Brain Fingerprinting Technology

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Abstract—Brain fingerprinting is based on finding that the brain generates a unique brain wave pattern when a person encounters a familiar stimulus. Use of functional magnetic resonance imaging in lie detection derives from studies suggesting that persons asked to lie show different patterns of brain activity than they do when being truthful. Issues related to the use of such evidence in courts are discussed. It is a new computer-based technology to identify the perpetrator of a crime accurately and scientifically by measuring brain-wave responses to crime-relevant words or pictures presented on a computer screen. It has proven 100% accurate in over 120 tests, including tests on FBI agents, tests for a US intelligence agency and for the US Navy, and tests on real-life situations including felony crimes.

Keywords—Fingerprinting, Brain fingerprinting, P300, EEG (Electroencephalography), polygraph.

I. INTRODUCTION
Brain Fingerprinting was developed and patented in 1995 by Lawrence A. Farwell, Ph.D., chairman of the Brain Wave Institute in Fairfield, Iowa, and former Harvard University research associate. Brain fingerprinting is based on the theory that throughout any action, the brain plans, records, executes all of the actions. Such details, all concealed within the brain, can now be revealed through brain fingerprinting.

This technique measures how brain waves respond to specific words or pictures flashed across a screen. In the field of criminology, a new lie detector has been developed in the United States of America. This is called “brain fingerprinting”. This invention is supposed to be the best lie detector available as on date and is said to detect even smooth criminals who pass the polygraph test (the conventional lie detector test) with ease. The new method employs brain waves, which are useful in detecting whether the person subjected to the test, remembers finer details of the crime. Even if the person willingly suppresses the necessary information, the brain wave is sure to trap him, according to the experts who are very excited about the new kid on the block. It is designed to determine whether an individual recognizes specific information related to an event or activity by measuring electrical brain wave responses to words, phrases, or pictures presented on a computer screen. The technique can be applied only in situations where investigators have a sufficient amount of specific information about an event or activity that would be known only to the perpetrator and investigator. In this respect, Brain Fingerprinting is considered a type of Guilty Knowledge Test, where the “guilty” party is expected to react strongly to the relevant detail of the event of activity.

Farwell’s brain fingerprinting originally used the well-known P300 brain response to detect the brain’s recognition of the known information (Farwell and Donchin, 1986, 1991; Farwell
1995a). Later Farwell discovered the "memory and encoding related multifaceted electroencephalographic response" (MERMER), which includes the P300 and additional features and is reported to provide a higher level of accuracy than the P300 alone (Farwell and Smith, 2001; Farwell, 1994, 1995b). One of the applications is lie detection.

II. TECHNIQUE

A. P300

The technique uses an electrical signal known as P300 which is emitted from an individual’s brain beginning approximately 300 milliseconds after it is confronted with a stimulus of special significance. “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 300ms in the EEG.”

“The P300 signal is an aggregate recording from many neurons”. for example, a rare vs. a common stimulus or a stimulus the subject is asked to count (Gaillard and Ritter, 1983; Picton, 1988). The novel interpretation in brain fingerprinting is to look for P300 as response to stimuli related to the crime in question for example a murder weapon or a victim's face (Figures 1 and 2). Because it is based on EEG signals, the system does not require the testee to issue verbal responses to questions or stimuli.

B. P300-MERMER

Dr. Lawrence Farwell improvised on the P300 test. He recognized that the P300 is only a subcomponent of a more complicated response called a MERMER. A positive wave followed by a negative one. Tests using the MERMER produced no false negatives or positives and no indeterminate. The discovery of the P300-MERMER was one more step in the ongoing progression from very short latency evoked potentials to longer and longer latency event-related potentials as the stimuli and the processing demanded by the experimental task become more rich and complex.

What is MERMER?

![Figure 1: Victim’s facial expression](image1.png)

![Figure 2: Victim’s Stimulus](image2.png)

![Figure 3: Brain Wave](image3.png)
C. ELECTROENCEPHALOGRAPHY

Electroencephalography (EEG) is the measurement of electrical activity produced by the brain as recorded from electrodes placed on the scalp.

Different types of stimuli are used in this technique. There are three types of stimuli:
1) Irrelevant: Kind of stimuli those are irrelevant to the investigated situation and to test subject both,
2) Target: Kind of stimuli that are relevant to the investigated situation and are known to the subject.
3) Probe: Kind of stimuli that are relevant to the investigated situation and that the subject denies knowing.

III. EXPERIMENTAL DESIGN

Brain fingerprinting tests are conducted according to the following scientific protocols. In a brain fingerprinting test, stimuli are presented to the subject in the form of words, phrases, or pictures on a computer screen. Brain responses are measured non-invasively from the scalp, digitized, and analyzed to determine the presence or absence of information stored in the brain. Figure 1 outlines the stages of data acquisition and analysis in brain fingerprinting.

Three types of stimuli are presented: probes, targets and irrelevant. Probes have three necessary attributes.

1. Probes contain features of the crime that in the Judgment of the criminal investigator the perpetrators would have experienced in committing the crime.
2. Probes contain information that the subject has no way of knowing if he did not participate in the crime.
3. Probes contain information that the subject claims not to know or to recognize as significant for any reason.
IV. INSTRUMENTAL REQUIREMENTS

1. Personal Computer
2. A Data acquisition board
3. A Graphics Card for driving two monitors from one PC
4. A four-channel EEG amplifier system.
5. Software developed by the Brain Fingerprinting laboratories for the data acquisition and analysis.

V. COMPARISON OF WAVEFORM

A Suspect is tested by looking at three kinds of information represented by Different colored lines:

-----Red: information the suspect is expected to know
-----Green: information not known to suspect
-----Blue: information of the crime that only perpetrator would know.

NOT GUILTY:
1. Because the blue and green
2. Lines closely correlate, suspect does
3. Critical knowledge of the crime

GUILTY:
1. Because the blue and red
2. Lines closely correlate, and suspect does not
3. Critical knowledge of the crime.

VI. PHASES OF BRAIN FINGERPRINTING

There are four stages to Farwell brain fingerprinting which are similar to the steps in fingerprinting and DNA fingerprinting:

1. Brain fingerprinting crime scene evidence collection
2. Brain fingerprinting brain evidence collection
3. Brain fingerprinting computer evidence analysis
4. Brain fingerprinting scientific result.

Figure 6: Waveform of Brain Fingerprinting

VII. APPLICATIONS

The various applications are as follows:

1. Individuals who were “information present” and “Information Absent”.
2. A group of 17 FBI agents and 4 non-agents were exposed to stimuli.
3. To detect symptoms of Alzheimer’s diseases.
4. Criminal cases.
5. Advertisements (researches are being carried on).
6. Counter-Terrorism.

VIII. ADVANTAGES
1. Identify criminals quickly and scientifically.
2. Record of 100% accuracy.
3. Identify terrorists and members of gangs, criminals.
4. Reduce expenditure of money and other resources in law enforcement.
5. Reduce evasion of justice.

IX. DISADVANTAGES
1. Brain fingerprinting detects information processing brain responses that reveal what information is stored in the subjects brain. It does not detect how that information got there, be it a witness or a perpetrator.
2. Brain fingerprinting detects only information, and not intent. The fact that the suspect knows the uncontested facts of the circumstance does not tell us which party’s version of the intent is correct.
3. Brain fingerprinting is not applicable for general screening.
4. Brain fingerprinting does not detect lies. It simply detects information. No questions are asked a brain fingerprinting test, and the outcome of the test is unaffected by whether he has lied or answered during a brain fingerprinting test.
5. In the probe stimuli. Like all forensic science techniques, brain fingerprinting depends on the evidence-gathering process which lies outside the realm of science to provide the evidence to be scientifically tested. A DNA test determines only whether two DNA samples match, it does not determine whether the investigator did an effective job of collecting DNA from the crime scene. Similarly, a brain fingerprinting test determines only whether or not the information stored in the suspect's brain matches the information contained.

6. Brain fingerprinting is not a substitute for effective investigation on the part of the investigator or for commonsense and good judgment on the part of the judge and jury.

X. COMPARISON WITH OTHER TECHNOLOGIES
Conventional fingerprinting and DNA match physical evidence from a crime scene with evidence on the person of the perpetrator. Similarly, brain fingerprinting matches informational evidence from the crime scene with evidence stored in the brain. Fingerprints and DNA are available in only 1% of crimes. The brain is always there, planning, executing, and recording the suspect's actions. Brain fingerprinting has nothing to do with lie detection. Rather, it is a scientific way to determine if someone has committed a specific crime or other act. No questions are asked and no answers are given during Farwell brain fingerprinting. As with DNA and fingerprints,
the results are the same whether the person has lied or told the truth at any time.

XI. CONCLUSIONS

Brain Fingerprinting is a revolutionary new scientific technology for solving crimes, identifying perpetrators and exonerating innocent suspects, with a record of 100% accuracy in research with US government agencies, actual criminal cases, and other applications. The technology fulfills an urgent need for governments, law enforcement agencies, corporations, investigators, crime victims, and falsely accused innocent suspects.

REFERENCES


