

Jurnal Hukum Islam (JHI) is a scientific periodic journal with Print ISSN: 1829-7382; Online: 2502-7719 published by the Sharia Faculty of Universitas Islam Negeri K.H. Abdurrahman Wahid Pekalongan. This journal warmly welcomes contributions from scholars with related disciplines. Novelty and recency of issues, however, are the priority in publishing. The Islamic Law Journal is published in June and December every year. This journal has been indexed at a reputable international indexing

Indexed by:



ISSN : 1829-7382 E-ISSN : 2502-7719

Jurnal Hukum Islam

Volume 23, Nomor 1, June 2025

ISSN : 1829-7382

E-ISSN : 2502-7719

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of Inheritance in Sasak Tribe's Muslim Community**

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Published:
FACULTY OF SHARIA
UNIVERSITAS ISLAM NEGERI K.H. ABDURRAHMAN WAHID PEKALONGAN

Jurnal Hukum Islam

Nationally Accredited by Ministry of Research, Technology and
Higher Education, Number B/1796/E5.2/KI.02.00/2020

JOURNAL HISTORY

Jurnal Hukum Islam was established in 2007. Title with the title Jurnal Hukum Islam. Starting from Vol. 7 No. 1 (2009), this journal is only published two times a year using English language. The name of the journal with subtitles was changed to Jurnal Hukum Islam.

DESCRIPTION OF ISSUE

Issued every June and
December

ISSN

2502-7719 (Print) | 1829-7382 (Online)

Editor in Chief

Maghfur Ahmad

Managing Editor

Trianah Sofiani

Editor

Yunas Derta Luluardi

PUBLISHER

Faculty of Sharia
Universitas Islam Negeri K.H. Abdurrahman Wahid Pekalongan

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Kabupaten Pekalongan, Central Java, Indonesia, Postal Code 51161
E-mail: jhi@uingusdur.ac.id
Website: <https://e-journal.uingusdur.ac.id/jhi/index>

INDEXED

This journal has been indexed in SCOPUS, SINTA, DOI CrossRef, Google
Scholar, DOAJ, Dimensions

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Integrating Neurolaw and Principles of Islamic Law: A Scientific Ethical Model of Criminal Responsibility

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Abstract

Neurolaw offers an innovative interdisciplinary framework that bridges the gap between neuroscience and legal theory and providing new insights into how human brain influences behavior, intention, and moral decision-making. This study examines the intersection of neurolaw and Islamic law, emphasizing the importance of integrating neuroscience findings, such as brain function, decision-making processes, and mental disorders, into Islamic law's understanding of criminal responsibility, intention (*niyyah*), and reasoning (*'aql*). This study demonstrates the



potential of neurolaw to strengthen empathy, justice, and an evidence-based legal approach in Islamic law using normative legal research methods through legislative, conceptual, comparative, and futuristic approaches. Furthermore, this study explores how Islamic law's values of justice, objectivity, and responsibility can serve as ethical guidelines for the responsible use of neuroscience in legal reasoning. Ultimately, this study encourages a careful and principled integration of brain science and Islamic law that maintains fundamental Islamic values while embracing scientific advancements to create a more holistic and humane justice system.

KEYWORDS: *Brain Science; Islamic Law; Legal Responsibility; Neurolaw; Neuroscience*

Abstrak

Neurolaw menawarkan kerangka interdisipliner yang inovatif dan menjembatani kesenjangan antara ilmu saraf dan teori hukum, serta memberikan wawasan baru mengenai bagaimana otak manusia memengaruhi perilaku, niat, dan pengambilan keputusan moral. Penelitian ini mengkaji titik temu antara neurolaw dan hukum Islam, dengan menekankan pentingnya integrasi temuan ilmu saraf seperti fungsi otak, proses pengambilan keputusan, dan gangguan mental ke dalam pemahaman hukum Islam mengenai tanggung jawab pidana, niat (niyyah), dan kecakapan akal ('aql). Dengan menggunakan metode penelitian hukum normatif melalui pendekatan perundang-undangan, konseptual, komparatif, dan futuristik, studi ini menunjukkan potensi neurolaw dalam memperkuat empati, keadilan, dan pendekatan hukum berbasis bukti dalam hukum Islam. Lebih lanjut, penelitian ini mengeksplorasi bagaimana nilai-nilai keadilan, objektivitas, dan akuntabilitas dalam hukum Islam dapat menjadi pedoman etis dalam penggunaan ilmu saraf secara bertanggung jawab dalam penalaran hukum. Pada akhirnya, penelitian ini mendorong integrasi yang hati-hati dan berlandaskan prinsip antara ilmu otak dan hukum Islam agar tetap menjaga nilai-nilai fundamental Islam sambil merangkul kemajuan ilmiah, guna membentuk sistem peradilan yang lebih holistik dan manusiawi.

KATA KUNCI *Hukum Islam; Ilmu Saraf; Ilmu Otak; Neurolaw; Pertanggungjawaban hukum*

Introduction

At the beginning of the 21st century, neuroscience research has revealed how brain structure and function affect human behavior, decisions, and mental processes.⁵²⁷ In a legal context, these discoveries trigger profound questions about how this understanding can affect legal aspects such as the assessment of responsibility, the understanding of mental states, and even rehabilitation methods.⁵²⁸ Neurolaw is a growing field in which law, neuroscience, psychology, and ethics experts collaborate to explore the implications of neuroscientific findings for legal practice and policy.⁵²⁹ Questions of free will, responsibility, and moral capacity are the focus of the debate, prompting critical reviews of the way the legal system handles cases involving neurological and psychological conditions.⁵³⁰ Neurolaw not only provides new insights into the understanding of human behavior but also challenges and enriches the philosophical and practical foundations of contemporary law.

The development of neuroscience has led to a deeper understanding of how neuroscience findings can be integrated into legal practice to produce fairer and more evidence-based decisions.⁵³¹ Technological advances, such as brain imaging, have allowed researchers to observe previously inaccessible mental processes, opening the door to a better understanding of how biological factors influence human decisions and

⁵²⁷ Gerben Meynen, "Neurolaw: Neuroscience, Ethics, and Law," *Ethical Theory and Moral Practice* 17, no. 4 (2014): 819–29, <https://doi.org/10.1007/s10677-014-9501-4>.

⁵²⁸ Daniel Lawer Egbenya and Samuel Adjorlolo, "Advancement of Neuroscience and the Assessment of Mental State at the Time of Offense," *Forensic Science International: Mind and Law* 2 (2021): 1–9, <https://doi.org/doi.org/10.1016/j.fsimpl.2021.100046>.

⁵²⁹ Owen D Jones, Jeffrey D Schall, and Francis X Shen, "Law & Neuroscience: What, Why, and Where to Begin," *Law and Neuroscience*, 2016.

⁵³⁰ Georgia Gkotsi and Jacques Gasser, "Neuroscience in Forensic Psychiatry: From Responsibility to Dangerousness. Ethical and Legal Implications of Using Neuroscience for Dangerousness Assessments," *International journal of law and psychiatry* 46 (2016): 58–67, <https://doi.org/10.1016/j.ijlp.2016.02.030>.

⁵³¹ Georgia Martha Gkotsi and Jacques Gasser, "Neuroscience in Forensic Psychiatry: From Responsibility to Dangerousness. Ethical and Legal Implications of Using Neuroscience for Dangerousness Assessments," *International Journal of Law and Psychiatry* 46 (2016): 58–67, <https://doi.org/10.1016/j.ijlp.2016.02.030>.

behavior.⁵³² This aspect is particularly important in cases relating to mental capacity, such as the assessment of the defendant's mental state at the time of the crime.⁵³³

An interesting and complex integration is observed in linking neurolaw with Islamic law. Islamic law, which is based on the Quran and Sunnah, has traditionally emphasized intention, responsibility, and justice in a moral and spiritual context. Neurolaw, with its neuroscience-based approach, offers an additional perspective on how biological and neurological understanding can influence our understanding of these concepts.⁵³⁴ In Islamic law, understanding one's intentions and mental state is crucial in determining responsibility and punishment. Neuroscientific findings, such as an understanding of how brain structures influence decisions and behavior, can provide additional insights into Islamic law cases. For example, brain imaging can reveal neurological conditions that might affect a person's ability to make responsible decisions or understand the consequences of their actions. However, this integration also presents challenges.⁵³⁵ Islamic law has a highly structured framework with clear principles and rules that must be kept intact.⁵³⁶

Neurolaw can assist in exploring how mental conditions and neurological disorders can be considered in the legal system.⁵³⁷ This allows for the development of a more empathetic and individualized approach to

⁵³² Hans-W Muller-Gartner, "Imaging Techniques in the Analysis of Brain Function and Behaviour," *Trends in Biotechnology* 16, no. 3 (1998): 122–30, [https://doi.org/10.1016/S0167-7799\(97\)01163-3](https://doi.org/10.1016/S0167-7799(97)01163-3).

⁵³³ Robert J. Sbordone, Tony L. Strickland, and Arnold D. Purisch, "Neuropsychological Assessment," in *Handbook of Cross-Cultural Neuropsychology* (Boston: Springer Science & Business Media, 2000), 335, https://doi.org/10.1007/978-1-4615-4219-3_19.

⁵³⁴ Arian Petoft, "Neurolaw: A Brief Introduction," *Iranian Journal of Neurology* 14, no. 1 (2015): 53.

⁵³⁵ R James R Blair, "Neurocognitive Models of Aggression, the Antisocial Personality Disorders, and Psychopathy," *Journal of Neurology, Neurosurgery & Psychiatry* 71, no. 6 (2001): 727–31, <https://doi.org/10.1136/jnnp.71.6.727>.

⁵³⁶ Abdullah Saad Alarefi, "Overview of Islamic Law," *International Criminal Law Review* 9, no. 4 (2009): 707–31, <https://doi.org/10.1163/156753609X12487030862782>.

⁵³⁷ David R Lawrence, "Neurolaw—A Call to Action," *Cambridge Quarterly of Healthcare Ethics* 31, no. 4 (2022): 415–17, <https://doi.org/10.1017/S0963180122000123>.

determining punishment or legal resolution in accordance with principles of justice in Islamic law. From a practical perspective, the integration of neurolaw and Islamic law can provide guidance to judges and legal practitioners dealing with complex cases, and neuroscientific understanding can provide additional explanations for certain behaviors. This helps in making more informed and just legal decisions in line with the principles of justice in Islamic law. However, maintaining a balance between applying neuroscience findings and maintaining ethical and moral principles in Islamic law is challenging. This linkage requires a sensitive and reflective approach to ensure that modern knowledge and Islamic legal principles are integrated in a way that respects and enriches both.

Thus, the integration of neurolaw in Islamic law not only expands our understanding of law and human behavior but also raises important questions and dialogues on how the principles of justice and responsibility are applied in an increasingly evolving and complex context. Neurolaw's interrelationship with Islamic law not only presents an opportunity to enrich legal understanding but also offers an avenue to integrate contemporary scientific understanding into a rich and historical legal framework, strengthening legal practice with new insights that benefit society.

Several studies have examined the relationship between neuroscience and legal systems. Aharoni et al. explored the potential and limitations of neurological evidence in helping courts assess criminal responsibility, emphasizing the need for cautious interpretation due to ethical and scientific constraints.⁵³⁸ Chandler analyzed the use of neuroscientific evidence in Canadian criminal proceedings, highlighting procedural and

⁵³⁸ Eyal Aharoni, Chadd Funk, Walter Sinnott-Armstrong and Michael Gazzaniga, "Can Neurological Evidence Help Courts Assess Criminal Responsibility? Lessons from Law and Neuroscience," *Annals of the New York Academy of Sciences* 1124, no. 1 (2008): 145–60, <https://doi.org/10.1196/ANNALS.1440.007>.

constitutional challenges when neuromata are introduced in trials.⁵³⁹ Egbenya and Adjorlolo focused on how neuroscience can assist in the evaluation of mental states during an offense, particularly within the African legal context, stressing the importance of scientific assessments for ensuring fair trials.⁵⁴⁰ The current article is distinguished from these three studies by its specific integration of neuroscientific findings with Islamic legal principles, particularly the concepts of *niyyah* (intention) and *'aql* (mental capacity), grounded in Qur'anic values such as justice, objectivity, and responsibility. While previous studies were situated in secular Western and African legal frameworks, this study is pioneering in its normative, conceptual, and futuristic approach to harmonizing neurolaw with Islamic jurisprudence, thereby offering a novel contribution toward a more empathetic, just, and evidence-based Islamic legal system.

This research explores the normative and ethical integration of neuroscientific findings within the framework of Islamic law by examining how concepts such as intention (*niyyah*), mental capacity (*'aql*), and legal responsibility can be better understood and applied through insights from neurolaw. This study develops a comprehensive, principled approach that aligns modern brain science with the moral and doctrinal foundations of Islamic law. This research contributes to the advancement of a more empathetic, fair, and scientifically informed justice system in Islamic law, especially in assessing the culpability of individuals with mental or neurological impairments.

⁵³⁹ Jennifer A. Chandler, "The Use of Neuroscientific Evidence in Canadian Criminal Proceedings," *Journal of Law and the Biosciences* 2, no. 3 (2015): 550–79, <https://doi.org/10.1093/jlb/lsv026>.

⁵⁴⁰ Daniel Lawer Egbenya and Samuel Adjorlolo, "Advancement of Neuroscience and the Assessment of Mental State at the Time of Offense," *Forensic Science International: Mind and Law* 2 (2021): 1–9, <https://doi.org/10.1016/j.fsimpl.2021.100046>.

Methods

The applied research methodology is normative legal research, which includes conceptual, comparative, and futuristic approaches.⁵⁴¹ The conceptual approach is used to examine the foundational ideas, doctrines, and theories that form the basis of the relationship between neuroscience, law, and Islamic principles. The comparative approach analyzes and contrasts the integration of neurolaw principles within different legal systems and Islamic jurisprudence to identify similarities, differences, and potential best practices. Meanwhile, the futuristic approach is applied to anticipate the future development of legal norms considering emerging neuroscientific advancements, proposing legal innovations aligned with Islamic ethical values. This methodological framework enables a comprehensive and structured exploration of the research topic, ensuring that the study not only reflects the current state of knowledge but also contributes to the formulation of progressive legal thought responsive to scientific and societal changes. The nature of this research is descriptive-prescriptive,⁵⁴² which aims to explore and understand the interrelationship between neurolaw and principles of Islamic law. By combining insights from these two fields, this research seeks to show that a deep understanding of the brain and mental processes can contribute to increased empathy and fairness in legal practice. This approach offers a more informed and evidence-based way of implementing the law while acknowledging and considering the complexity of human behavior.

Discussion

Legal Responsibility and the Mystery of the Brain: A Neurolaw and Islamic Law Framework

⁵⁴¹ Erdianto Effendi et al., "Trading in Influence (Indonesia): A Critical Study," *Cogent Social Sciences* 9, no. 1 (December 2023): 1–13, <https://doi.org/10.1080/23311886.2023.2231621>.

⁵⁴² Herawan Sauni et al., "Beyond Borders: Shedding Light on Foreign Bribery through an Islamic Legal Lens," *Al-Istinbath: Jurnal Hukum Islam* 9, no. 2 (September 2024): 649–78, <https://doi.org/10.29240/JHI.V9I2.9752>.

Neurolaw is a field that produces products that combine neuroscience and the legal system.⁵⁴³ Neurolaw products cover various aspects, including the evaluation of individual responsibility in the legal system, the understanding of intention and consciousness, and the handling of cases involving neurological factors.⁵⁴⁴ Neurolaw is a neuropsychological evaluation tool that helps courts assess individuals' ability to make rational decisions and control their behavior.⁵⁴⁵ Neurolaw's products also include updated legal guides and guidelines that consider neuroscience findings in the judicial process. Neurolaw products play an important role in bridging the gap between science and the legal system, assisting courts in making informed decisions based on scientific evidence, and ensuring that the modern judicial process upholds the principles of fairness and responsibility.

Neurolaw products include various tools and innovations that integrate neuroscience with the legal system.⁵⁴⁶ One of these is a neuropsychological evaluation tool that assists courts in assessing an individual's ability to make decisions, control behavior, or understand the consequences of their actions. Neuroimaging technologies, such as functional magnetic resonance imaging (MRI) and electroencephalography (EEG), are used to understand the brain activity of individuals in certain situations, and these neuroimaging results can be used as evidence in legal cases.⁵⁴⁷ Functional MRI and EEG are two

⁵⁴³ Shane S Bush and Chriscelyn M Tussey, "Neuroscience and Neurolaw: Special Issue of Psychological Injury and Law," *Psychological Injury and Law* 6, no. 1 (2013): 1–2, <https://doi.org/10.1007/s12207-013-9144-0>.

⁵⁴⁴ Neil Krishan Aggarwal and Elizabeth Ford, "The Neuroethics and Neurolaw of Brain Injury," *Behavioral Sciences & the Law* 31, no. 6 (2013): 789–802, <https://doi.org/10.1002/BSL.2086>.

⁵⁴⁵ Elise Caccappolo, "The Neuropsychological Evaluation," in *Genetic Counseling for Adult Neurogenetic Disease: A Casebook for Clinicians* (Springer, 2014), 313–22, https://doi.org/10.1007/978-1-4899-7482-2_26.

⁵⁴⁶ Annabelle Belcher and Walter Sinnott Armstrong, "Neurolaw," *Wiley Interdisciplinary Reviews: Cognitive Science* 1, no. 1 (2010): 18–22, <https://doi.org/10.1002/WCS.8>.

⁵⁴⁷ Jay D. Aronson, "The Law's Use of Brain Evidence," *Annual Review of Law and Social Science* 6 (October 2010): 93–108, <https://doi.org/10.1146/ANNUREV-LAWSOCSCI-102209-152948>.

advanced neuroimaging technologies that play a key role in the understanding of human brain function, both in research and clinical applications. Functional MRI is a relatively new imaging technology that allows researchers and clinicians to monitor brain activity in real-time by measuring changes in blood flow associated with neuronal activity. This technique is very useful in identifying brain areas responsible for specific cognitive and emotional functions and in understanding how the brain works during various tasks and circumstances.⁵⁴⁸ EEG is a method that records the electrical activity of the brain through electrodes placed on the scalp. EEG is famous for its ability to temporally capture high-resolution data, which means it can track changes in brain activity over time very quickly.⁵⁴⁹ Therefore, EEG is a very useful tool for studying dynamic brain processes such as sleep, seizures, and other neurological disorders. Both functional MRI and EEG provide valuable insights into brain mechanisms, aid in the diagnosis and research of neurological and psychiatric conditions, and are increasingly being used in neurolaw research to strengthen the understanding of the relationship between the brain, behavior, and legal responsibility.

Current neuroscientific findings continue to reveal the complexity of the human brain and nervous system. An important finding is a deeper understanding of neuroplasticity, which is the brain's ability to change and adapt throughout one's life. This concept is a key aspect of modern neuroscience and demonstrates how the brain can change its structure and function in response to experience, learning, and various environmental conditions.⁵⁵⁰ There are several main forms of neuroplasticity:

⁵⁴⁸ John A Detre and Thomas F Floyd, "Functional MRI and Its Applications to the Clinical Neurosciences," *The Neuroscientist* 7, no. 1 (2001): 64–79, <https://doi.org/10.1177/107385840100700110>.

⁵⁴⁹ Andrea Biasiucci, Benedetta Franceschiello, and Micah M Murray, "Electroencephalography," *Current Biology* 29, no. 3 (2019): 80–85, <https://doi.org/10.1016/j.cub.2018.11.052>.

⁵⁵⁰ Jordan Grafman, "Conceptualizing Functional Neuroplasticity," *Journal of Communication Disorders* 33, no. 4 (2000): 345–56, [https://doi.org/10.1016/S0021-9924\(00\)00030-7](https://doi.org/10.1016/S0021-9924(00)00030-7).

- 1) Synaptic plasticity. Synaptic plasticity refers to the ability of the brain to change and adapt the way neurons or brain cells communicate with one another. This process occurs at the synapses, which are the contact points where one neuron transmits a signal to another. Through mechanisms such as learning and memory formation, synaptic connections can either strengthen or weaken over time. Strengthening of synaptic connections, often called long-term potentiation, enhances the efficiency of signal transmission between neurons, facilitating the activation of certain neural pathways. Conversely, the weakening of synapses, known as long-term depression, reduces the likelihood of signal transmission along specific pathways.⁵⁵¹ Synaptic plasticity illustrates the remarkable flexibility of the brain and underpins many cognitive functions, including learning, memory retention, emotional regulation, and problem-solving.
- 2) Structural plasticity. Structural plasticity refers to the capacity of the brain to undergo physical changes in its architecture in response to new experiences, learning, or injury. This form of plasticity involves the growth and reorganization of neuronal structures, such as the formation of new dendritic branches, the development of additional synapses, or even the generation of new neurons in certain brain regions. When individuals encounter novel experiences or challenges, the brain adapts by modifying its structural framework to support the acquisition of new skills or the recovery of lost functions.⁵⁵² Thus, structural plasticity plays a crucial role not only in learning and memory but also in rehabilitation and adaptation.
- 3) Functional plasticity. Functional plasticity refers to the remarkable ability of the brain to reassign functions from a damaged area to other undamaged regions. This adaptive mechanism becomes particularly vital following injury

⁵⁵¹ Lawrence G Appelbaum et al., "Synaptic Plasticity and Mental Health: Methods, Challenges and Opportunities," *Neuropsychopharmacology* 48, no. 1 (2023): 113–20, <https://doi.org/10.1038/s41386-022-01370-w>.

⁵⁵² Christos Pliatsikas, "Understanding Structural Plasticity in the Bilingual Brain: The Dynamic Restructuring Model," *Bilingualism: Language and Cognition* 23, no. 2 (2020): 459–71, <https://doi.org/10.1017/S1366728919000130>.

or trauma, such as a stroke or traumatic brain injury, where specific neural pathways may be disrupted. In response, other parts of the brain can reorganize themselves to compensate for lost functions, enabling individuals to regain abilities that were initially impaired, such as movement, speech, or memory. For example, if the area of the brain responsible for motor control is damaged, neighboring regions or even areas on the opposite hemisphere may gradually take over motor functions through rehabilitation and therapy. This capacity for functional reassignment highlights the dynamic and resilient nature of the brain and forms a critical foundation for neurological recovery processes.⁵⁵³ Understanding functional plasticity has implications for medical and therapeutic interventions, guiding the development of rehabilitation strategies to maximize recovery outcomes.

- 4) Compensatory plasticity. Compensatory plasticity refers to the brain's ability to develop alternative strategies or pathways to perform tasks previously managed by a damaged area. When specific brain regions are injured due to trauma, stroke, or disease, the brain not only relies on restoring the original functions but also actively seeks to compensate by reassigning tasks to other areas or creating new neural circuits. This adaptation enables individuals to relearn skills or regain lost abilities through mechanisms that differ from those originally used. Compensatory plasticity thus illustrates the brain's resilience and resourcefulness, providing a foundation for rehabilitation therapies aimed at harnessing these new pathways to support functional recovery and enhance the quality of life for affected individuals.⁵⁵⁴

Understanding neuroplasticity can provide important insights into how environmental factors and experiences influence behavior and decision-making abilities. Neuroscience has expanded our understanding

⁵⁵³ Carlo Sala and Menahem Segal, "Dendritic Spines: The Locus of Structural and Functional Plasticity," *Physiological Reviews* 94, no. 1 (2014): 141–88, <https://doi.org/10.1152/physrev.00012.2013>.

⁵⁵⁴ Ron Kupers and Maurice Ptito, "Compensatory Plasticity and Cross-Modal Reorganization Following Early Visual Deprivation," *Neuroscience & Biobehavioral Reviews* 41 (2014): 36–52, <https://doi.org/10.1016/j.neubiorev.2013.08.001>.

of the genetic influences on the development of neurological and psychiatric disorders. Genetic research has identified a number of genes involved in the development of conditions such as autism, schizophrenia, and Alzheimer's disease, thereby opening the door to more targeted and personalized treatments.⁵⁵⁵

Other recent findings in the field of neuroimaging have also allowed humans to look deeper into the human brain. Using techniques such as functional MRI enables researchers to understand the relationship between brain activity and cognitive and emotional functioning. This has applications in the diagnosis and treatment of mental disorders. Neurotechnology has brought great advances in the development of devices and therapies that can help individuals with neurological disorders. For example, developments in the field of brain-computer interface (BCI) allow people to control devices with their minds, opening up potential help for those with paralysis. In the neurolaw world, the BCI opens up revolutionary opportunities while posing significant ethical and legal challenges.⁵⁵⁶ As a technology capable of interpreting brain signals and converting them into computer commands, BCIs could have a major impact on the justice system. For example, the potential of BCIs to access and interpret a person's memories or knowledge could be used as evidence in legal cases, delving deeper into subjective aspects such as intention or honesty. It also allows for lie detection applications, providing new insights that could go beyond the boundaries of traditional lie detectors. However, the use of this technology in the legal realm raises serious questions about liability and freedom of will, especially if BCIs are used to influence or control behavior.⁵⁵⁷

⁵⁵⁵ Huda Y Zoghbi and Stephen T Warren, "Neurogenetics: Advancing the 'Next-Generation' of Brain Research," *Neuron* 68, no. 2 (2010): 165–73, <https://doi.org/10.1016/j.neuron.2010.10.015>.

⁵⁵⁶ Surjo R Soekadar, Klaus Haagen, and Niels Birbaumer, "Brain-Computer Interfaces (BCI): Restoration of Movement and Thought from Neuroelectric and Metabolic Brain Activity," in *Coordination: Neural, Behavioral and Social Dynamics* (Springer, 2008), 229–52, https://doi.org/10.1007/978-3-540-74479-5_11/COVER.

⁵⁵⁷ Aronson, "The Law's Use of Brain Evidence."

Understanding brain function and mental processes can have a significant impact on the concept of criminal liability in Islamic law, as found in Sharia law. In Islamic law, criminal liability relies heavily on the intention, consciousness, and mental capabilities of the individual involved in the criminal act. Some of the main points to be considered are as follows:

- 1) Intention (*niyyah*). In Islamic law, intention (*niyyah*) plays a central role in determining criminal liability, reflecting the principle that moral and legal responsibility depends not only on the external act but also on the internal motivation behind it.⁵⁵⁸ The culpability of a person is significantly influenced by malicious intent. Islamic law allows for the possibility of reduced or even nullified criminal liability if an individual commits an act without the requisite intention or malice. This emphasis on *niyyah* underscores the moral foundation of Islamic criminal law, which seeks to ensure that punishment is proportionate to the individual's true moral blameworthiness.⁵⁵⁹ Furthermore, developments in neuroscience, particularly in understanding mental processes related to decision-making and intention, can offer valuable insights to courts in evaluating a defendant's mental state. A deeper comprehension of how neurological and psychological factors influence intentions can assist judges in more accurately assessing responsibility, thereby promoting justice that aligns with legal and ethical standards in Islamic law.
- 2) Mental ability (*'aql*). In Islamic law, mental ability (*'aql*) is a fundamental factor in determining an individual's criminal responsibility. If an individual is found to be mentally impaired, suffering from an intellectual disability, or otherwise lacking the cognitive capacity to understand the nature and consequences of their actions, their criminal liability may be diminished or completely waived. This principle reflects the broader commitment of Islamic

⁵⁵⁸ Junaidi Abdillah et al., "Contribution Model of Al-Mas' Ūliyyah Al-Jinā'iyah in the Formulation of Criminal Liability in Indonesia's New Criminal Code," *Al-Ahkam* 34, no. 2 (2024): 367–92, <https://doi.org/10.21580/ahkam.2024.34.2.22592>.

⁵⁵⁹ Agustorido Gusto and Mar'ie Mahfudz Harahap, "Attempt to Commit Murder: A Comparative Study of Criminal Law and Islamic Criminal Law," *Syiah Kuala Law Journal* 8, no. 3 (2024), <https://doi.org/10.24815/sklj.v8i3.42472>.

jurisprudence to justice and fairness, ensuring that only those capable of rational thought and volition are subject to legal sanctions.⁵⁶⁰ In contemporary contexts, advancements in neuroscience and psychology provide valuable tools for assessing brain function and mental processes, offering empirical support for evaluating a defendant's mental state. By integrating scientific insights into legal practice, courts can more accurately determine whether an individual possesses the necessary mental competence (*'aql*) to be held criminally liable, thus aligning modern evidentiary approaches with the ethical and doctrinal foundations of Islamic law.

- 3) Consciousness (*idrak*). In Islamic law, an individual's level of consciousness at the time of committing a criminal act is a crucial factor in assessing criminal liability.⁵⁶¹ The perpetrator must be fully aware of their actions and the consequences thereof. If a person acts while in a state of unconsciousness, confusion, or diminished awareness due to illness, psychological conditions, the influence of intoxicants, or other impairments, their culpability may be reduced or even eliminated. Islamic jurisprudence recognizes that acts committed without full cognitive awareness do not reflect true moral blameworthiness because the individual lacks the essential element of volition and understanding.⁵⁶² In this context, modern insights into brain function and mental processes have become highly valuable, assisting courts in evaluating the degree of consciousness at the time the act was committed. It is possible to determine whether an individual was capable of forming intent and exercising control through neurological and psychological assessments, thereby ensuring that legal judgments are both fair and consistent with the ethical foundations of Islamic law.

⁵⁶⁰ Ian Grey et al., "Forensic Psychology and Islamic Jurisprudence," *Mental Health, Religion & Culture* 21, no. 1 (2018): 20–34, <https://doi.org/10.1080/13674676.2018.1437720>.

⁵⁶¹ Hajed A Alotaibi, "The Challenges of Execution of Islamic Criminal Law in Developing Muslim Countries: An Analysis Based on Islamic Principles and Existing Legal System," *Cogent Social Sciences* 7, no. 1 (2021): 1925413, <https://doi.org/10.1080/23311886.2021.1925413>.

⁵⁶² Omar Farahat, "Time and Moral Choice in Islamic Jurisprudence," *Canadian Journal of Law & Jurisprudence* 35, no. 1 (2022): 141–67, <https://doi.org/10.1017/cjlj.2021.22>.

The understanding of brain function and mental processes has grown rapidly in neuroscience and psychology. This understanding can help courts more fairly and accurately assess an individual's criminal responsibility by considering factors such as intent, mental ability, and consciousness.⁵⁶³ This is a crucial step in upholding justice within the Islamic legal system, while maintaining adherence to the principles of justice and mercy that underpin the law. A person's neurological or psychological condition, such as mental illness or brain damage, may affect Islamic law's assessment of an individual's responsibility for his or her actions. Islamic law emphasizes the moral responsibility of individuals for committing criminal acts.⁵⁶⁴ However, for individuals suffering from mental illness or brain damage, the concept of responsibility becomes more complex. In imposing punishment, key considerations involve the individual's ability to think rationally (*'aql*), intention (*niyyah*), awareness (*iqrar*), and the Islamic legal principle of wisdom (*hikmah*). In practice, the Islamic legal system often works with psychologists or psychiatrists to evaluate a person's mental state and the extent to which it affects their responsibility. This reflects the principles of justice, mercy, and wisdom, based on which Islamic law deals with individuals who are mentally impaired or brain-damaged. By providing insight into the role of the brain in the process of forming an individual's intention and consciousness, neuroscientific understanding can be used to evaluate intention and consciousness in the context of criminal offenses.

Some considerations on how neuroscientific understanding can be used in this regard are as follows:

First, understanding brain anatomy and function. Neuroscience, through its exploration of brain anatomy and function, offers critical

⁵⁶³ Aharoni et al., "Can Neurological Evidence Help Courts Assess Criminal Responsibility? Lessons from Law and Neuroscience."

⁵⁶⁴ Abdul Hamid et al., "The Intersection of Psychology and Islamic Law: Addressing Mental Health in Legal Decision-Making Processes," *The Journal of Academic Science* 1, no. 8 (December 2024): 1105–12, <https://doi.org/10.59613/QWDNN545>.

insights that are increasingly relevant in legal contexts, particularly in understanding the complexities of human behavior and mental processes.⁵⁶⁵ The brain comprises various regions, each of which is responsible for distinct functions. The frontal lobe, which is crucial for decision-making and problem-solving, and the amygdala, which is central to emotional processing, play significant roles in shaping behavior. This understanding is pivotal in legal settings, especially when considering the concept of intent, which is a key element in many criminal offenses. Neuroscience sheds light on how intent is formed in the brain, revealing whether it is a product of deliberate decision-making or influenced by mental illness or impaired cognitive functioning. Moreover, the way information is processed in the brain is crucial in assessing behavior. This encompasses perception, memory, and cognitive biases, all of which can affect the reliability of an individual's actions and eyewitness testimony. Understanding these aspects in legal proceedings can be critical in evaluating criminal responsibility. For instance, if a defendant has a brain condition that impairs judgment or control, this condition might affect their sentencing or capacity to stand trial. However, the integration of neuroscience in legal settings also brings forth ethical considerations, such as the balance between the utility of neuroimaging as evidence and the potential privacy concerns and misuse risks.⁵⁶⁶ As neuroscience continues to advance, it promises to offer deeper and more refined insights into the workings of the brain and its connection to behavior. This evolving knowledge can significantly influence legal practices and policies, particularly regarding the treatment of mental health issues within the criminal justice system. Neuroscience not only enriches our understanding

⁵⁶⁵ Leon Zurawicki, "Exploring the Brain," in *Neuromarketing: Exploring the Brain of the Consumer* (Springer, 2010), 1–53, https://doi.org/10.1007/978-3-540-77829-5_1.

⁵⁶⁶ Bibek Rajbhandari et al., "The Intersection of Neuroscience and Criminology: Role of Brain Mapping in Addressing Criminal Behavior by Nepal Police," *Journal of Nepal Medical Association* 62, no. 278 (September 2024): 709–11, <https://doi.org/10.31729/JNMA.8786>.

but also provides a more informed basis for judicial decisions concerning criminal responsibility and mental competence.

Second, identification of neurological disorders. Identification of neurological disorders is of paramount importance in legal settings, particularly for courts tasked with assessing an individual's capacity to form intentions or control their actions. Neurological impairments, often resulting from conditions such as traumatic brain injuries (TBI) or brain tumors, can have profound effects on behavior and decision-making processes.⁵⁶⁷ For example, a TBI can lead to significant alterations in personality, cognitive functions, and emotional regulation, potentially increasing impulsivity or diminishing the individual's ability to comprehend the consequences of their actions. Similarly, brain tumors can impair critical brain areas responsible for decision-making and impulse control depending on their location and size. This is particularly relevant in cases involving frontal lobe tumors, which could drastically affect an individual's ability to form intent or control actions in a legally acceptable manner. These neurological conditions present unique challenges in the legal sphere, as they raise questions about the extent to which affected individuals can be held fully responsible for their actions. In such cases, the courts must consider the impact of these disorders on the individual's behavior and intentions. Understanding the neurological basis of these changes is crucial for fair and informed judicial decision-making. A careful and nuanced approach that balances legal principles with medical insights is required to ensure that individuals with neurological impairments are treated with the appropriate level of understanding and compassion within the justice system.⁵⁶⁸ This intersection of neuroscience and law underscores the need for ongoing collaboration between medical

⁵⁶⁷ Martha E Shenton et al., "Mild Traumatic Brain Injury: Is DTI Ready for the Courtroom?," *International Journal of Law and Psychiatry* 61 (2018): 50–63, <https://doi.org/10.1016/j.ijlp.2018.09.002>.

⁵⁶⁸ Ian Freckelton QC, "Dilemmas for The Criminal Justice System in Dealing with Diagnoses for Neuropsychiatrically Impaired Offenders," *Forensic Research & Criminology International Journal* 8, no. 2 (2020): 64–75, <https://doi.org/10.15406/frcij.2020.08.00308>.

professionals and legal practitioners to ensure that the complexities of brain disorders are adequately and ethically considered in legal proceedings.

Third, understanding cognitive processes. Neuroscience has significantly enhanced our understanding of cognitive processes, such as decision-making and impulse control, and this knowledge has profound implications in the legal arena.⁵⁶⁹ Neuroscience provides courts with essential insights into an individual's mental state at the time of committing a crime by unraveling the complexities of brain functions during these cognitive processes. This deeper understanding aids in determining whether a person was acting rationally or whether biological factors influenced their actions. For instance, abnormalities in brain regions responsible for decision-making or impulse control might indicate that biological factors played a role in the individual's behavior, thereby affecting their ability to form rational intentions. This information is crucial for courts in assessing criminal responsibility as it can distinguish between crimes committed with clear intent and those influenced by compromised cognitive functioning. Consequently, the application of neuroscience in legal contexts ensures a more nuanced and informed approach to understanding criminal behavior, allowing for more equitable and just legal outcomes.

Fourth, effects of psychoactive substances. The neuroscientific exploration of how psychoactive substances impact brain function is particularly relevant in legal contexts, particularly in cases involving individuals who are under the influence of such substances during criminal offenses. Understanding the effects of alcohol, drugs, and other psychoactive agents on the brain is crucial for courts to accurately evaluate an individual's state of mind and level of control at the time of committing a crime. For instance, in cases of drunk driving or crimes committed under

⁵⁶⁹ Barbara Bottalico, "Cognitive Neuroscience, Decision Making and the Law," *European Journal of Risk Regulation* 2, no. 3 (2011): 427–32, <https://doi.org/10.1017/S1867299X00001458>.

the influence of drugs, neuroscience provides insights into how these substances alter cognitive functions, decision-making capabilities, and motor skills. This includes understanding the impairment of judgment, reduction in impulse control, and potential loss of consciousness that can occur with substance use.⁵⁷⁰ This knowledge is vital in determining the extent to which an individual's actions were voluntary or controlled. It aids in assessing criminal responsibility and intent, especially in determining whether the individual had the capacity to understand the consequences of their actions or to conform to the law's requirements. By incorporating neuroscientific evidence about the effects of psychoactive substances, courts can make more informed decisions, considering the accused's altered mental state due to substance use. This approach ensures a more nuanced and fair assessment of cases involving substance-induced criminal behavior, contributing to just and balanced legal outcomes.

Fifth, neuropsychological track record. Neuroscience, particularly through neuropsychological testing, offers a powerful tool for providing concrete evidence about an individual's cognitive abilities and potential neurological disorders, which holds significant value in legal settings.⁵⁷¹ These tests, which are designed to assess various aspects of cognition, such as memory, attention, problem-solving skills, and executive functioning, can yield critical insights into an individual's mental state and capacities. In court, this information becomes pivotal in evaluating an individual's ability to understand the consequences of their actions and their level of awareness regarding the criminal acts they commit. For example, neuropsychological evaluations can reveal impairments that might affect judgment or decision-making, thereby influencing an individual's criminal responsibility. The ability to demonstrate these cognitive limitations or

⁵⁷⁰ Keith J Yoder and Jean Decety, "The Neuroscience of Morality and Social Decision-Making," *Psychology, Crime & Law* 24, no. 3 (March 2018): 279–95, <https://doi.org/10.1080/1068316X.2017.1414817>.

⁵⁷¹ George F Koob, "Negative Reinforcement in Drug Addiction: The Darkness Within," *Current Opinion in Neurobiology* 23, no. 4 (2013): 559–63, <https://doi.org/10.1016/j.conb.2013.03.011>.

disorders through objective testing provides courts with a more robust basis for assessing the mental state of defendants. This approach ensures that a comprehensive understanding of the individual's neuropsychological profile informs legal decisions, particularly those concerning criminal responsibility and competency, leading to more just and appropriate outcomes in the judicial process.

Comparative Analysis of Global Neurolaw Practices

The development of neuroscience in various legal systems around the world has offered significant insights into how neuroscience can influence the interpretation and application of legal principles, particularly in relation to criminal responsibility, intent, and sentencing. Several landmark cases from different jurisdictions illustrate how courts have used neuroscientific evidence to ensure evidence-based justice that is attuned to human cognitive and psychological realities. A comparative analysis of these cases not only enriches the theoretical discourse on neurolaw but also provides practical models that may be adapted to other legal traditions, including Islamic law.

In the United States, one of the most cited cases involving neurolaw is *Roper v. Simmons* (2005). In this landmark decision, the US Supreme Court ruled that imposing the death penalty on individuals who were under 18 years old at the time of their crime was unconstitutional. Neuroscientific evidence played a pivotal role in this decision. Experts presented findings demonstrating that adolescent brains are not yet fully developed, particularly in areas related to impulse control, risk assessment, and moral judgment.⁵⁷² The Court acknowledged that because of these neurological immaturities, juveniles have a diminished culpability compared to adults, the application of the death penalty would violate the Eighth Amendment's prohibition on cruel and unusual punishment. This case marked a significant moment in the acceptance of neuroscientific

⁵⁷² Gui Xue et al., "Brain Imaging Techniques and Their Applications in Decision-Making Research," *Xin Li Xue Bao. Acta Psychologica Sinica* 42, no. 1 (February 2010): 120–37, <https://doi.org/10.3724/SP.J.1041.2010.00120>.

insights within constitutional adjudication and set a precedent for integrating brain science into criminal responsibility and sentencing determinations.

In Italy, the influence of neurolaw was demonstrated in a 2009 murder case commonly referred to as the Savona Case. The defendant, a woman who had committed homicide, received a reduced sentence after the court accepted neuroimaging evidence indicating structural brain abnormalities. Neuroimaging suggested impairments in brain areas associated with emotional regulation and impulse control, which could have influenced her behavior during the crime. This case is noteworthy for its incorporation of neuroscientific data as mitigating evidence and a crucial factor in the judicial process. The willingness of the Italian court to reduce the sentence based on such evidence reflects an evolving attitude toward scientific and psychological evidence within civil law jurisdictions. It also raises profound ethical and jurisprudential questions regarding the boundaries between neurological determinism and legal responsibility.⁵⁷³

India offers a contrasting stance through the Supreme Court's 2010 decision in *Selvi v. State of Karnataka*. In this case, the Court examined the legality of using neuroscientific techniques, such as *Brain Electrical Oscillation Signature* (BEOS) profiling, in criminal investigations. BEOS is a method that aims to detect experiential knowledge of a crime in the subject's brain patterns without requiring verbal responses. The Court ruled that such techniques violated the fundamental rights enshrined in the Indian Constitution, including the right against self-incrimination and the right to the privacy of thought.⁵⁷⁴ The Court emphasized that the involuntary administration of neuroscientific tests undermines individuals' ethical autonomy and mental sanctity. Thus, unlike the United

⁵⁷³ Elisabetta Sirgiovanni, Gilberto Corbellini, and Cinzia Caporale, "A Recap on Italian Neurolaw: Epistemological and Ethical Issues," *Mind and Society* 16, no. 1–2 (November 2017): 17–35, <https://doi.org/10.1007/S11299-016-0188-1/METRICS>.

⁵⁷⁴ Steven K. Erickson and Alan R. Felthous, "Introduction to This Issue: The Neuroscience and Psychology of Moral Decision Making and the Law," *Behavioral Sciences & the Law* 27, no. 2 (March 2009): 119–21, <https://doi.org/10.1002/BSL.858>.

States and Italy, India adopted a more cautionary and rights-based approach to neurolaw, prioritizing the protection of civil liberties over the perceived benefits of neuroscientific evidence.

The Canadian Supreme Court addressed the role of mental disorder in determining criminal responsibility in the case of *R. v. Bouchard-Lebrun* (2011). The case involved a defendant who committed a violent assault while under the influence of ecstasy. The patient had an undiagnosed underlying mental disorder, likely schizophrenia, which became symptomatic due to drug consumption. The Court acknowledged the influence of both the mental disorder and the intoxicating substance on the defendant's behavior. However, it held that temporary psychosis induced solely by voluntary intoxication would not qualify for exemption from criminal responsibility under Section 16 of the Canadian Criminal Code unless it was linked to a pre-existing mental illness. The court drew upon expert psychiatric and neurological testimony to evaluate the extent to which the defendant's cognitive functions and decision-making capacity were compromised. This case illustrates the nuanced approach adopted in Canadian law, where neuroscience is used as part of a broader evidentiary framework to assess criminal liability rather than as a sole determinant.⁵⁷⁵

From this comparative overview, it becomes clear that jurisdictions have adopted a variety of approaches to neurolaw research, depending on their legal traditions, constitutional principles, and levels of receptiveness to scientific innovation. While the United States and Italy have embraced neuroscience as a tool for advancing more compassionate sentencing, India has underscored the need for ethical safeguards and human rights protections. Meanwhile, Canada presents a balanced model that incorporates neuroscientific insights within a doctrinal and statutory framework. These global experiences provide valuable lessons for integrating neurolaw into other legal systems, including Islamic law. In

⁵⁷⁵ Vincent Laliberté et al., "When The Law Influences Medical Practice: Potential Impact of the Bouchard-Lebrun Ruling on the Forensic Unit of the Malartic Psychiatric Hospital in Northern Quebec, Canada," *International Journal of Law and Psychiatry* 76 (May 2021): 1–6, <https://doi.org/10.1016/J.IJLP.2021.101686>.

particular, they demonstrate how neuroscientific evidence can be harmonized with foundational legal values, such as justice, fairness, and moral responsibility, which are also central to Islamic jurisprudence.

Principles of Islamic Law in Neurolaw: Fairness, Objectivity, and Integrity

There are no verses in the Quran or Hadith that directly discuss or specifically refer to the concept of neurolaw because neurolaw, as a scientific discipline, is a more modern development. However, the principles and values in the Quran and Hadith, such as Surah *An-Nisa* verse 135, can guide in linking neuroscience with law in the Islamic framework:

“O believers! Stand firm for justice as witnesses for Allah even if it is against yourselves, your parents, or close relatives. Be they rich or poor, Allah is best to ensure their interests. So do not let your desires cause you to deviate from justice. If you distort the testimony or refuse to give it, then know that Allah is certainly All-Aware of what you do.”

Surah *An-Nisa* verse 135 has profound implications. Neurolaw explores how an understanding of the brain and human behavior can influence the legal system and emphasizes the importance of fairness and objectivity in assessing a person's actions and motives. This verse calls on humans to remain fair witnesses for Allah, even if it means testifying against themselves, their parents, or close relatives. In neurolaw practice, this could mean that legal decisions or judgments against a person should be based on objective evidence, including neuroscience findings, without allowing prejudice or self-interest to cloud decision-making.⁵⁷⁶ This principle of fairness becomes particularly important when neuroscience evidence is considered to understand a person's motives, intentions, and psychiatric capabilities in legal proceedings. For example, understanding

⁵⁷⁶ Eryn Brown, “The Brain, The Criminal and The Courts,” Knowable Magazine, 2019.

certain neurological conditions can help determine legal responsibility or organize more just and effective punishments.

Furthermore, this verse asserts that no difference in legal treatment should exist between the rich and the poor, demonstrating the importance of equality before the law. This underscores the importance of equal access to justice and the impartial use of neuroscience evidence in neurolaw studies.⁵⁷⁷ This verse, when applied in the context of neuroscience, emphasizes the importance of fairness, objectivity, and equality in the legal system by responsibly and fairly integrating neuroscience findings. It demands an impartial and evidence-based approach to assessing a person's responsibility and intentions to achieve justice in accordance with Islamic principles. Furthermore, Surah *Al-Maidah* Verse 8 reads as follows:

“O believers! Stand firm for Allah and bear true testimony. Do not let the hatred of a people lead you to injustice. Be just! That is closer to righteousness. And be mindful of Allah. Surely Allah is All-Aware of what you do.”

This verse has significant relevance. Neurolaw combines neuroscientific knowledge with legal practice to discuss how understanding the brain can help in legal assessments of human behavior. This verse calls for fairness and integrity, two critical aspects of neurolaw function.⁵⁷⁸ In legal practice, maintaining objectivity and fairness is often challenging, especially when there is prejudice or negative sentiment toward certain individuals or groups. In the context of neurolaw, this verse reminds humans that it is important not to allow prejudice or hatred to influence judgment in making legal decisions. For example, in a case where the judge might have changed his or her thoughts about a disagreement or a problem, neuroscientists can provide a more objective

⁵⁷⁷ Daniel D. Langleben and Jane Campbell Moriarty, “Using Brain Imaging for Lie Detection: Where Science, Law, and Policy Collide,” *Psychology, Public Policy, and Law* 19, no. 2 (2013): 222–34, <https://doi.org/10.1037/A0028841>.

⁵⁷⁸ Stephan Schleim, “Real Neurolaw in the Netherlands: The Role of the Developing Brain in the New Adolescent Criminal Law,” *Frontiers in Psychology* 11 (2020): 1–2, <https://doi.org/10.3389/FPSYG.2020.01762/BIBTEX>.

and non-biased view of the player's mental state and behavior. This verse also emphasizes the importance of being a true and fair witness. For example, when neurosurgeons use brain scans during surgery, their neuroscience expert witnesses must present their findings with integrity, without allowing personal bias or external pressure to influence their testimony. Next is Surah *Al-Hujurat* verse 13, which reads as follows:

O mankind, indeed We have created you from male and female and made you peoples and tribes that you may know one another. Indeed, the most noble of you in the sight of Allah is the most righteous of you. Indeed, Allah is Knowing and Acquainted.

This verse, which invites humanity to recognize and appreciate diversity between people, has deep implications in the context of neurolaw. It emphasizes that humans were created in various tribes and nations to know and respect each other and not engage in conflicts. In the practice of neurolaw, this means the importance of considering individual diversity, be it cultural, social, or biological, in assessing neurological behavior and conditions. Recognition of this diversity supports a more holistic and empathetic approach in the legal system, where neuroscientific evidence is used not only to identify "abnormalities" or deviance but also to understand the broader context of human behavior.⁵⁷⁹ Thus, a deep understanding of an individual's background and experiences is key in determining responsibility and fair punishment. Therefore, this verse encourages the practice of neurolaw to go beyond mere scientific and technical assessments, integrating broader insights about humanity, diversity, and the complexity of human behavior in accordance with the principles of justice, empathy, and respect for diversity taught in Islam. Next is Surah *Al-Isra* verse 36, which reads:

⁵⁷⁹ Langleben and Moriarty, "Using Brain Imaging for Lie Detection: Where Science, Law, and Policy Collide."

“Don't follow something you don't know. In fact, hearing, sight and conscience will all be held accountable.”

This verse provides an important message regarding responsibility and responsibility for knowledge, which is very relevant in the context of neurolaw. This verse emphasizes that individuals should not follow or make decisions based on things they do not fully understand, emphasizing the importance of a solid knowledge base and accurate information in every aspect of life, including in the legal system. In neurolaw practice, legal decisions, especially those relating to the assessment of criminal responsibility or punishment, must be based on a solid scientific understanding of brain function and human behavior.⁵⁸⁰ This paragraph encourages courts and parties in the legal system to responsibly use neuroscientific evidence, ensuring that the interpretation and application of such evidence are based on sound and valid knowledge. This also implies the need for transparency and caution in the use of neuroscientific evidence to avoid errors or mistakes in determining justice. In other words, this verse emphasizes that every neurolaw step and decision must be taken with full awareness of moral and ethical responsibilities and a deep understanding of the consequences that can arise from the use of neuroscientific knowledge in law.⁵⁸¹

Overall, when applied in the context of neurolaw, this verse emphasizes the importance of fairness, integrity, and objectivity in the legal system. This demands a fair and unbiased approach based on evidence and scientific knowledge to evaluate and understand human behavior as well as justice and piety in Islam.

Understanding the function of the brain and mental processes is highly significant in the context of neurolaw and Islamic law, especially in

⁵⁸⁰ Jennifer A. Chandler, Neil Harrel, and Tijana Potkonjak, “Neurolaw Today – A Systematic Review of The Recent Law and Neuroscience Literature,” *International Journal of Law and Psychiatry* 65 (2019): 1–12, <https://doi.org/10.1016/j.ijlp.2018.04.002>.

⁵⁸¹ S. Zeki et al., “The Brain and The Law,” *Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences* 359, no. 1451 (November 2004): 1727–36, <https://doi.org/10.1098/RSTB.2004.1545>.

assessing criminal responsibility. A hadith frequently referenced in this context is, *“Actions are but intentions, and every person will only get what they intended.”* This hadith, recorded in Sahih Bukhari and Muslim, is often regarded as one of the foundational hadiths underpinning Islamic principles. It emphasizes the importance of intention in all actions, including in legal and responsibility contexts. Imam Al-Bukhari begins his compilation of hadiths (Sahih Al-Bukhari) with this hadith, highlighting the importance of intention in all deeds. According to him, every deed not performed to seek Allah’s pleasure is considered invalid and devoid of reward. A renowned scholar, Imam Ash-Shafi’i, even stated that this hadith constitutes a third of all religious knowledge.

In Islam, the understanding of intention is not limited to acts of worship but also encompasses permissible (mubah) actions. These actions can become forms of worship and earn rewards with a righteous intention. For example, walking with the intention of maintaining health to better obey Allah’s commands is considered an act of worship. Scholars also discuss how intention can affect an action’s validity and acceptance. If an action is performed with a pure intention that later becomes tainted by a desire to show off or seek human praise, the reward can be lost. This underscores the importance of maintaining intention purity in every action. In the context of neurolaw, this understanding of mental processes such as intention is crucial, as it aids in determining the extent of an individual’s mental responsibility for their actions under Islamic law. The emphasis on intention also reflects the understanding that mental processes and psychological states influence a person’s actions and decisions, which is a key aspect of modern law and neurolaw.

Based on the values and principles explained in the Al-Quran and Hadith, the integration between neuroscience and Islamic law opens up new, challenging, and enriching insights. Neurolaw, as a relatively new discipline, offers a unique perspective on assessing responsibility and intent in a legal context. Al-Quran verses such as those contained in Surah

An-Nisa, Surah *Al-Maidah*, Surah *Al-Hujurat*, and Surah *Al-Isra* place a strong emphasis on the principles of justice, objectivity, and integrity. This agrees with the neurolaw goals, which seek to understand human behavior based on scientific evidence of brain function. On the contrary, the Hadith narrated in Sahih Bukhari and Muslim regarding the importance of intention in every action shows that a person's motivation and mental condition have an important role in determining legal responsibility in Islamic law. Neurolaw can provide additional insight in this regard, allowing the legal system to more accurately assess criminal intent and responsibility based on neuroscientific understanding.

The application of neurolaw therapy must also be carried out carefully to ensure that Islamic values and principles are respected. A balance between the use of scientific knowledge and the maintenance of ethical and moral principles in Islam is key to successfully integrating these two fields. Neurolaw, with its great potential, must be used to improve the fairness and effectiveness of the legal system while remaining grounded in the long-established foundations of justice, equality, and truth in Islamic teachings. Therefore, from an Islamic legal perspective, neurolaw is not only about the application of new knowledge in the legal system but also about how this knowledge can be used to strengthen the principles of justice and truth in Islamic law. Neurolaw offers a way to learn more about how people behave; however, it must be in line with Islamic legal values and principles. This will ensure that any future use of neurolaw is done responsibly and in line with Islamic teachings.

How is Neurolaw Integration in the Indonesian Legal System?

In the context of Indonesia, the integration of neurolaw into the national legal system must be viewed not merely as a matter of legal-technological adoption but as a constitutional and philosophical imperative grounded in the framework of the 1945 Constitution and Pancasila's values. Article 28I paragraph (1) of the Constitution guarantees

the right to life, the right not to be tortured, and the right to be free from inhumane and degrading treatment. These constitutional guarantees resonate with global ethical concerns about the potential abuse of neuroscientific techniques, such as coercive brain scans or non-consensual neuroimaging, as seen in India's *Selvi v. State of Karnataka*, where such practices were ruled unconstitutional.⁵⁸² In this regard, Indonesia must ensure that any use of neuroscience in the legal process upholds the integrity of human dignity (*martabat manusia*) and respects the right to mental privacy and personal autonomy.

Furthermore, Article 28D paragraph (1) of the Constitution guarantees every citizen the right to recognition, protection, and certainty of law as well as equal treatment before the law. This provision opens the normative gateway for integrating neuroscientific evidence, such as brain scans, neuropsychological assessments, and cognitive functioning reports, into the judicial process to better assess defendants' mental state and criminal responsibility. By doing so, the law not only becomes more accurate in identifying culpability but also more responsive to the individual conditions of those who suffer from mental illness or neurodevelopmental disorders. This approach ensures that justice is not only formal but also substantive, reinforcing the principles of proportionality and fairness in sentencing.

Philosophically, the values of Pancasila, especially the second and fifth principles: *Kemanusiaan yang adi dan berada* (Just and Civilized Humanity) and *Keadilan social bag silurus rayat Indonesia* (Social Justice for All Indonesians), serve as a moral compass for the incorporation of neurolaw in Indonesia. The second principle demands that the legal system treat individuals as human beings with cognitive, emotional, and psychological dimensions, not merely as abstract legal subjects. Meanwhile, the fifth principle calls for a justice system that reduces inequality, protects the vulnerable, and ensures that no individual

⁵⁸² Saikat Bhattacharya, "Selvi vs. State of Karnataka: A Critical Analysis," SSRN, 2017, 1–10, <https://doi.org/10.2139/ssrn.3629205>.

is punished beyond their actual capacity to understand or control their behavior. Neuroscience offers tools that can help legal actors better understand the mental and emotional state of offenders, especially those from marginalized communities who are often misjudged due to lack of access to psychological defense or expert evaluation.⁵⁸³

The development of neurolaw in Indonesia should be pursued through a deliberate and inclusive law reform agenda. This includes designing a comprehensive legal framework that regulates the admissibility, ethical boundaries, and procedural use of neuroscientific evidence in both criminal and civil proceedings. In tandem, judicial and prosecutorial training in forensic neuroscience, the creation of multidisciplinary panels involving legal scholars, neuroscientists, psychiatrists, and religious experts, and the development of standardized guidelines to interpret such evidence are urgently needed. Establishing oversight mechanisms to ensure that neuroscientific tools are not used as instruments of discrimination, coercion, or arbitrary sentencing is equally important.

In the broader perspective of legal reform, neurolaw also opens up discussions about the transformation of criminal law from a retributive model toward a more rehabilitative and restorative paradigm.⁵⁸⁴ The scientific recognition of diminished capacity or impulse-control disorders may shift the focus from punishment to treatment and reintegration,⁵⁸⁵ in line with Indonesia's vision of a humane correctional system. Moreover, the integration of neuroscience with Islamic legal thought, which emphasizes *'aql* (reason) and *niyyah* (intention) in determining criminal responsibility, presents an opportunity for Indonesia as the largest

⁵⁸³ Tuomas K. Pernu and Nadine Elzein, "From Neuroscience to Law: Bridging the Gap," *Frontiers in Psychology* 11 (2020): 1–23, <https://doi.org/10.3389/FPSYG.2020.01862/BIBTEX>.

⁵⁸⁴ Gregg D Caruso, *Neurolaw* (Cambridge University Press, 2024), <https://doi.org/10.1017/9781009271172>.

⁵⁸⁵ K Jayasankara Reddy, "Neuropsychology of Criminal Responsibility," in *Foundations of Criminal Forensic Neuropsychology: Bridging Mind, Law, and Criminal Justice* (Springer, 2025), 93–127, https://doi.org/10.1007/978-3-031-83771-5_5.

Muslim-majority country to pioneer a unique model of neuro-Islamic jurisprudence that is both scientifically informed and theologically grounded.

Ultimately, Indonesia is well-positioned to become a global leader in developing a contextualized and ethically responsible neurolaw model by learning from international experiences while anchoring its approach in constitutional mandates and Pancasila values. This model would not only enhance the quality of justice in individual cases but also reaffirm the nation's commitment to upholding human dignity, legal certainty, and social justice in an increasingly complex and neurotechnological world.

Conclusion

The integration of neurolaw into Islamic law is both theoretically plausible and normatively justified, provided that it is grounded in the ethical values and interpretive frameworks of Sharia. Rather than positioning neuroscience as a threat to the Islamic law tradition, this study demonstrates that the foundational Islamic concepts of *niyyah* (intention), *'aql* (mental capacity), and *taklif* (legal responsibility) are not only conceptually compatible with neuroscientific findings but also potentially enriched by them. In particular, the use of neuroscientific evidence to assess criminal responsibility aligns with the Qur'anic principles of fairness (*'adl*), moral discernment (*ta'addul*), and individualized justice. Therefore, neuroscience may serve as a powerful tool to support and deepen Islamic legal reasoning, particularly in cases involving mental disorders, diminished capacity, or neurodevelopmental impairments. However, while theoretical compatibility has been established, this research acknowledges that the practical implementation of neurolaw therapy within Islamic legal systems remains limited and fragmented. For neurolaw to become a meaningful part of Islamic adjudication, a multidisciplinary approach is required that involves not only Islamic

jurists (*fuqahā'*) and judges but also neuroscientists, psychologists, and ethicists.

Therefore, future research should move beyond conceptual inquiry and focus on the empirical analysis of how Islamic courts in contemporary Muslim-majority societies evaluate neuroscientific evidence. In particular, comparative studies across different *madhāhib* (schools of thought) and qualitative research involving courtroom practices, judicial reasoning, and expert testimony are necessary to develop a more operational and context-sensitive model of Islamic neurolaw. Additionally, research should explore the formulation of procedural safeguards and ethical guidelines that ensure that neuroscientific evidence is used responsibly and does not infringe upon Islamic values related to human dignity, privacy, or *mitral* (innate human nature). These recommendations also call for the inclusion of neurolaw topics within legal education curricula in Muslim countries, especially in sharia and Islamic law faculties, to cultivate legal professionals who are equipped to engage with modern scientific challenges in a manner that respects the integrity of the Islamic legal tradition. The future of neurolaw in Islam lies not in the passive reception of Western scientific models but in the active articulation of a distinctive, justice-oriented Islamic approach that bridges revelation and reason, tradition and innovation. In the Islamic context, neurolaw has the potential to grow beyond an interdisciplinary tool into a fully developed school of legal thought (*madhhab fikrah*) that integrates neuroscience, theology, and jurisprudence to reinterpret human accountability in a deeply humane, rational, and spiritually grounded manner. Such a vision invites Muslim legal scholars to lead global legal transformations by placing the Qur'anic ethos of justice, mercy, and human dignity at the forefront of cutting-edge scientific and legal integration.

References

Abdillah, Junaidi, Tri Nurhayati, Najichah Najichah, Lira Zohara, and Muchammad Tholchah. "Contribution Model of Al-Mas' Ūliyyah

- Al-Jinā'iyah in the Formulation of Criminal Liability in Indonesia's New Criminal Code." *Al-Ahkam* 34, no. 2 (2024): 367–92. <https://doi.org/10.21580/ahkam.2024.34.2.22592>.
- Aggarwal, Neil Krishan, and Elizabeth Ford. "The Neuroethics and Neurolaw of Brain Injury." *Behavioral Sciences & the Law* 31, no. 6 (2013): 789–802. <https://doi.org/10.1002/BSL.2086>.
- Aharoni, Eyal, Chadd Funk, Walter Sinnott-Armstrong, and Michael Gazzaniga. "Can Neurological Evidence Help Courts Assess Criminal Responsibility? Lessons from Law and Neuroscience." *Annals of the New York Academy of Sciences* 1124, no. 1 (March 2008): 145–60. <https://doi.org/10.1196/ANNALS.1440.007>.
- Alarefi, Abdullah Saad. "Overview of Islamic Law." *International Criminal Law Review* 9, no. 4 (2009): 707–31. <https://doi.org/10.1163/156753609X12487030862782>.
- Alotaibi, Hajed A. "The Challenges of Execution of Islamic Criminal Law in Developing Muslim Countries: An Analysis Based on Islamic Principles and Existing Legal System." *Cogent Social Sciences* 7, no. 1 (2021): 1925413. <https://doi.org/10.1080/23311886.2021.1925413>.
- Appelbaum, Lawrence G, Mohammad Ali Shenasa, Louise Stolz, and Zafiris Daskalakis. "Synaptic Plasticity and Mental Health: Methods, Challenges and Opportunities." *Neuropsychopharmacology* 48, no. 1 (2023): 113–20. <https://doi.org/10.1038/s41386-022-01370-w>.
- Aronson, Jay D. "The Law's Use of Brain Evidence." *Annual Review of Law and Social Science* 6 (October 2010): 93–108. <https://doi.org/10.1146/ANNUREV-LAWSOCSCI-102209-152948>.
- Belcher, Annabelle, and Walter Sinnott Armstrong. "Neurolaw." *Wiley Interdisciplinary Reviews: Cognitive Science* 1, no. 1 (2010): 18–22. <https://doi.org/10.1002/WCS.8>.
- Bhattacharya, Saikat. "Selvi vs. State of Karnataka: A Critical Analysis." *SSRN*, 2017, 1–10. <https://doi.org/10.2139/ssrn.3629205>.
- Biasiucci, Andrea, Benedetta Franceschiello, and Micah M Murray. "Electroencephalography." *Current Biology* 29, no. 3 (2019): 80–85. <https://doi.org/10.1016/j.cub.2018.11.052>.
- Blair, R James R. "Neurocognitive Models of Aggression, the Antisocial Personality Disorders, and Psychopathy." *Journal of Neurology, Neurosurgery & Psychiatry* 71, no. 6 (2001): 727–31. <https://doi.org/10.1136/jnnp.71.6.727>.
- Bottalico, Barbara. "Cognitive Neuroscience, Decision Making and the Law." *European Journal of Risk Regulation* 2, no. 3 (2011): 427–32. <https://doi.org/10.1017/S1867299X00001458>.
- Brown, Eryn. "The Brain, The Criminal and The Courts." Knowable

Magazine, 2019.

- Bush, Shane S, and Chriscelyn M Tussey. "Neuroscience and Neurolaw: Special Issue of Psychological Injury and Law." *Psychological Injury and Law* 6, no. 1 (2013): 1–2. <https://doi.org/10.1007/s12207-013-9144-0>.
- Caccappolo, Elise. "The Neuropsychological Evaluation." In *Genetic Counseling for Adult Neurogenetic Disease: A Casebook for Clinicians*, 313–22. Springer, 2014. https://doi.org/10.1007/978-1-4899-7482-2_26.
- Caruso, Gregg D. *Neurolaw*. Cambridge University Press, 2024. <https://doi.org/10.1017/9781009271172>.
- Chandler, Jennifer A., Neil Harrel, and Tijana Potkonjak. "Neurolaw Today – A Systematic Review of The Recent Law and Neuroscience Literature." *International Journal of Law and Psychiatry* 65 (2019): 1–12. <https://doi.org/10.1016/j.ijlp.2018.04.002>.
- Chandler, Jennifer A. "The Use of Neuroscientific Evidence in Canadian Criminal Proceedings." *Journal of Law and the Biosciences* 2, no. 3 (November 2015): 550–79. <https://doi.org/10.1093/jlb/lsv026>.
- Detre, John A, and Thomas F Floyd. "Functional MRI and Its Applications to the Clinical Neurosciences." *The Neuroscientist* 7, no. 1 (2001): 64–79. <https://doi.org/10.1177/107385840100700110>.
- Effendi, Erdianto, Zico Junius Fernando, Ariesta Wibisono Anditya, and M Jeffri Arlinandes Chandra. "Trading in Influence (Indonesia): A Critical Study." *Cogent Social Sciences* 9, no. 1 (December 2023): 1–13. <https://doi.org/10.1080/23311886.2023.2231621>.
- Egbenya, Daniel Lawer, and Samuel Adjorlolo. "Advancement of Neuroscience and the Assessment of Mental State at the Time of Offense." *Forensic Science International: Mind and Law* 2 (2021): 1–9. <https://doi.org/doi.org/10.1016/j.fsimpl.2021.100046>.
- Erickson, Steven K., and Alan R. Felthous. "Introduction to This Issue: The Neuroscience and Psychology of Moral Decision Making and the Law." *Behavioral Sciences & the Law* 27, no. 2 (March 2009): 119–21. <https://doi.org/10.1002/BSL.858>.
- Farahat, Omar. "Time and Moral Choice in Islamic Jurisprudence." *Canadian Journal of Law & Jurisprudence* 35, no. 1 (2022): 141–67. <https://doi.org/10.1017/cjlj.2021.22>.
- Gkotsi, Georgia Martha, and Jacques Gasser. "Neuroscience in Forensic Psychiatry: From Responsibility to Dangerousness. Ethical and Legal Implications of Using Neuroscience for Dangerousness Assessments." *International Journal of Law and Psychiatry* 46 (2016): 58–67. <https://doi.org/10.1016/j.ijlp.2016.02.030>.

- Grafman, Jordan. "Conceptualizing Functional Neuroplasticity." *Journal of Communication Disorders* 33, no. 4 (2000): 345–56. [https://doi.org/10.1016/S0021-9924\(00\)00030-7](https://doi.org/10.1016/S0021-9924(00)00030-7).
- Grey, Ian, Amraim AlMazrouei, Justin Thomas, and Patrick Randall. "Forensic Psychology and Islamic Jurisprudence." *Mental Health, Religion & Culture* 21, no. 1 (2018): 20–34. <https://doi.org/10.1080/13674676.2018.1437720>.
- Gusto, Agustorido, and Mar'ie Mahfudz Harahap. "Attempt to Commit Murder: A Comparative Study of Criminal Law and Islamic Criminal Law." *Syiah Kuala Law Journal* 8, no. 3 (2024). <https://doi.org/10.24815/sklj.v8i3.42472>.
- Hamid, Abdul, Lely Setyawati Kurniawan, Rajab Lesraluhu, Satria Yudistira, Islam Kalimantan Muhammad Arsyad Al-Banjari Banjarmasin, Universitas Udayana, Universitas Muhammadiyah Sorong, Provinsi Papua Barat Daya, Stai Miftahul Huda Pamanukan Subang, and Yayasan Abhipraya. "The Intersection of Psychology and Islamic Law: Addressing Mental Health in Legal Decision-Making Processes." *The Journal of Academic Science* 1, no. 8 (December 2024): 1105–12. <https://doi.org/10.59613/QWDNN545>.
- Jones, Owen D, Jeffrey D Schall, and Francis X Shen. "Law & Neuroscience: What, Why, and Where to Begin." *Law and Neuroscience*, 2016.
- Koob, George F. "Negative Reinforcement in Drug Addiction: The Darkness Within." *Current Opinion in Neurobiology* 23, no. 4 (2013): 559–63. <https://doi.org/10.1016/j.conb.2013.03.011>.
- Kupers, Ron, and Maurice Ptito. "Compensatory Plasticity and Cross-Modal Reorganization Following Early Visual Deprivation." *Neuroscience & Biobehavioral Reviews* 41 (2014): 36–52. <https://doi.org/10.1016/j.neubiorev.2013.08.001>.
- Laliberté, Vincent, Maxine Aird, Ugo Gilbert Tremblay, and Sébastien Gendron. "When The Law Influences Medical Practice: Potential Impact of the Bouchard-Lebrun Ruling on the Forensic Unit of the Malartic Psychiatric Hospital in Northern Quebec, Canada." *International Journal of Law and Psychiatry* 76 (May 2021): 1–6. <https://doi.org/10.1016/J.IJLP.2021.101686>.
- Langleben, Daniel D., and Jane Campbell Moriarty. "Using Brain Imaging for Lie Detection: Where Science, Law, and Policy Collide." *Psychology, Public Policy, and Law* 19, no. 2 (2013): 222–34. <https://doi.org/10.1037/A0028841>.
- Lawrence, David R. "Neurolaw—A Call to Action." *Cambridge Quarterly of Healthcare Ethics* 31, no. 4 (2022): 415–17. <https://doi.org/10.1017/S0963180122000123>.

- Meynen, Gerben. "Neurolaw: Neuroscience, Ethics, and Law." *Ethical Theory and Moral Practice* 17, no. 4 (2014): 819–29. <https://doi.org/10.1007/s10677-014-9501-4>.
- Muller-Gartner, Hans-W. "Imaging Techniques in the Analysis of Brain Function and Behaviour." *Trends in Biotechnology* 16, no. 3 (1998): 122–30. [https://doi.org/10.1016/S0167-7799\(97\)01163-3](https://doi.org/10.1016/S0167-7799(97)01163-3).
- Pernu, Tuomas K., and Nadine Elzein. "From Neuroscience to Law: Bridging the Gap." *Frontiers in Psychology* 11 (2020): 1–23. <https://doi.org/10.3389/FPSYG.2020.01862/BIBTEX>.
- Petoft, Arian. "Neurolaw: A Brief Introduction." *Iranian Journal of Neurology* 14, no. 1 (2015): 53.
- Pliatsikas, Christos. "Understanding Structural Plasticity in the Bilingual Brain: The Dynamic Restructuring Model." *Bilingualism: Language and Cognition* 23, no. 2 (2020): 459–71. <https://doi.org/10.1017/S1366728919000130>.
- QC, Ian Freckelton. "Dilemmas for The Criminal Justice System in Dealing with Diagnoses for Neuropsychiatrically Impaired Offenders." *Forensic Research & Criminology International Journal* 8, no. 2 (2020): 64–75. <https://doi.org/10.15406/frcij.2020.08.00308>.
- Rajbhandari, Bibek, Sushant Regmi, Kanchan Dahal, and Sandesh Shrestha. "The Intersection of Neuroscience and Criminology: Role of Brain Mapping in Addressing Criminal Behavior by Nepal Police." *Journal of Nepal Medical Association* 62, no. 278 (September 2024): 709–11. <https://doi.org/10.31729/JNMA.8786>.
- Reddy, K Jayasankara. "Neuropsychology of Criminal Responsibility." In *Foundations of Criminal Forensic Neuropsychology: Bridging Mind, Law, and Criminal Justice*, 93–127. Springer, 2025. https://doi.org/10.1007/978-3-031-83771-5_5.
- Sala, Carlo, and Menahem Segal. "Dendritic Spines: The Locus of Structural and Functional Plasticity." *Physiological Reviews* 94, no. 1 (2014): 141–88. <https://doi.org/10.1152/physrev.00012.2013>.
- Sauni, Herawan, Zico Junius Fernando, David Aprizon Putra, Saivol Virdaus, and Aris Hardinanto. "Beyond Borders: Shedding Light on Foreign Bribery through an Islamic Legal Lens." *Al-Istinbath: Jurnal Hukum Islam* 9, no. 2 (September 2024): 649–78. <https://doi.org/10.29240/JHI.V9I2.9752>.
- Sbordone, Robert J., Tony L. Strickland, and Arnold D. Purisch. "Neuropsychological Assessment." In *Handbook of Cross-Cultural Neuropsychology*, 335. Boston: Springer Science & Business Media, 2000. https://doi.org/10.1007/978-1-4615-4219-3_19.
- Schleim, Stephan. "Real Neurolaw in the Netherlands: The Role of the Developing Brain in the New Adolescent Criminal Law." *Frontiers in*

- Psychology* 11 (2020): 1–2.
<https://doi.org/10.3389/FPSYG.2020.01762/BIBTEX>.
- Shenton, Martha E, Bruce H Price, Laura Levin, and Judith G Edersheim. “Mild Traumatic Brain Injury: Is DTI Ready for the Courtroom?” *International Journal of Law and Psychiatry* 61 (2018): 50–63.
<https://doi.org/10.1016/j.ijlp.2018.09.002>.
- Sirgiovanni, Elisabetta, Gilberto Corbellini, and Cinzia Caporale. “A Recap on Italian Neurolaw: Epistemological and Ethical Issues.” *Mind and Society* 16, no. 1–2 (November 2017): 17–35.
<https://doi.org/10.1007/S11299-016-0188-1/METRICS>.
- Soekadar, Surjo R, Klaus Haagen, and Niels Birbaumer. “Brain-Computer Interfaces (BCI): Restoration of Movement and Thought from Neuroelectric and Metabolic Brain Activity.” In *Coordination: Neural, Behavioral and Social Dynamics*, 229–52. Springer, 2008.
https://doi.org/10.1007/978-3-540-74479-5_11/COVER.
- Xue, Gui, Chuansheng Chen, Zhong-Lin Lu, and Qi Dong. “Brain Imaging Techniques and Their Applications in Decision-Making Research.” *Xin Li Xue Bao. Acta Psychologica Sinica* 42, no. 1 (February 2010): 120–37. <https://doi.org/10.3724/SP.J.1041.2010.00120>.
- Yoder, Keith J, and Jean Decety. “The Neuroscience of Morality and Social Decision-Making.” *Psychology, Crime & Law* 24, no. 3 (March 2018): 279–95. <https://doi.org/10.1080/1068316X.2017.1414817>.
- Zeki, S., O. R. Goodenough, Terrence Chorvat, and Kevin McCabe. “The Brain and The Law.” *Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences* 359, no. 1451 (November 2004): 1727–36. <https://doi.org/10.1098/RSTB.2004.1545>.
- Zoghbi, Huda Y, and Stephen T Warren. “Neurogenetics: Advancing the ‘Next-Generation’ of Brain Research.” *Neuron* 68, no. 2 (2010): 165–73. <https://doi.org/10.1016/j.neuron.2010.10.015>.
- Zurawicki, Leon. “Exploring the Brain.” In *Neuromarketing: Exploring the Brain of the Consumer*, 1–53. Springer, 2010.
https://doi.org/10.1007/978-3-540-77829-5_1.

DECLARATION OF CONFLICTING INTERESTS

The authors state that there is no conflict of interest in the research, authorship, or publication of this article.

ACKNOWLEDGMENT

The authors would like to express their deepest gratitude to Beasiswa Pendidikan Indonesia (The Indonesian Education Scholarship) for providing financial support that made this research and its dissemination possible. We also extend our sincere appreciation to the Pusat Pelayanan Pembiayaan dan Asesmen Pendidikan Tinggi (Center for Higher Education Funding and Assessment), Ministry of Higher Education, Science, and Technology of the Republic of Indonesia, for their continuous guidance and funding assistance. Special thanks are also due to the Lembaga Pengelola Dana Pendidikan (Indonesia Endowment Fund for Education Agency), Ministry of Finance of the Republic of Indonesia, whose generous support has been crucial in facilitating participation in international academic forums and publications. Their contributions have significantly enabled the advancement of our academic work and the broader dissemination of knowledge.

HISTORY OF ARTICLE

Submitted : March 28, 2025
Revised : April 30, 2025
Accepted : June 25, 2025
Published : June 28, 2025

