual, and was observed in ideal viewing conditions. The same is not true of most witness incidents. In general, the available research supports Loftus' view that witness testimony can be affected by leading questions, but only under certain circumstances:

- The witness believes the questioner knows what happened.
- The witness is unaware they may be misled.
- The misleading information concerns peripheral details of the incident, rather than central ones.
- The misleading information is not blatantly incorrect.

OBJECTIVES

- To elicit the evidence for supporting that during the remembrance of the particular scenario by an individual the presence of experiential knowledge can be detected by the neuro signature system used in the forensic application.
- To understand how the Experiential Knowledge of an individual of two different scenarios and its electrophysiological responses which is used in the forensic investigation purpose and are relevant during the remembrance of the incidence.

METHODS & MATERIALS

Sample

Subjects for the study were selected through the Purposive Sampling technique from Gandhinagar, Gujarat. The age group was 20-25 years. The total sample size was 42 i.e. 21 males & 21 females. All the individuals are supposed to share their incident that has happened in his/her life i.e. their Episodic Memory and on the other hand, a common incident that the individual has never experienced in which the individual is supposed to remember every scenario of the particular incident i.e. something a crime related scenario that he/she has never been committed in his/her entire life and it is called to be as the Repetitive Memory. Informed consent was taken from each subject.

Inclusion Criteria

- Individuals who are above 20 years old and below 25 years old.
- Individuals with knowledge and experience in experiencing the particular event-related scenario.
- Individuals who gave consent for BEOS profiling.

Exclusion Criteria

- Individuals below 19 years old and above 30 years.
- Individuals without knowledge and experience in recalling their incident.

(c) Individuals who haven't the consent for BEOS profiling.

Hypothesis

There will be a significant difference between the numbers of EK's due to the repetition of Probes.

Instrument

BEOS Profiling was conducted in the study. BEOS profiling is a technique primarily developed as a forensic tool for deception detection in suspects which was developed and tested by Dr. C. R. Mukundan. Analyzing the electrophysiological data recorded from the scalp of a subject, the test is expected to provide information on the presence of "experiential knowledge" of participation in any activity. The scientific basis of the test uses the distinction between recognition using familiarity or knowledge and remembrance of experience from autobiographical memory of the individual.

PROCEDURE

The objective of the study was to find out whether the experiential knowledge can be elicited on the repetitive memory in parallel with the episodic memory with the use of the certain forensic investigative method – Brain Electrical Oscillation Signature (B.E.O.S) Profiling. To fulfill the objective of the study, a proper format is decided upon. The format was to collect a narration of a particular incident experienced by the subject to make one set of probes for the episodic memory and to make another set of the repetitive memory to design the standard set of probes to be presented and tested on the subjects.

Phase I – Collection of the Information from the Subject

Information from the sample was collected through interviews to prepare two different scripts; one will be the common script A (based on a crime which they have never committed) and script B will be the subject's episodic memory-based script. The subject was supposed to memorize the entire Script A multiple times until the subject remembers the entire script. And script B will be presented once. This would help in the retrieval of the episodic memory of the entire scenario given by the subject.

Phase II – Designing of Probes

Once the specific episodic narrations of all 42 subjects and step by step detailed process were entered in notepad in the VASP system. Individuals episode was entered in the notepad in the VASP system, probes were designed in sequence. The standard set which has the repetitive memory script has consisted of 30 probes, divided into 5 scenarios including Control and Neutral Probes. The Specific sets consisted of 60 minimum and 90 maximum probes divided into 6 to 10 scenarios including Neutral and Control probes. Event Markers were given to each respective probe. The sets were uploaded into VASP after which the auditory probes were recorded, based on the gender. The recorded probes are then saved and uploaded into recorded probes in the VASP, which will automatically upload them into NSS for presentation during the BEOS testing.

Phase III – BEOS Recording

The subjects were brought to the BEOS lab for recording, according to the convenience of the subject. Once the subject is being brought to the BEOS lab, the following instructions were given to the subject. "At the very first the subject will be asked to seat comfortably in the chair. Before recording the temperature of the room was maintained. It was ensured that the temperature of the room was not hot and it was also ensured that the subject has removed his/her watches or any other metal things. The subject was asked to keep away any electronic devices as it may hamper the recording. The subject was seated comfortably in a wooden chair. The subject was asked to rest their arms on the armrest. The harness was worn around the subject's chest. Then the head cap with 32 channels was placed on the subject's head. The placement of the head cap was significant for proper recording. The saline gel was then infused into electrodes using a syringe with the blunt needle. The reference point is attached to the earlobe and using the connector the head cap is then connected to the amplifier. The subject is asked to close the eyes for a baseline recording which lasts for 2 minutes. After the baseline session, a BEOS session is conducted where the probes are presented. The subject is asked to close the eyes and then the probes will be presented to the subject. Each probe is presented and there is a gap of 6 seconds between the presentations of probes. The gap is because the brain requires 6 seconds to respond to each probe. And it was also instructed that subject should not sleep while recording, otherwise, the probe presentation will be stopped automatically. The recording will be done using the BEOS instrument to run both the scripts A and B for analysis.

After the recording of probes, the data analysis was done. Data analysis is a software-based analysis done by the Neuro Signature System itself. The analyzed data was then used to measure the number of EKs produced by the subjects in Episodic & Repetitive Based Experiences.

RESULT & ANALYSIS

- The data obtained based on the experiential knowledge on both the sets of the scripts were analyzed using the statistical measures i.e. the t-test & Mean Standard Deviation and the result will be obtained for the desired hypothesis. The objective of the research was to elicit the evidence for supporting that during the remembrance of the particular scenario by an individual the presence of experiential knowledge can be detected by the neuro signature system used in the forensic application and to understand how the Experiential Knowledge of an individual of two different scenarios and its electrophysiological responses which is used in the forensic investigation purpose and are relevant during the remembrance of the incidence.

After recording the response of 42 participants on their one episodic and the other repetitive events based experiences. A total of 84 recordings were done. The analysis of the data was done using N.S.S. version 6.2 automated software to measure the Experiential Knowledge responses by each individual.

- Experiential Knowledge - Activity related to remembrance of the experience triggered by the probe presented.

Table 1 explains the Mean and Standard Deviation of EK in Specific and Standard Probes. The numbers of EK's is more in "Specific Episodic Experience as compared with the numbers of EK's in Standard Repetitive Experience.

Set of Probes	Mean	Std. Deviation
Specific (Episodic Memory)	1.98	2.925
Standard (Repetitive Memory)	1.02	1.896

Table 2 indicates the Paired Sample t-test of EKs in Event Specific Script and Standard Script Probes.

Script of Probes	t	df	Sig. 2 tailed
Event Specific Script - Standard Script	4.634	123	.00

This indicates that there is a significant difference between the number of Experiential Knowledge on Standard Repetitive Experience process as compared to the Specific Episodic Experience due to probe repetition. Thus, the Experiential Knowledge of an individual of two different scenarios and its electrophysiological responses can be used in the forensic investigative purpose and are relevant during a remembrance of the incidence and also elicit the evidence for supporting that during the remembrance of the particular scenario by an individual the presence of experiential knowledge can be detected by the neuro signature system used in the forensic application. This shows the significant relevant difference between the Episodic Memory as well as the Repetitive Memory. From the above result it has shown BEOS Profiling has correctly elicited the maximum Rate of Experiential Knowledge in an episodic specific script as compared with repetitive standard script acquired by the normal subject during the exposure of two different scenarios using the appropriate probes facilitating such remembrance.

CONCLUSION

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. So, it can be concluded that BEOS Profiling can be used to get clarification regarding the particular case that has committed the crime or not. Also, the relevancy of the testimony of eyewitness could be identified through this investigative tool. Hence, continuous repetition of any information won't give any Experiential Knowledge until and unless the incident has been experienced by an individual. Also, criteria of third-degree can be excluded as well because sometimes police officials use third-degree torture to get a confession from a suspect even that particular crime has not been committed by the suspect. This can help the investigators to differentiate between the suspect, eyewitness, and the victim.

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