

Brain Fingerprinting

Introduction

- ▶ Brain Fingerprinting was developed and patented in 1995 by Dr. Lawrence A. Farwell.
- ▶ Is based on the theory that throughout any action, the brain plans, records, and executes all of the actions.
- ▶ "Brain Fingerprinting" is a controversial forensic science technique that determines whether specific information is stored in a subject's brain by measuring electrical brainwave responses to words, phrases, or pictures that are presented on a computer screen.

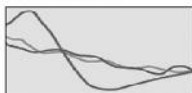
Technique

- ▶ Electrical signal known as P300 is emitted from an individual's brain beginning approximately 300 milliseconds after it is confronted with a stimulus of special significance.
- ▶ The application of this in brain fingerprinting is to detect the P300 as a response to stimuli.
- ▶ The system does not require the subject to issue verbal responses to questions or stimuli.
- ▶ brain fingerprinting uses cognitive brain responses, brain fingerprinting does not depend on the emotions of the subject, nor is it affected by emotional responses.

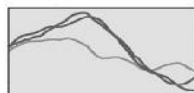
- ▶ The person to be tested wears a special headband with electronic sensors that measure the EEG from several locations on the scalp.
- ▶ The subject views stimuli consisting of words, phrases, or pictures presented on a computer screen. Stimuli are of three types:
 - "irrelevant" stimuli that are irrelevant to the investigated situation and to the test subject,
 - "target" stimuli that are relevant to the investigated situation and are known to the subject.
 - "probe" stimuli that are relevant to the investigated situation and that the subject denies knowing.



- ▶ A suspect is provided with information as follows :
 - Information the suspect is expected to know
 - Information suspect shouldn't know
 - Information of crime that only perpetrator would know



Not Guilty



Guilty

Electroencephalography

- ▶ Electroencephalography (EEG) is the measurement of electrical activity produced by the brain as recorded from electrodes placed on the scalp.
- ▶ Scalp EEG is collected from tens to hundreds of electrodes positioned on different locations at the surface of the head.
- ▶ EEG signals (in the range of milli-volts) are amplified and digitalized for later processing

Source of EEG Activity

- ▶ Scalp EEG activity oscillates at multiple frequencies having different characteristic spatial distributions associated with different states of brain functioning such as waking and sleeping.
- ▶ These oscillations represent synchronized activity over a network of neurons.

Method of EEG

- ▶ Scalp EEG, the recording is obtained by placing electrodes on the scalp.
- ▶ Each electrode is connected to one input of a differential amplifier and a common system reference electrode is connected to the other input of each differential amplifier
- ▶ In digital EEG systems, the amplified signal is digitized via an analog to digital converter



P300

- ▶ The P300 (P3) wave is an event related potential (ERP) which can be recorded via electroencephalography (EEG) as a positive deflection in voltage at a latency of roughly 300 ms in the EEG.
- ▶ The P300 signal is an aggregate recording from a great many neurons.
- ▶ P300 waveform must be evoked using a stimulus delivered by one of the sensory modalities

The Role of Brain Fingerprinting in Criminal Proceedings

- ▶ The application of Brain Fingerprinting testing in a criminal case involves four phases:
 - Investigation
 - Interview
 - Scientific
 - Testing
 - Adjudication
- ▶ Third -> the domain of science.(scientist)
- ▶ The first phase is undertaken by a skilled investigator
- ▶ The second by an interviewer (investigator or scientist)
- ▶ The fourth by a judge and jury.

Current Uses and Applications

The various applications are as follows:-

- ▶ Test for several forms of employment, especially in dealing with sensitive military and foreign intelligence screening.
- ▶ Individuals who were "information present" and "information absent"
- ▶ A group of 17 FBI agents and 4 non-agents were exposed to stimuli.

- ▶ To detect symptoms of Alzheimer's disease, Mental Depression and other forms of dementia including neurological disorders.
- ▶ Criminal cases.
- ▶ Advertisements (researches are being carried on).
- ▶ Counter-Terrorism.
- ▶ Security Testing.

Limitations of Brain Finger-Printing

- ▶ It does not detect how that information got there.
- ▶ Brain fingerprinting detects only information, and not intent.
- ▶ Where the suspect knows everything that the investigators can ask.
- ▶ Authorities have no information about what crime may have taken place.
- ▶ General pre-employment or employee screening wherein any number of undesirable activities or intentions may be relevant.

- ▶ Brain fingerprinting does not detect lies. It simply detects information.
- ▶ Brain fingerprinting does not determine whether a suspect is guilty or innocent of a crime. This is a legal determination to be made by a judge and jury, not a scientific determination to be made by a computer or a scientist.
- ▶ the limitations on human memory and the factors affecting it

