

## **Artificial Intelligence Technology in the Field of Modern Forensic Evidence: Brain Fingerprinting as a Model**

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### **Abstract**

Brain Fingerprinting (BF) is one of the modern technologies that rely on artificial intelligence in the field of criminal evidence law. Brain information can be obtained accurately and reliably in criminal procedures without resorting to complex and multiple procedures or questions. It is not embarrassing for a person or even violates his human dignity, as well as gives immediate and accurate results. BF is considered one of the advanced techniques related to neuroscientific evidence that relies heavily on artificial intelligence, through which it is possible to recognize whether the suspect or criminal has information about the crime or not. This is done through Magnetic Resonance Imaging (EEG) of the brain and examining the signals emanating from a person's brain, which are called p300. The BF test does not prove guilt or innocence, but rather it provides information regarding what is stored in a person's memory about the crime, and the judge can use this information when ruling the case.

**Keywords:** AI, modern forensic evidence, brain fingerprinting, p300, MERMER, position of legislation and judiciary.

### **Introduction**

BF is considered a new computer-based technology to identify the perpetrator of a crime accurately and scientifically by measuring brain wave responses to words or images related to the crime displayed on a computer screen (Fikri, 2017, p.122; Al-Sayed, 2019, P.290). BF is grounded on the fact that the brain is the focus of all human actions and in the criminal act, there may be or there is not much physical evidence at a crime scene, but the brain is always there, planning, carrying out, and recording the crime (Khadija, 2022, p.10). The importance of the subject lies in its seriousness, the novelty of the issue understudy, the acceptability of evidence resulting from modern technology in criminal evidence in some countries, and the luck or scarcity of studies. This study is purposed at shedding light on modern scientific evidence, especially BF, in the field of modern criminal proof. BF is considered one of the advanced techniques related to neuroscientific evidence that relies heavily on artificial

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intelligence. This is done through magnetic resonance imaging (EEG) of the brain and examining the signals emanating from a person's brain, which are called p300 (Faisal, 2020, p.2; Al-Hani, 2013, P.80).

**Methods:** The present study relied on the descriptive and comparative analytical approach by examining legal Articles in various countries.

**The research question:** Can the judge use whatever modern scientific evidence he/she wants, including brain fingerprinting, so as to reach the truth? Or can that be considered a presumption? Based on that, a clear and frank position must be taken in order to reconcile the use of these methods.

### **Basic Concepts in Criminal Evidence and BF**

The rules of criminal proof in any system reflect the intellectual and cultural level of society. Additionally, the criminal proof system must balance the rights and freedoms of the accused individual as well as the right of society to punish (Ajaj, 2017, p. 42; Al-Hani, 2013, p. 88).

Under such a requirement, the following section will illuminate the concept of criminal proof in detail. According to modern criminal policy, the principle is that a person is innocent until proven guilty, which requires the availability of evidence based on certainty and not on doubt and guesswork within the limits of what the law stipulates (Fikri, 2017, p.126; Sorour, 1989, p.7; Halawa, 1996, p. 7) , acquittal indicates that there is doubt about the accusation. Criminal proof means, "establishing evidence with the competent authorities of a specific fact in the ways specified by the law in accordance with the rules to which it is subject." (Hassan, 2012, p.19). Some jurists (Al-Wafa, 2003, p.10) defines proof as an evidence used to either support or ascertain that something happened or that a person's statement is true in accordance with the requirements set by the legislator. As a result, concept of confession, experts, evidence of inspection and testimony (Munjid, 2023, p. 36) are all included in the legal and procedural term of proof. In addition, the evidence is produced by collecting evidence for the purpose of examining and auditing it in the first stage and presenting it to the judges to investigate. Also, if the evidence is sufficient to convict, the accused will be referred to the competent court. Then, the court's judge assesses the value of all traditional or scientific evidence and takes into account that evidence generates certainty according to his personal conviction to issue a sentence (Al-Malihi, 2019, p.18). A judicial system is divided into three basic doctrines of proof, which are addressed as follows:

**A. First Doctrine: The Free Proof Doctrine**

This doctrine is based on the freedom of proof by its entire means, without being restricted by specific means of proof determined by the law, as well as it allows a judge to have a broad discretion in accepting or rejecting the evidence. The Common law system (Swiss, American, German, and the former Soviet Union laws) all adopted this doctrine (Al-Malihi, 2019, p.21; Damaška, 1981, p. 343; Bousila, 2022, p.21; Vinusha, 2014, p. 1456; Al-Hawari, 2012, p.22). In the Arab legislation, Article (147) of The Act of Jordanian criminal of Procedure No.9 (1961) and the Act of Syrian criminal Procedure (1961) Article (175) Syrian law, have adopted this doctrine.

**B. Second Doctrine: The Restricted Proof Doctrine**

Historically, this doctrine is considered the oldest legal doctrine of proof. It originated in ancient Pharaonic and Roman laws. It was applied in France during the period of the barbarian invasion, and its effects are still present in America and Britain (Hassan, 2012, p.12). This doctrine is called “the legal approach,” (Subhi, 1991, p.28), which state that, the legislator has the main role in proof by specifying in advance the evidence presented in the lawsuit on which the criminal judge bases his/her ruling convicting an offender. The judge cannot use means of proof other than those specified by the law, and he/she cannot be convinced except with this evidence specified in the law. The judge determines the type of evidence, its value, and the procedures for submitting it to the judiciary. Opponents are obligated to present this evidence mentioned in the law and no other evidence. Additionally, legal jurists have called this doctrine the “negative doctrine of proof ,” because it limits the judge to the evidence he/she takes and no other evidence (Abu Daser, 2012, p.13).

**C. Third Doctrine: The Mixed Proof Doctrine**

This doctrine is based on combining the two previous doctrines. It allows a judge to direct the parties to the case and complete the missing evidence as well as clarify ambiguous points in the facts of the case before him/her (Bousila, 2022, p.13-14). Moreover, he takes the necessary evidentiary measures, as well as provided that they do not conflict with the judge’s adherence to the legally specified evidence (Hassan, 2012, p.19).

### **Modern Proof through Scientific Means**

In the modern era, criminal investigation has developed significantly to keep pace with the development of crime and the methods of committing it. In the past, the methods were characterized by violence, torture, and cruelty in order to reach evidence. However, in the present time, modern scientific methods have been used in order to reach evidence and reveal the truth (Korbatieh, 2019, p.50). Additionally, the first who predicted a system of scientific evidence was the jurist "Ferri", who indicates that the tremendous scientific progress in all fields, would be reflected in the fields of criminal study in general and criminal proof in particular. The jurist proposed a system of scientific criminal proof based on adopting modern scientific methods in order to search for evidence to prove and reveal the truth in the lawsuit, such as: hypnosis - use of drugs - recording blood pressure changes using a sphygmograph device (Salim, 2015, p.12; Omran, 2009, p.72; Sahib, 2022, p.55). However, the positivist school preferred the scientific proof system over other systems used in criminal legislation, and they predicted that, the scientific criminal proof system would replace the judge's system of freedom of personal conviction in the future. On the other hand, some criticize this development because the expert will become the judge of the case (Sahib, 2022, p.67-72), which will result in depriving the accused of the guarantees of individual freedom stipulated in the constitution and the law because the judge is considered the only one who can apply the guarantees of individual freedom. Likewise, the expert's performance of his work requires specifying the elements of his mission and then estimating the value of the report he submits. These are two judicial functions that are the responsibility of the judge alone, especially when adjudicating the criminal case; it raises legal issues that the expert cannot decide. (Salim, 2015, p.15). There are many modern means of proof, including fingerprints, voice, eye, genetic fingerprint, and others (Faisal, 2020, p.4). The researcher considers that it is not correct to exclude the judge's personal conviction system in the criminal proof system, but rather, it must work alongside the modern scientific proof system.

### **The Concept of Brain Fingerprinting Technology**

Forensic brainwave analysis or BF can add a revolutionary new dimension to criminal investigations to the world in convicting or acquitting the accused because the evidence in the brain is permanent and cannot be erased (Sultan, 2022, p. 25). This concept is addressed as follows:

The story began in 1995, when Mr. Lawrence A. Farwell at Harvard University, director and chief scientist at Brain Wave Science, IOWA, developed and patented BF technology for the first time. Brain fingerprinting is a forensic

technique that uses electroencephalography (EEG) to detect unique brain wave patterns that correspond to specific memories or knowledge (Burke, 1999, p.28) . This technique has been used to determine whether a suspect is aware of a specific crime or event. This technique is considered as a new (Huang et al., 2016, p.5) and relative. Nowadays, it is gaining popularity in the legal system. BF can be defined as, a mechanism or scientific method in forensic medicine to detect confidential information or hidden information stored in the brain by measuring the brain's electroencephalographic (EEG) responses, or brain waves, non-invasively with sensors attached to a headband placed on the scalp. This mechanism or technology includes displaying words, pictures, and video clips of various audio types related to the crime scene, and this is done as follows: (Vinusha, 2014, p. 1457)

- A sensor-equipped headset with two electrodes is placed on the head non-invasively or placed on the scalp covering the forehead between the eyebrows and the back of the head, where the brain stores experiential memory. One electrode is placed on the forehead, and the other on the back of the head. At this stage, this electrode is connected to a computer or laptop equipped with BF software via Bluetooth.

-Then, various types of images, words, phrases, videos and other relevant materials are displayed in a series or in an organized pattern containing salient details about a crime or investigating a situation on a digital screen ,which could be a computer, laptop or anything else. If the brain somehow recognizes this presentation or recognizes something important in this current context, the brain will send a specific, measurable brain response known as a P300 to the program (Dickson & McMahon, 2005, p. 208),Wave p300 was defined by Professor (Farwell) (Al-Sayed, 2019, p.1456) as a positive response that reaches its highest level in the middle parietal region of the brain at the top of the head, and also at the top of the back of the head. Positivity, from an electrical standpoint, means that the person has knowledge of the stimulus. Scientists agreed that there is a wave in the brain linked to memory and called p300. When a person learns something very important and wants to remember it and retrieve it when he/she needs it later, the brain wave p300 does this involuntarily. The response is characterized by a specific brain wave pattern, also known as a P300( Huang et al., 2016, p.297; Al-Sayed, 2019, p.1456) MERMER, which means "Multifaceted EEG Response Related to Memory and Encoding. It refers to the multi-faceted electrical memory of the brain related to concentration, and it is part of the brain wave. When the brain recognizes something, the memory centers and nerve cells are activated simultaneously, and thus clear changes occur in brain activity and are

thus measured using electrodes, and these are the changes that investigators are looking for. MERMER is picked up during that process, and that response helps in analyzing whether specific information is stored in that person's brain or not which helps in the investigation and collection of evidence (Goswami, 2023, p.13; Bhilota,Patel, 2013, p.163) . The BF does not detect guilt or innocence, and determine whether a person is guilty or not, it is a legal decision made by the judge and/or jury in countries that adopt this system, and not by a scientist or computer. Likewise, the BF does not detect whether the person committed the crime or not, it only reveals whether the person has information about the crime under investigation.(Farwell, 2012, p.204) The 30 minute test (Bhilota, 2013, p.164) involves three types of waves that emanate from the suspect's mind, which are classified according to the relationship of this data to the subject of the crime as follows: waves related to the subject of the crime, waves do not relate to the subject of the crime, waves that may be related to the subject of the crime.(Farwell, 2012, p.18; Mohammed-Abed, 2023, p. 706). However, the suspect is tested by looking at three types of information represented by different colored lines: Red: Information that the suspect is expected to know. Green: Information that cannot be doubted. Blue: Information about the crime that only the perpetrator knows. (Boya Ranganayakulu, 2022, p.6).

In 2012, scientists Lawrence A. Farwell, Drew C. Richardson, and Graham M. Richardson conducted BF studies comparing the P300-MERMER and P300 brainwave responses in detecting hidden information. Also, they compared the event-related brain potentials of the P300 and P300-MERMER in terms of (error rate/accuracy and statistical confidence) in four field/real-world studies. The study recommended that the accuracy, reliability and validity of BF results depend on the following scientific standards for BF (Bhilota, 2013, p.2; Farwell, 2012, p.2) .

### **The Characteristics of Brain Fingerprinting**

Experiments conducted by scientists have proven that it is possible to obtain evidence from the brain and mind with the assistance of artificial intelligence in an accurate manner. It can be relied upon in criminal procedures without resorting to complex and multiple procedures, or embarrassing methods for humans or violation of their human dignity. Scientists Allen J.J.B and Jacono have supported the validity of Lawrence A. Farwell's method of using BF in criminal proof. After conducting independent research, experiments and study statistics prove that the BF used in criminal cases enjoys high credibility and that this technique is not designed for use in the interrogation stage, because it does not require any questions or answers (Al-Hasani, 2017, p.239). It objectively reveals

whether certain information exists in the accused's brain or not, regardless of whether the statements he/she makes are false or true. In other words, it is the brain that speaks as the witness who does not make mistakes. One of the characteristics of BF is the presence of information about the crime in the perpetrator's brain, which he/she cannot tamper with or erase. Also, the use of this modern technology does not involve any violation of the suspect's body, as is the case with other modern technologies (Al-Hasani, 2017, p. 239). Additionally, the possibility of applying it to everyone, regardless of their psychological and physical condition, and it is not expensive and does not require time to conduct to obtain immediate results. Moreover, it can be applied to all crimes (Goswami, 2023, p.5). BF shortens time in the modern scientific criminal proof process, and most importantly, it does not violate human rights and dignity of the suspect. It is considered an effective means of achieving security and assisting justice in acquitting the innocent and convicting the guilty (Bousila, 2022, p.26). It is reliable in terms of the accuracy of the results in the BF technology system (Al-Sayed, 2019, p.300; Fanoos and Bkeet, 2022, p. 291).

### **The Validity of BF Technology from a Legislative and Judicial Perspective**

Countries have varied in adopting the BF in the field of criminal proof, despite the revolution brought about by this technology in the field of modern scientific criminal proof. Therefore, the position of the legislative and the judiciary from BF are discussed below.

In this section, we will address the legislative position in different countries from using BF as an evidence (Lighthart et al., 2021, p.4; Masoud Shuaib, 2019, p.7).

#### **Anglo-American System**

Under US law: - The American Human Genome Act, issued in 1993, permitted the use of genetic fingerprinting as a scientific method in the field of criminal proof, provided that it is necessary to reach the truth in a criminal case or investigation and that the matter is issued by a competent court (Al-Sayed, 2019, p.302). The court must evaluate the benefit of conducting the analysis or test, and balance them against the harm that may result from violating people's freedom. Correspondingly, the Genetic Privacy Law of the American state of Illinois has permitted, for example, taking a sample for genetic fingerprint analysis during an investigation or accusation without the person's consent. Likewise, a BF can be taken and it may be used as an acceptable evidence before the court (Al-Sayed, 2019, p.302).

### **Arabic Legislation System**

The Arabic laws do not clearly stipulate the scientific evidence generated by BF. However, the general rules contained in the laws of criminal procedure can be applied provided that this evidence is legitimate and not obtained by coercion in order to preserve the individual's right of privacy and dignity. Meaning this that the evidence obtained from a BF is not considered conclusive and authentic evidence if it is taken in the case of coercion (Munjid, 2023, p. 60). Under Iraqi law, Article 212 of the Criminal Procedure Code amended No. (23) of 1971 amended, stipulates, The court is not permitted, in its ruling, to rely upon a piece of evidence which has not been brought up for discussion or referred to during the hearing, nor is it permitted to rely on a piece of paper given to it by a litigant without the rest of the litigants seeing it. The judge cannot give a ruling on the basis of his personal knowledge. And Article 213, states, (A) the court's verdict in a case is based on the extent to which it is satisfied by the evidence presented during any stage of the inquiry or the hearing. Evidence includes admission reports, witness statements, written records of an investigation, other official discoveries, reports of experts and technicians, background information and other legally established evidence. (B) one testimony is not sufficient for ruling if it is not corroborated by background information or other convincing evidence or an admission from the accused. The exception to this rule is if the law specifies a particular way of proving a case, which must be followed, (C) states, the court can accept an admission only if it is satisfied with it.

The Iraqi legislature adopted the principle of not specifying criminal evidence, but it restricted that. However, Article 70 of the Criminal Procedure Code, allowed the investigating judge and investigator to conduct a fingerprint examination and a blood test; furthermore it allows the accused to be forced to undergo this examination against their will, as this can be relied upon as a legitimate legal presumption for the Iraqi judge to detect crimes using fingerprints, including BF. On the other hand, Evidence Law amended No. 107 of 1979, for the reasons required by the law, allowed the court to benefit from scientific progress in deducing evidence. Article 104 of the Iraqi Evidence Law gives the right to the Iraqi judge to benefit from modern scientific methods to derive judicial evidence, including fingerprints. The means of scientific advancement can be used in the process of deducing judicial evidence; provided that these methods are not at all inconsistent with human freedom unless they are conclusive proof, and the issue of leaving the assessment of these means to the trial court limits the power of these means (Ajaj, 2017, p.238; Hadi and Abdel Salam, 2020, p.238).



### **The Judiciary's Position on the Evidence Arising from the Use of BF.**

The judicial authority is of great significance in evaluating scientific evidence (Jumaa, 2022, p.263) due to its role in modern criminal proof, whether it follows the principle of self-conviction or the mixed doctrine of the criminal proof. The American judiciary and the Iraqi judiciary are presented in the section below.

#### **American judiciary**

BF technique has been applied in the United States of America, in the case *Harrington v. State 2001, Case No. PCCV 073247*. on August 5<sup>th</sup>, 1999. Dr. Lawrence Farwell conducted a BF test on murder suspect J.B. Grinder. The 30 minutes test of BF was designed to determine if Grinder's brain contained specific details of the rape and murder of Julie Hilton. After that, Drew Richardson, an FBI laboratory scientist, was the criminal investigator who developed the probe's catalysts (RW, 2017, p.339). The BF test found that the specific details of the crime were recorded in Grinder's brain and the result was "information present" with a statistical confidence of 99.9%. Given the results of the BF test and other evidence, Grinder faced an almost certain conviction and a very likely death sentence. One week after the BF test, Grinder pleaded guilty to the rape and murder of Julie Hilton in exchange for a life sentence without parole. He is currently serving this sentence. Additionally, Grinder confessed and later pleaded guilty to killing three other young women (RW, 2017, p.339).

It is noteworthy that the IOWA COURT judge in the United States of America accepted the BF as a scientific evidence to be taken as criminal evidence in the, *Harrington v. State (2001)* case. The ruling stated that the test relies on the effect of P300 waves, and physiological psychologists have studied the effect of P300 waves. It has been known for approximately more than twenty years, when its effect has been investigated in scientific circles. Consensus among these scientists was that the effect of these waves on suspects is correct and effective.

In US law, when using this technique in modern criminal proof, some conditions must be met according to the "*Daubert Standard*," (*Frye v. United States, 293 F. 1013 (D.C. Cir. 1923)*). Modern forensic evidence is evaluated based on several criteria: (1) Has this technology been tested? (2) Is this technology accurate? (3) Have analogues of this technique been reviewed and published? (4) Does this science have good acceptance in the scientific community (Khadija, 2022, P.38)?

The *Daubert Standard* provides a systematic framework for a trial court judge to assess the reliability and relevance of expert witness testimony before it is presented to a jury. Established in the 1993 U.S. Supreme Court case *Daubert v.*

*Merrell Dow Pharmaceuticals Inc.*, 509 U.S. 579 (1993), this standard transformed the landscape of expert testimony by placing the responsibility on trial judges to act as "gatekeepers" of scientific evidence. The Daubert case introduced a more comprehensive approach that requires judges to scrutinize not only the expert's methodology but also the underlying scientific principles. This shift aimed to curtail the admission of pseudoscientific or unreliable expert testimony. Therefore, judges are required to assess the methodology and reasoning behind an expert's opinions, rather than simply relying on the expert's credentials or reputation (Khadija, 2022, P.38). The US Federal Court has approved several criteria to determine the acceptability of scientific evidence from a forensic expert in general, including BF, which are as follows: that the expert be proficient in scientific material in the field of required expertise, that the expert's opinion be accurate and productive in the case, a statement of the extent of reliance on testimony, the expert and his discussion before the court, clarifying the extent of the possibility of error occurring in the procedures for carrying out the expert, explaining the extent of the possibility of fabricating charges, or treating the person with the sample unfairly (Khadija, 2022, p.38).

In one case, the Federal Supreme Court of the United States of America set several conditions for adopting scientific evidence in criminal matters and cases. These are: General acceptance of specialists, testing objectivity, monitoring the technology used, the experts must be characterized by honesty, trustworthiness, good reputation (Al-Sayed, 2019, p.299; Khadija, 2022 ,p. 25-30) and beware of technology (Al-Muhaimid and Al-Sawy, 2019, p.898). The US Federal Supreme Court indicates about the above conditions that the presence of some differences of opinion about the scientific method does not weaken its value in proof as long as the preponderant opinion supports the use of scientific methods in proof (Khadija, 2022, p.29) .

### **The Iraqi judiciary**

Under the Iraqi judiciary, the Iraqi legislature relied on the principle of the personal conviction (Al-Hawari, 2012, p.21; Al-Shammari, 2020, p.51), in the criminal proof system. According to this doctrine, the judge can prove crimes by any means of proof except for the cases that the law stipulates that they must be proven otherwise. The criminal judge rules the case according to the doctrine of personal conviction, and he/she has complete freedom to evaluate all the evidence obtained by modern criminal proof methods. In addition, he/he weighs all the evidence and rules with conviction and acquittal. Moreover, the Iraqi legislator did not explicitly refer to take the BF as evidence in criminal proof, but rather referred to the fingerprint in Article 70 of the Code of Criminal Procedure. Besides, the

Iraqi judiciary tends not to consider the fingerprint alone as sufficient evidence for conviction, but rather relies on it to strengthen other evidence. The judge has the discretion (Asya, 2011, p.61) to evaluate the criminal expert's report by proving or denying the accusation against the suspect, and the researcher, did not find a judicial ruling that took a BF due to the fact that this technique has not yet been applied in criminal evidence in Iraq.

### **Conclusion**

The current study demonstrated BF is one of the most essential techniques of artificial intelligence and technological development, which will have a major role in the future in the field of criminal proof for conviction and innocence. Despite the controversial issues, such an important technique enables establishing the identity of the real criminals in various crimes without violating human's dignity. The researcher of the present study recommends that the Iraqi legislator amend the Code of Criminal Procedure and allow the use of BF and other modern scientific evidence in the field of criminal proof due to its significance. Moreover, the researcher recommends that the Iraqi judiciary to adopt BF tests and consider them as an acceptable judicial presumption in a court along with other newly discovered evidence. The judge must weigh and evaluate this evidence in order to make a fair ruling on the accused.

Finally, this study opens prospects in the field of forensic methods in the investigation of crime

## References

- Abu Daser. (2012). *Proving the Criminal Case, a Comparative Study* [Kingdom of Saudi Arabia]. <https://www.scribd.com/document/440833506/-اثبات-الدعوى-الجنائية-دراسة-مقارنة-pdf>
- Ajaj, K. M. (2017). The Possibility of Using the Brain Imprint in the Criminal Proof in the Iraqi Law. *IOSR Journal of Humanities and Social Science*, 22(04), 42–44. <https://doi.org/10.9790/0837-2204074244>
- Al-Hani. (2013). BF technique and validity in criminal evidence. *Police Thought Magazine - Police Research Center - Sharjah Police General Command - UAE*, 22(2), 6–7. <https://doi.org/DOI:10.12816/0000132>
- Al-Hasani. (2017). *Principles of Modern Criminal Investigation* (1st ed.). Dar Al-Sanhouri Legal and Political Sciences. <http://www.daralsanhuri.com/home/bookdetails/Mjkz/Mg==>
- Al-Hawari. (2012). *Criminal Evidence* (1st ed.). Dar Al-Fikr and Law. [https://books.google.iq/books/about/أدلة\\_الإثبات\\_الجنائي.html?id=IMOFDwAAQBAJ&redir\\_esc=y](https://books.google.iq/books/about/أدلة_الإثبات_الجنائي.html?id=IMOFDwAAQBAJ&redir_esc=y)
- Al-Malihi. (2019). *The criminal proof system in Moroccan and comparative legislation:: A study of the controls of the criminal proof theory in light of scientific trends in modern means of proof*. Dār Nashr al-Ma‘rifah. [https://books.google.iq/books/about/نظام\\_الإثبات\\_الجنائي.html?id=cHj6zQEACAAJ&redir\\_esc=y](https://books.google.iq/books/about/نظام_الإثبات_الجنائي.html?id=cHj6zQEACAAJ&redir_esc=y)
- Al-Muhaimid and Al-Sawy. (2019). Recklessness in Criminal Proof Using Modern Technology in Light of the Provisions of Islamic Jurisprudence and Positive Law, a Contemporary Study. *Journal of the College of Islamic and Arab Studies for Girls in Damanhour*, 4(4), 939–998. <https://doi.org/10.21608/jcia.2019.85551>
- Al-Sayed. (2019). The validity of brain fingerprinting in criminal evidence. *Arab Journal for Security Studies*, 35(2), 291–304. <https://doi.org/https://doi.org/10.26735/16588428.2019.020>
- Al-Shammari. (2020). Evidence and its role in the criminal case, a comparative study. *Journal of Kufa Legal and Political Science*, 1(45/1), 127–192. <https://www.iasj.net/iasj/article/182339>
- Al-Wafa, A. (2003). The extent of the validity of the genetic fingerprint in criminal proof in positive law and Islamic jurisprudence, Modern Criminal Bureau. *Journal of College of Sharia & Islamic Studies*, 21(21), 30321. <https://doi.org/http://hdl.handle.net/10576/9332>
- Asya. (2011). *Judicial certainty and the authority to supervise it, a comparative study between jurisprudence, text and jurisprudence* [Mentouri University - Constantine]. file:///C:/Users/SFM/Downloads/ANAA3706.pdf
- Bhilota, P. (2013). Brain Fingerprinting. *International Journal of Research Publication and Reviews*, 4, 163–166. <https://doi.org/10.55248/gengpi.234.5.40436>
- Bousila. (2022). *The validity of brain fingerprinting in criminal proof*. Yahya Fares University/Medea.
- Boya Ranganayakulu, S. M. M. (2022). Brain Fingerprint Technology.

- International Research Journal of Modernization in Engineering Technology and Science*, 4(06), 2582–5208. [https://www.irjmets.com/uploadedfiles/paper/issue\\_6\\_june\\_2022/27189/final/fin\\_irjmets1656499429.pdf](https://www.irjmets.com/uploadedfiles/paper/issue_6_june_2022/27189/final/fin_irjmets1656499429.pdf)
- Burke. (1999). Brain Fingerprinting. *Law and Order*, 47(6), 28–31. <https://doi.org/10.23880/ijfsc-16000189>
- Damaška. (1981). free Proof and Its Detractors. *Journal of the Adelaide Botanic Gardens*, 43(3), 187–262. <https://doi.org/https://doi.org/10.2307/840641>
- Dickson, K., & McMahon, M. (2005). Will the law come running? The potential role of “brain fingerprinting” in crime investigation and adjudication in Australia. *Journal of Law and Medicine*, 13(2), 204–222. [https://www.researchgate.net/publication/7463563\\_Will\\_the\\_law\\_come\\_running\\_The\\_potential\\_role\\_of\\_brain\\_fingerprinting\\_in\\_crime\\_investigation\\_and\\_adjudication\\_in\\_Australia](https://www.researchgate.net/publication/7463563_Will_the_law_come_running_The_potential_role_of_brain_fingerprinting_in_crime_investigation_and_adjudication_in_Australia)
- Faisal. (2020). Brain Fingerprinting. *International Journal of Forensic Sciences*, 3(28), 1–4. <https://doi.org/10.23880/ijfsc-16000189>
- Fanoos and Bkeet. (2022). Deterritorialized States Within the Framework of Public International Law. *Social Science Journal Res Militaris*, 12(1), 2022. <https://resmilitaris.net/menu-script/index.php/resmilitaris/article/view/474>
- Farwell, L. A. (2012). Brain fingerprinting: A comprehensive tutorial review of detection of concealed information with event-related brain potentials. *Cognitive Neurodynamics*, 6(2), 115–154. <https://doi.org/10.1007/s11571-012-9192-2>
- Fikri. (2017). The criminal responsibility about acts Artificial intelligence. *Strategic Visions Magazine, Emirates Center for Strategic Studies and Research*, 4(13).
- Goswami. (2023). *Brain fingerprinting and evidentiary analogy What is brain fingerprinting*. <https://blog.ipleaders.in/brain-fingerprinting-and-evidentiary-analogy/>
- Hadi and Abdel Salam. (2020). The authority of the criminal judge in proving the authority of brain fingerprinting. *Journal of Imam Al-Kadhum College*, 4(1), 218–274. <https://www.iasj.net/iasj/search?query=au:%22م. زمن حامد هادي الحسناوي%22>
- Halawa. (1996). *Criminal Proof, Its Rules and Evidence, A Comparative Study with Islamic Sharia*. Arab Renaissance House. [https://books.google.iq/books/about/الإثبات\\_الجناي\\_قواعد.html?id=K9XJAAAA\\_CAAJ&redir\\_esc=y](https://books.google.iq/books/about/الإثبات_الجناي_قواعد.html?id=K9XJAAAA_CAAJ&redir_esc=y)
- Hassan. (2012). *Modern Scientific Evidence and its Role in Criminal Proof* [Middle East University]. [https://meu.edu.jo/libraryTheses/58b2b81a49289\\_1.pdf](https://meu.edu.jo/libraryTheses/58b2b81a49289_1.pdf)
- Huang, M., Daly, I., Jin, J., Zhang, Y., Wang, X., & Cichocki, A. (2016). An exploration of spatial auditory BCI paradigms with different sounds: music notes versus beeps. *Cognitive Neurodynamics*, 10(3), 201–209. <https://doi.org/10.1007/s11571-016-9377-1>

- Jumaa. (2022). The nature of digital evidence and its role in strengthening the judge's conviction. *Thi Qar Arts Journal*, 2(38), 251–273. <https://www.iasj.net/iasj/article/243433>
- Khadija, K. and. (2022). *The validity of brain fingerprinting in criminal proof* [Zian Ashour University - Djelfa]. [http://dspace.univ-djelfa.dz:8080/xmlui/bitstream/handle/123456789/5048/حجية\\_بصمة\\_المخ\\_في\\_الاثبات\\_الجناي.pdf?sequence=1&isAllowed=y](http://dspace.univ-djelfa.dz:8080/xmlui/bitstream/handle/123456789/5048/حجية_بصمة_المخ_في_الاثبات_الجناي.pdf?sequence=1&isAllowed=y)
- Korbatieh. (2019). *The law of evidence in the Islamic criminal justice system: a critical appraisal in the light of modern technology* (Issue November) [Macquarie University Sydney]. <https://figshare.mq.edu.au/ndownloader/files/34539569>
- Ligthart, S., Douglas, T., Bublitz, C., Kooijmans, T., & Meynen, G. (2021). Forensic Brain-Reading and Mental Privacy in European Human Rights Law: Foundations and Challenges. *Neuroethics*, 14(2), 191–203. <https://doi.org/10.1007/s12152-020-09438-4>
- Masoud Shuaib. (2019). *Scientific evidentiary evidence and its role in forming the criminal judge's conviction* [Kasdi-Mariah University - Ouargla]. <http://dspace.univ-ouargla.dz/jspui/handle/123456789/22220>
- Mohammed-Abed. (2023). International Child Abduction in the Framework of the Hague Conference on Private International Law. *Journal of Legal Sciences*, 37(Special issue for teachers and postgraduate students\_2 /), 698–724. <https://doi.org/https://doi.org/10.35246/jols.v38i2.691>
- Munjid. (2023). Criminal Protection for the Scientific Certificates in the UAE Law-A Comparative Analytical. *Journal of Legal Sciences*, 38(1). <https://doi.org/https://doi.org/10.35246/jols.v38i1.599>
- Omran. (2009). *Modern Scientific Methods in the Field of Criminal Proof* [Mentouri Fraternity University]. <https://bu.umc.edu.dz/theses/droit/AOMA2918.pdf>
- RW. (2017). Time to Take Brain-Fingerprinting Seriously? A Consideration of International Developments in Forensic Brainwave Analysis (FBA) , in the Context of the Need for Independent Verification of FBA's Scientific Validity, and the Potential Legal Implications of. *The Wharenga - New Zealand Criminal Law Review*, 6, 330–365.
- Sahib. (2022). *The personal judge's knowledge and its impact on criminal proof, a comparative study*. University of Baghdad.
- Salim. (2015). *Criminal Proof Using Modern Scientific Methods* [Arabi Ben Mahdi University/Oum El Bouaghi]. <https://revistas.ufrj.br/index.php/rce/article/download/1659/1508%0Ahttp://hipatiapress.com/hpjournals/index.php/qre/article/view/1348%5Cnhttp://www.tandfonline.com/doi/abs/10.1080/09500799708666915%5Cnhttps://mckinseysociety.com/downloads/reports/Educa>
- Sorour. (1989). *The Theory of Evidence in Islamic Criminal Jurisprudence* (5th ed.). Dar Al-Shorouk. [https://budsp.univ-saida.dz/index.php?lvl=notice\\_display&id=13031](https://budsp.univ-saida.dz/index.php?lvl=notice_display&id=13031)
- Subhi. (1991). *Al-Wajeez in the Principles of Jordanian Criminal Trials* (1st ed.).

- Dar Al-Thaqafa Publishing and Distribution Library. [https://books.google.iq/books/about/الوجيز\\_في\\_قانون\\_أصول\\_/QAACAAJ&redir\\_esc=y](https://books.google.iq/books/about/الوجيز_في_قانون_أصول_/QAACAAJ&redir_esc=y)
- Sultan. (2022). Controls for Transfer and Transplantation of Human Organs and Tissues in Sultanate of Oman-Reality and Hope. *Journal of Legal Sciences Home*, 37(2). <https://doi.org/https://doi.org/10.35246/jols.v37i2.545>
- Keywords:
- Vinusha, R. (2014). A breakthrough in criminal investigations using farwell brain fingerprinting. *Middle - East Journal of Scientific Research*, 19(11), 1455–1459. <https://doi.org/10.5829/idosi.mejsr.2014.19.11.11230>
- Abu Daser. (2012). *Proving the Criminal Case, a Comparative Study* [Kingdom of Saudi Arabia]. <https://www.scribd.com/document/440833506/اثبات-الدعوى-الجنائية-دراسة-مقارنة-pdf>
- Ajaj, K. M. (2017). The Possibility of Using the Brain Imprint in the Criminal Proof in the Iraqi Law. *IOSR Journal of Humanities and Social Science*, 22(04), 42–44. <https://doi.org/10.9790/0837-2204074244>
- Al-Hani. (2013). BF technique and validity in criminal evidence. *Police Thought Magazine - Police Research Center - Sharjah Police General Command - UAE*, 22(2), 6–7. <https://doi.org/DOI:10.12816/0000132>
- Al-Hasani. (2017). *Principles of Modern Criminal Investigation* (1st ed.). Dar Al-Sanhouri Legal and Political Sciences. <http://www.daralsanhury.com/home/bookdetails/Mjkz/Mg==>
- Al-Hawari. (2012). *Criminal Evidence* (1st ed.). Dar Al-Fikr and Law. [https://books.google.iq/books/about/أدلة\\_الإثبات\\_الجنائي\\_/id=IMOFDwAAQBAJ&redir\\_esc=y](https://books.google.iq/books/about/أدلة_الإثبات_الجنائي_/id=IMOFDwAAQBAJ&redir_esc=y)
- Al-Malihi. (2019). *The criminal proof system in Moroccan and comparative legislation:: A study of the controls of the criminal proof theory in light of scientific trends in modern means of proof*. Dār Nashr al-Maʿrifah. [https://books.google.iq/books/about/نظام\\_الإثبات\\_الجنائي\\_/id=cHj6zQEACAAJ&redir\\_esc=y](https://books.google.iq/books/about/نظام_الإثبات_الجنائي_/id=cHj6zQEACAAJ&redir_esc=y)
- Al-Muhaimid and Al-Sawy. (2019). Recklessness in Criminal Proof Using Modern Technology in Light of the Provisions of Islamic Jurisprudence and Positive Law, a Contemporary Study. *Journal of the College of Islamic and Arab Studies for Girls in Damanhour*, 4(4), 939–998. <https://doi.org/10.21608/jcia.2019.85551>
- Al-Sayed. (2019). The validity of brain fingerprinting in criminal evidence. *Arab Journal for Security Studies*, 35(2), 291–304. <https://doi.org/https://doi.org/10.26735/16588428.2019.020>
- Al-Shammari. (2020). Evidence and its role in the criminal case, a comparative study. *Journal of Kufa Legal and Political Science*, 1(45/1), 127–192. <https://www.iasj.net/iasj/article/182339>
- Al-Wafa, A. (2003). The extent of the validity of the genetic fingerprint in criminal proof in positive law and Islamic jurisprudence, Modern Criminal Bureau. *Journal of College of Sharia & Islamic Studies*, 21(21), 30321.

- <https://doi.org/http://hdl.handle.net/10576/9332>
- Asya. (2011). *Judicial certainty and the authority to supervise it, a comparative study between jurisprudence, text and jurisprudence* [Mentouri University - Constantine]. file:///C:/Users/SFM/Downloads/ANAA3706.pdf
- Bhilota, P. (2013). Brain Fingerprinting. *International Journal of Research Publication and Reviews*, 4, 163–166. <https://doi.org/10.55248/gengpi.234.5.40436>
- Bousila. (2022). *The validity of brain fingerprinting in criminal proof*. Yahya Fares University/Medea.
- Boya Ranganayakulu, S. M. M. (2022). Brain Fingerprint Technology. *International Research Journal of Modernization in Engineering Technology and Science*, 4(06), 2582–5208. [https://www.irjmets.com/uploadedfiles/paper/issue\\_6\\_june\\_2022/27189/final/fin\\_irjmets1656499429.pdf](https://www.irjmets.com/uploadedfiles/paper/issue_6_june_2022/27189/final/fin_irjmets1656499429.pdf)
- Burke. (1999). Brain Fingerprinting. *Law and Order*, 47(6), 28–31. <https://doi.org/10.23880/ijfsc-16000189>
- Damaška. (1981). free Proof and Its Detractors. *Journal of the Adelaide Botanic Gardens*, 43(3), 187–262. <https://doi.org/https://doi.org/10.2307/840641>
- Dickson, K., & McMahon, M. (2005). Will the law come running? The potential role of “brain fingerprinting” in crime investigation and adjudication in Australia. *Journal of Law and Medicine*, 13(2), 204–222. [https://www.researchgate.net/publication/7463563\\_Will\\_the\\_law\\_come\\_running\\_The\\_potential\\_role\\_of\\_brain\\_fingerprinting\\_in\\_crime\\_investigation\\_and\\_adjudication\\_in\\_Australia](https://www.researchgate.net/publication/7463563_Will_the_law_come_running_The_potential_role_of_brain_fingerprinting_in_crime_investigation_and_adjudication_in_Australia)
- Faisal. (2020). Brain Fingerprinting. *International Journal of Forensic Sciences*, 3(28), 1–4. <https://doi.org/10.23880/ijfsc-16000189>
- Fanoos and Bkeet. (2022). Deterritorialized States Within the Framework of Public International Law. *Social Science Journal Res Militaris*, 12(1), 2022. <https://resmilitaris.net/menu-script/index.php/resmilitaris/article/view/474>
- Farwell, L. A. (2012). Brain fingerprinting: A comprehensive tutorial review of detection of concealed information with event-related brain potentials. *Cognitive Neurodynamics*, 6(2), 115–154. <https://doi.org/10.1007/s11571-012-9192-2>
- Fikri. (2017). The criminal responsibility about acts Artificial intelligence. *Strategic Visions Magazine, Emirates Center for Strategic Studies and Research*, 4(13).
- Goswami. (2023). *Brain fingerprinting and evidentiary analogy What is brain fingerprinting*. <https://blog.ipleaders.in/brain-fingerprinting-and-evidentiary-analogy/>
- Hadi and Abdel Salam. (2020). The authority of the criminal judge in proving the authority of brain fingerprinting. *Journal of Imam Al-Kadhun College*, 4(1), 218–274. <https://www.iasj.net/iasj/search?query=au:%22م. زمن حامد هادي الحسناوي%22>
- Halawa. (1996). *Criminal Proof, Its Rules and Evidence, A Comparative Study with Islamic Sharia*. Arab Renaissance House.



- [https://books.google.iq/books/about/الإثبات\\_الجناي\\_قواعد.html?id=K9XJAAAA\\_CAAJ&redir\\_esc=y](https://books.google.iq/books/about/الإثبات_الجناي_قواعد.html?id=K9XJAAAA_CAAJ&redir_esc=y)
- Hassan. (2012). *Modern Scientific Evidence and its Role in Criminal Proof* [Middle East University]. [https://meu.edu.jo/libraryTheses/58b2b81a49289\\_1.pdf](https://meu.edu.jo/libraryTheses/58b2b81a49289_1.pdf)
- Huang, M., Daly, I., Jin, J., Zhang, Y., Wang, X., & Cichocki, A. (2016). An exploration of spatial auditory BCI paradigms with different sounds: music notes versus beeps. *Cognitive Neurodynamics*, 10(3), 201–209. <https://doi.org/10.1007/s11571-016-9377-1>
- Jumaa. (2022). The nature of digital evidence and its role in strengthening the judge's conviction. *Thi Qar Arts Journal*, 2(38), 251–273. <https://www.iasj.net/iasj/article/243433>
- Khadija, K. and. (2022). *The validity of brain fingerprinting in criminal proof* [Zian Ashour University - Djelfa]. [http://dspace.univ-djelfa.dz:8080/xmlui/bitstream/handle/123456789/5048/حجية\\_بصمة\\_المخ\\_في\\_الإثبات\\_الجناي.pdf?sequence=1&isAllowed=y](http://dspace.univ-djelfa.dz:8080/xmlui/bitstream/handle/123456789/5048/حجية_بصمة_المخ_في_الإثبات_الجناي.pdf?sequence=1&isAllowed=y)
- Korbatieh. (2019). *The law of evidence in the Islamic criminal justice system: a critical appraisal in the light of modern technology* (Issue November) [Macquarie University Sydney]. <https://figshare.mq.edu.au/ndownloader/files/34539569>
- Ligthart, S., Douglas, T., Bublitz, C., Kooijmans, T., & Meynen, G. (2021). Forensic Brain-Reading and Mental Privacy in European Human Rights Law: Foundations and Challenges. *Neuroethics*, 14(2), 191–203. <https://doi.org/10.1007/s12152-020-09438-4>
- Masoud Shuaib. (2019). *Scientific evidentiary evidence and its role in forming the criminal judge's conviction* [Kasdi-Mariah University - Ouargla]. <http://dspace.univ-ouargla.dz/jspui/handle/123456789/22220>
- Mohammed-Abed. (2023). International Child Abduction in the Framework of the Hague Conference on Private International Law. *Journal of Legal Sciences*, 37(Special issue for teachers and postgraduate students\_2 ), 698–724. <https://doi.org/https://doi.org/10.35246/jols.v38i2.691>
- Munjid. (2023). Criminal Protection for the Scientific Certificates in the UAE Law-A Comparative Analytical. *Journal of Legal Sciences*, 38(1). <https://doi.org/https://doi.org/10.35246/jols.v38i1.599>
- Omran. (2009). *Modern Scientific Methods in the Field of Criminal Proof* [Mentouri Fraternity University]. <https://bu.umc.edu.dz/theses/droit/AOMA2918.pdf>
- RW. (2017). Time to Take Brain-Fingerprinting Seriously? A Consideration of International Developments in Forensic Brainwave Analysis (FBA) , in the Context of the Need for Independent Verification of FBA's Scientific Validity, and the Potential Legal Implications of. *The Wharenga - New Zealand Criminal Law Review*, 6, 330–365.
- Sahib. (2022). *The personal judge's knowledge and its impact on criminal proof, a comparative study*. University of Baghdad.

- Salim. (2015). *Criminal Proof Using Modern Scientific Methods* [Arabi Ben Mahdi University/Oum El Bouaghi]. <https://revistas.ufrj.br/index.php/rce/article/download/1659/1508%0Ahttp://hupatiapress.com/hpjournals/index.php/qre/article/view/1348%5Cnhttp://www.tandfonline.com/doi/abs/10.1080/09500799708666915%5Cnhttps://mckinseyonsociety.com/downloads/reports/Educa>
- Sorour. (1989). *The Theory of Evidence in Islamic Criminal Jurisprudence* (5th ed.). Dar Al-Shorouk. [https://budsp.univ-saida.dz/index.php?lvl=notice\\_display&id=13031](https://budsp.univ-saida.dz/index.php?lvl=notice_display&id=13031)
- Subhi. (1991). *Al-Wajeez in the Principles of Jordanian Criminal Trials* (1st ed.). Dar Al-Thaqafa Publishing and Distribution Library. [https://books.google.iq/books/about/الوجيز\\_في\\_قانون\\_أصول\\_/id=aMLTcQAACAAJ&redir\\_esc=y](https://books.google.iq/books/about/الوجيز_في_قانون_أصول_/id=aMLTcQAACAAJ&redir_esc=y)
- Sultan. (2022). Controls for Transfer and Transplantation of Human Organs and Tissues in Sultanate of Oman-Reality and Hope. *Journal of Legal Sciences Home*, 37(2). <https://doi.org/https://doi.org/10.35246/jols.v37i2.545>
- Keywords:
- Vinusha, R. (2014). A breakthrough in criminal investigations using farwell brain fingerprinting. *Middle - East Journal of Scientific Research*, 19(11), 1455–1459. <https://doi.org/10.5829/idosi.mejsr.2014.19.11.11230>