



Moral Dilemmas and the Accountability of Criminal Offenders: A Neuroethical Perspective on Decision-Making in the Indonesian Criminal Justice System

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Abstract: *Advancements in cognitive neuroscience are increasingly challenging traditional legal concepts of free will, intent, and individual culpability. In Indonesia, criminal liability remains grounded in classical legal doctrines that emphasize moral agency, raising critical questions about their compatibility with contemporary neuroethical insights. This article examines trauma, impulse control disorders, and cognitive dysfunction in criminal behavior from a neuroethical perspective, which can provide a more contextual understanding of criminal behavior in the Indonesian legal system. Using a qualitative normative method, this study combines doctrinal legal analysis with interdisciplinary approaches from neuroethics and moral psychology and compares jurisdictions that have recognized neuroscientific evidence in the criminal justice process. Using a qualitative normative method, this research integrates doctrinal legal analysis with interdisciplinary approaches from neuroethics and moral psychology, drawing comparative insights from jurisdictions that admit neuroscientific evidence in criminal adjudication. The study finds that although Indonesian law acknowledges mental incapacity in certain sentencing provisions, it lacks a consistent framework to assess neurocognitive impairments in determining guilt and punishment. As a result, current legal mechanisms may fail to adequately reflect the complex biological and moral dimensions of deviant conduct. This study concludes that integrating neuroethical considerations into Indonesian criminal law could improve its fairness, scientific relevance, and humaneness.*

Keywords: *Neuroethics, Criminal Responsibility, Moral Decision-Making, Cognitive Neuroscience*

Abstrak: Kemajuan dalam ilmu saraf kognitif semakin menantang konsep hukum tradisional tentang kehendak bebas, niat, dan kesalahan individu. Di Indonesia, pertanggungjawaban pidana masih berakar pada doktrin klasik yang menekankan agensi moral, sehingga memunculkan pertanyaan kritis tentang kesesuaiannya dengan wawasan neuroetika kontemporer. Artikel ini mengkaji mengenai trauma, gangguan kontrol impuls, dan disfungsi kognitif perilaku kriminal dalam perspektif neuroetika, dapat membentuk pemahaman yang lebih kontekstual terhadap perilaku kriminal dalam sistem hukum Indonesia. The method used is qualitative normative, this study combines doctrinal legal analysis with an interdisciplinary approach from neuroethics and moral psychology, and compares jurisdictions that have recognized neuroscience evidence in the criminal justice process. Hasil penelitian menunjukkan bahwa meskipun hukum Indonesia mengakui ketidakmampuan mental dalam beberapa ketentuan pidana, belum tersedia kerangka hukum yang konsisten untuk menilai gangguan neurokognitif dalam menentukan kesalahan dan sanksi pidana. Akibatnya, mekanisme hukum saat ini belum sepenuhnya mencerminkan kompleksitas biologis dan moral dari perilaku menyimpang. Kajian ini menyimpulkan bahwa integrasi pertimbangan neuroetika ke dalam hukum pidana Indonesia dapat meningkatkan keadilan, relevansi ilmiah, dan pendekatan yang lebih manusiawi.

Kata Kunci: Neuroetika, Pertanggungjawaban Pidana, Pengambilan Keputusan Moral, Ilmu Saraf Kognitif

A. Introduction

In recent decades, rapid advancements in cognitive neuroscience have generated profound implications for various fields of study, not least the domain of criminal law. Neuroscience provides novel insights into the underlying brain mechanisms that govern moral decision-making and human behavior, revealing complexities that challenge traditional legal notions of free will, intent, and individual responsibility.¹ In Indonesia, the criminal justice system predominantly relies on classical legal doctrines grounded in the presumption of autonomous moral agency, where every individual is considered fully capable of making reasoned choices and thus held entirely accountable for their actions. However, emerging scientific evidence suggests that a range of neurocognitive factors, including impulse control disorders, psychological trauma, and cognitive impairments, can significantly influence a person's capacity to engage in moral reasoning and lawful conduct.²

¹Manu Sharma et al., "Neuroscience and Legal Aspects of Criminal Responsibility," *A Journal for New Zealand Herpetology* 12, no. 2 (2023): 2939–44; Neil Krishan Aggarwal and Abhishek Jain, "Neuroethics and Neurolaw in Forensic Neuropsychiatry: A Guide for Clinicians," *Behavioral Sciences and the Law* 42, no. 1 (2024); 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).

²Steven Penney, "Impulse Control and Criminal Responsibility: Lessons from Neuroscience," *International Journal of Law and Psychiatry* 35, no. 2 (2012): 99–103; Nigel Eastman and Colin Campbell, "Science and Society: Neuroscience and Legal Determination of Criminal Responsibility," *Nature Reviews Neuroscience*, 2006.

This intersection between neuroscience and law raises pressing questions about the adequacy of existing legal frameworks in addressing the realities of human behavior as understood through a neuroethical lens. The motivation to explore this topic stems from a discernible disjunction between the established principles of criminal liability in Indonesian law and the nuanced understanding of human cognition provided by modern neuroscience.³ This gap highlights a tension between the empirical facts about brain function and its impact on behavior, and the normative ideals embedded in criminal law regarding accountability and punishment. This tension, captured in the classical philosophical distinction between "das sein" and "das sollen," forms the conceptual foundation of this study. Addressing this gap is essential for achieving justice that is both empirically grounded and normatively sound. This study, therefore, seeks to answer the following question: To what extent can neuroethical insights inform Indonesian criminal law in addressing diminished cognitive and moral capacity?

The relevance of this inquiry is underscored by practical challenges encountered in Indonesian criminal courts, where adjudication often struggles to reconcile the biological and psychological conditions of defendants with rigid legal standards. For instance, cases involving defendants with mental health disorders or diminished cognitive faculties reveal inconsistencies between legal outcomes and the complex, sometimes mitigating, neuropsychological realities underlying their conduct.⁴ Despite some recognition of mental incapacity within Indonesian criminal law, the system lacks comprehensive guidelines or structured mechanisms to systematically incorporate neuroscientific evidence into assessments of culpability, sentencing, or rehabilitation. This shortfall risks perpetuating unjust outcomes that fail to account for diminished moral and cognitive capacities, potentially undermining the fairness and effectiveness of the justice system.

However, the application of neuroethical reasoning in Indonesia remains problematic, as current doctrines and courtroom practices seldom recognize neuroscientific data as a legitimate basis for judicial decision-making. This creates a normative and procedural gap between empirical knowledge about brain function and the legal norms that determine culpability. Explicitly problematising neuroethics in the Indonesian context highlights three interconnected concerns:

1. Evidentiary legitimacy, whether and how courts may admit and evaluate neuroscientific data;
2. Normative fit, whether doctrines such as *schuld* and *mens rea* can accommodate graded impairments; and

³Zico Junius Fernando et al., "The Role of Neuroprediction and Artificial Intelligence in the Future of Criminal Procedure Support Science: A New Era in Neuroscience and Criminal Justice," *Yuridika* 38, no. 3 (2023): 593–620; Armin Alimardani, "Neuroscience, Criminal Responsibility and Sentencing in an Islamic Country: Iran," *Journal of Law and the Biosciences* 5, no. 3 (2018).

⁴Yeni Vitrianingsih et al., "The Dilemma of Criminal Responsibility: A Juridical Study of Offenders with Mental Disorders," *Vitrianingsih, Yeni Mardikaningsih, Rahayu Issalillah, Fayola Ariyanti Mamesan, Devi Natalia Mathius, Devy* 5, no. 2 (2025): 143–1156.

3. Institutional capacity, whether judges, prosecutors, and forensic experts have the training and protocols to interpret neurodata responsibly.

Addressing these concerns is central to the present inquiry, which asks: To what extent can neuroethical insights inform Indonesian criminal law in addressing diminished cognitive and moral capacities?

Recent developments in medical neurotechnologies, such as neuroimaging, neuropsychological testing, and neuromodulation, have expanded the availability of brain-based evidence in clinical contexts. The legal relevance of these medical practices lies in their potential translation into forensic contexts, raising questions about admissibility, interpretation, and potential coercion. Accordingly, this paper focuses on the object of research: the role of neurocognitive evidence and neuroethical reasoning as inputs for decision-making in Indonesian criminal adjudication.

The existing literature on neuroethics and criminal responsibility provides valuable insights into these issues, particularly from jurisdictions that have begun integrating neuroscientific evidence into their legal proceedings.⁵ However, scholarly engagement specifically focused on Indonesia's legal context remains sparse, revealing a significant research gap. The Indonesian legal tradition, shaped by civil law principles and influenced by indigenous legal culture, presents both unique challenges and opportunities for incorporating neuroethical insights. Therefore, this study aims to contribute to an emerging discourse by critically examining the compatibility between contemporary neurocognitive science and Indonesian criminal law doctrines.

The theoretical framework underpinning this research draws on interdisciplinary scholarship at the nexus of neuroscience, philosophy, and law. Neuroethics, as an evolving field, examines the ethical implications of neuroscientific findings, particularly how these findings challenge traditional assumptions about human agency, moral judgment, and legal responsibility.⁶ This study also engages with foundational legal theories concerning *mens rea* (the mental element of a crime), the concept of free will, and the justifications for criminal sanctions. By synthesizing these bodies of knowledge, the research endeavors to provide a comprehensive analysis of how neurocognitive data might inform or challenge the principles governing criminal accountability in Indonesia.

Specifically, the focus is on evaluating how neuroethical insights into brain function, such as those related to impulse control deficits, traumatic brain injury, and cognitive dysfunction, should influence legal determinations about intent, capacity, and moral blameworthiness.⁷ The research further examines the implications of

⁵Stephen J Morse, *Neuroethics: Neurolaw*, 2017.

⁶Joshua D. Greene, "The Cognitive Neuroscience of Moral Judgment and Decision Making" (Boston: Boston Review, 2014); Syahrul Fauzul Kabir, "Kejahatan Dan Hukuman: Tantangan Filosofis Determinisme-Kausal Terhadap Pertanggungjawaban Pidana," *Jurnal Hukum & Pembangunan* 49, no. 2 (2019).

⁷Geert Philip Stevens, "'My Brain Made Me Do It?' Reflections on the Role of Neuroscience in Assessing Criminal Responsibility—A South African Medico-Legal Perspective," *Psychiatry, Psychology*

emerging neurotechnologies, including brain imaging and neurostimulation, for evidentiary standards and ethical considerations in the criminal justice system. These technologies, while promising enhanced diagnostic and explanatory power, also raise complex questions about privacy, autonomy, and potential misuse within legal contexts.⁸

The choice of this topic is driven not only by academic curiosity but also by its urgent practical importance. Indonesia, like many countries, faces growing demands to modernize its legal system in response to advances in science and evolving social norms. Addressing the integration of neuroscientific knowledge into criminal law can contribute to more just, individualized, and effective legal responses to criminal behavior. Moreover, it aligns with international trends toward neurolegal reforms and enhances Indonesia's capacity to engage in global legal and ethical dialogues.⁹

Empirical data from neuropsychological studies and case law analyses provide substantive grounding for this exploration. For example, research demonstrates that individuals with impaired impulse control or traumatic brain injuries often exhibit diminished capacity for moral judgment, which can affect their behavior in ways that the law must consider.¹⁰ Indonesian case studies reflecting judicial decisions on defendants with mental disorders highlight gaps in legal reasoning and procedural fairness.¹¹ By situating these findings within both scientific and legal frameworks, this study aims to provide evidence-based recommendations for legal reform.

In sum, this research addresses a critical and timely intersection of science and law by investigating how neuroethical perspectives on moral decision-making and behavior can inform Indonesian criminal law. It articulates the tension between established legal doctrines and the empirical realities uncovered by neuroscience, emphasizing the need for a more nuanced approach to criminal responsibility. Through qualitative and doctrinal analysis enriched by interdisciplinary insights, the study aims to contribute to the development of a legal paradigm that better reflects human cognitive complexity and promotes justice.

Several prior studies and academic inquiries have explored the relationship between neuroscience and criminal law, with a particular focus on integrating neuroethical insights into the judicial system. One pivotal study investigated the impact of advancements in neuroscience on criminal responsibility theories in the United

and Law 27, no. 2 (2020); Penney, "Impulse Control and Criminal Responsibility: Lessons from Neuroscience."

⁸Federica Coppola, "We Are More Than Our Executive Functions: On the Emotional and Situational Aspects of Criminal Responsibility and Punishment," *Criminal Law and Philosophy* 16, no. 2 (2022); Paul G. Nestor, "In Defense of Free Will: Neuroscience and Criminal Responsibility," *International Journal of Law and Psychiatry*, 2019.

⁹Fernando et al., "The Role of Neuroprediction and Artificial Intelligence in the Future of Criminal Procedure Support Science: A New Era in Neuroscience and Criminal Justice."

¹⁰Nicole A. Vincent, "On the Relevance of Neuroscience to Criminal Responsibility," *Criminal Law and Philosophy* 4, no. 1 (2010).

¹¹Vitrianingsih et al., "The Dilemma of Criminal Responsibility : A Juridical Study of Offenders with Mental Disorders."

States.¹² This research employed a multidisciplinary approach, combining a scientific literature review with legal policy analysis. Sharma concluded that although neuroscience provides empirical data that enriches the understanding of defendants' cognitive capacities, its application in courts faces significant ethical and procedural barriers. However, the study's primary limitation is its focus on Western legal systems, which may not be directly transferable to Indonesia's distinct cultural and normative legal context.

Another important contribution examined the neurobiological processes involved in moral decision-making within the context of the criminal justice system. Utilizing neuroimaging experimental methods, Greene analyzed brain activity in subjects presented with moral dilemmas.¹³ The findings demonstrated the involvement of various brain regions in moral judgment, which could explain differences in individual responsibility. Despite its theoretical strength, this study lacked practical recommendations for implementing neuroscience findings within legal frameworks.

Focusing on Indonesia, conducted an empirical study on the acceptance of neuroscientific evidence in criminal trials across courts in Jakarta.¹⁴ Using qualitative interviews with judges, prosecutors, and defense attorneys, they found a general interest in integrating neuroscience; however, legal practitioners showed limited understanding of its technical and ethical implications.¹⁵ The study advocates for specialized training and clear regulations to effectively incorporate neuroscientific evidence. Nonetheless, the research was geographically limited to urban areas and did not consider diverse regional legal contexts across Indonesia.

Examined Indonesian criminal cases involving defendants with mental disorders or cognitive impairments through a case study approach.¹⁶ They compared court rulings with available neuropsychological data and revealed inconsistencies in assessing defendants' capacities, which potentially undermine substantive justice. The authors criticized the lack of systematic integration of scientific evidence in legal procedures and called for reforms that respond to advances in neuroscience. However,

¹²"Neuroscience and Criminal Justice: Not Responsibility but Treatment," *Kansas Law Review*, 2016; Sharma et al., "Neuroscience and Legal Aspects of Criminal Responsibility."

¹³Federica Coppola, "Motus Animi in Mente Insana: An Emotion-Oriented Paradigm of Legal Insanity Informed By the Neuroscience of Moral Judgments and Decision-Making," *Journal of Criminal Law & Criminology* 109, no. 1 (2019); Greene, "The Cognitive Neuroscience of Moral Judgment and Decision Making."

¹⁴Tuomas K. Pernu and Nadine Elzein, "From Neuroscience to Law: Bridging the Gap," *Frontiers in Psychology* 11 (2020); Fernando et al., "The Role of Neuroprediction and Artificial Intelligence in the Future of Criminal Procedure Support Science: A New Era in Neuroscience and Criminal Justice."

¹⁵Didi Jubaidi and Timbo Sirait, "Implementing Justice for Children in Conflict with the Law: Philosophical Aspects of Living Law," *Scitepress*, 2024, 475–85; Dedy Sumardi, Mansari Mansari, and Maulana Fickry Albaba, "Restoratif Justice, Diversi Dan Peradilan Anak Pasca Putusan Mahkamah Konstitusi Nomor 110/Puu-X/2012," *Legitimasi: Jurnal Hukum Pidana Dan Politik Hukum* 11, no. 2 (2022): 248–65.

¹⁶Khoirunnisa Khoirunnisa and Didi Jubaidi, "Criminal Liability for Justice Collaborators Involved In Corruption Crimes In Indonesia," *Kanun Jurnal Ilmu Hukum* 25, no. 3 (2023): 491–506.

this study did not delve deeply into the neuroethical aspects or ethical consequences of integrating neuroscience into legal decision-making.

Explored ethical and legal challenges posed by the use of neurotechnology in criminal justice, focusing on cases from the US and Europe.¹⁷ Through comprehensive literature and regulatory analysis, Morse highlighted risks associated with privacy violations and the potential misuse of brain data. This study provides a valuable ethical framework to guide the responsible application of neurotechnology, but it offers limited insight into its practical implementation in non-Western legal systems, such as Indonesia.

Overall, these studies collectively illuminate both the potential and the challenges of integrating neuroscience into criminal law. Yet, a significant research gap remains regarding the comprehensive examination of this integration within Indonesia's legal system—particularly in addressing policy, ethical, and courtroom practice dimensions. The present study aims to fill this gap by critically examining the compatibility between neuroethical insights and Indonesian criminal law doctrines, while providing evidence-based and contextually grounded policy recommendations.

Existing scholarship has predominantly examined law-neuroscience interactions within Western legal traditions or approached mental illness from primarily psychiatric perspectives. While valuable, these works do not fully address how neuroethical principles can be operationalized within civil-law systems shaped by distinct doctrinal assumptions and socio-legal cultures.

The novelty of this article lies in situating neuroethical arguments within Indonesia's doctrinal framework (KUHP and case law), mapping procedural lacunae that hinder the responsible use of neuroevidence, and proposing concrete, context-sensitive reforms through procedural standards, capacity building, and diversionary mechanisms. By foregrounding Indonesian institutional realities, this study moves beyond abstract theoretical debates and contributes policy-relevant recommendations tailored to the domestic legal culture.

The theoretical framework of this study is grounded in an interdisciplinary paradigm that bridges neuroscience, philosophy, and criminal law. This integrative approach is essential for navigating the complexities that arise at the intersection of empirical brain science and normative legal principles. The choice of theoretical perspectives is intrinsically linked to the research objective, which aims to analyze the compatibility between neuroethical insights and Indonesian criminal law doctrines.

The research frames the issue through three theoretical lenses: the *das sein/das sollen* distinction, which highlights the empirical, normative gap, neuroethical principles, autonomy, privacy, and non-maleficence to evaluate ethical constraints in the use of neuroscientific evidence; and criminal law theory on *mens rea* and graded culpability to propose doctrinal coherence. This triadic framing enables the analysis to

¹⁷Morse, *Neuroethics : Neurolaw*.

progress from empirical neurocognitive findings to normative prescriptions that respect both scientific limitations and legal values.

At its core, the framework relies on the philosophical distinction between "*das sein*" and "*das sollen*," a classical conceptualization that differentiates empirical reality (*what is*) from normative ideals (*what ought to be*). This distinction provides a logical basis for examining the tensions between scientific evidence on brain function and existing doctrines of criminal responsibility.

Complementing this, the study draws upon neuroethics theory, which interrogates the ethical implications of neuroscientific discoveries for human agency, moral judgment, and legal accountability. Neuroethics serves as the normative compass guiding the interpretation of neuroscientific data within the justice system, emphasizing the importance of respecting autonomy, privacy, and fairness in adjudication.

From the legal perspective, the framework incorporates criminal law theory, specifically the principles of *mens rea* (the mental element of crime) and legal capacity. These principles form the backbone of criminal liability and are challenged by neuroscientific findings that reveal variability and impairments in cognitive function and impulse control.¹⁸ This intersection demands a reevaluation of traditional notions of free will and intent in the light of empirical brain science.

Furthermore, the framework integrates behavioral neuroscience models related to impulse control disorders, cognitive dysfunction, and trauma effects on moral reasoning¹⁹. These models provide explanatory mechanisms for deviations in behavior, which are crucial to assess the extent to which individuals can be held responsible for their actions under criminal law.

This theoretical framework not only guides the research analysis but also allows for potential expansion by incorporating emerging neurotechnologies and their associated legal and ethical challenges.²⁰ Thus, the framework remains dynamic, capable of evolving in response to ongoing scientific and legal developments.

This study employs a qualitative doctrinal legal approach, enriched with interdisciplinary analysis from neuroscience, neuroethics, and criminal law.²¹ The doctrinal method is employed to interpret and evaluate statutory provisions, case law, and legal doctrine within the Indonesian criminal justice system, particularly in relation to the concepts of *mens rea*, culpability, and legal responsibility. This core legal analysis is then critically contrasted with recent developments in neuroscience and neuroethics to identify normative gaps and propose reforms.²²

¹⁸Morse.

¹⁹Greene, "The Cognitive Neuroscience of Moral Judgment and Decision Making."

²⁰Sharma et al., "Neuroscience and Legal Aspects of Criminal Responsibility."

²¹Tuti Widyaningrum and Didi Jubaidi, "Corporate Criminal Liability : An Analysis Of Corporate Crime Perpetrators Under Positive Law In Indonesia," *Jurnal Cendekia Hukum* 9, no. 2 (2024): 146–57.

²²Terry Hutchinson and Nigel Duncan, "Defining and Describing What We Do: Doctrinal Legal Research," *Deakin Law Review* 17, no. 1 (2012): 83–119.

This study adopts a normative-analytical approach, which not only aims to describe the structure and substance of existing legal doctrines but also to evaluate their normative adequacy in light of evolving scientific knowledge. By integrating legal reasoning with empirical insights from cognitive neuroscience and ethical philosophy, this research emphasizes the interdisciplinary nature of the inquiry. Such an approach is essential in understanding how contemporary neuroscientific findings concerning brain function may reshape fundamental legal concepts such as human agency, intent, and accountability, particularly in the context of criminal responsibility.

To support this analysis, the study draws on a diverse range of data sources from legal, scientific, and ethical domains. Primary legal materials include the Indonesian Criminal Code (KUHP), judicial decisions that address mental health in criminal cases, and statutory instruments related to forensic psychiatric evaluation. These are complemented by secondary sources, such as doctrinal commentaries, peer-reviewed journal articles, legal reform proposals, and reports from judicial and legislative bodies. Furthermore, the research incorporates relevant scientific literature published within the last five years, focusing on topics such as neuroimaging, impulse control disorders, trauma-induced cognitive impairments, and dysfunctions linked to antisocial or disinhibited behavior. This multidisciplinary dataset allows the study to anchor legal analysis in empirical realities.

The analytical process proceeds through several interconnected methods. First, doctrinal interpretation is used to examine how Indonesian criminal law conceptualizes *mens rea* and legal capacity. Second, interdisciplinary desk research is conducted to integrate neuroscientific and neuroethical perspectives, enabling a critique of traditional legal assumptions. Third, a comparative legal analysis examines how selected jurisdictions, such as Germany, the United Kingdom, and the United States, address neuroscientific evidence in criminal adjudication, thereby identifying best practices and providing reference points for Indonesian law. Finally, normative synthesis is carried out using neuroethical principles, including autonomy, agency, and moral capacity as critical lenses to assess the justifiability of existing legal doctrines. This synthesis draws on frameworks such as those proposed by Farah,²³ which emphasizes the ethical stakes of applying neuroscience within legal reasoning.

Although this study does not involve direct human participants, ethical considerations remain central, especially concerning the interpretation and potential misuse of neuroscientific data in judicial settings. The research acknowledges risks such as reductionist determinism, violations of mental privacy, and the stigmatization of individuals with neurological conditions. In response, the study adheres to neuroethical standards that uphold fairness, safeguard autonomy, and promote respect for human dignity. These principles guide the evaluation of how scientific insights should be responsibly and justly incorporated into criminal legal processes.

²³Martha J. Farah, "Neuroethics: The Ethical, Legal, and Societal Impact of Neuroscience," *Annual Review of Psychology*, 2012.

B. Neurocognitive Findings and Criminal Behavior

In recent decades, interdisciplinary scholarship has increasingly emphasized the relevance of neuroscience to legal theory and practice, particularly in the realm of criminal responsibility. Neuroscientific research has consistently shown that dysfunction in certain brain regions, especially the prefrontal cortex, which governs executive functions such as reasoning, self-control, and planning, as well as the amygdala, which regulates emotional responses, can significantly impair an individual's capacity for moral judgment and impulse regulation.²⁴ These findings challenge the classical legal assumption of the rational, autonomous subject that underpins criminal liability in many legal systems, including Indonesia's.

From a legal perspective, this growing body of evidence calls into question the adequacy of traditional conceptions of *mens rea* (the mental element of a crime) when applied to defendants who suffer from demonstrable neurocognitive deficits. Individuals with traumatic brain injuries (TBI), neurodevelopmental disorders, or serious psychiatric conditions may engage in behavior that meets the *actus reus* of a criminal offense, but without the requisite level of intentionality, awareness, or volitional control that justifies full culpability under existing legal standards.

In Indonesia, however, the legal system has not yet developed the doctrinal or procedural tools necessary to meaningfully integrate such neuroscientific insights into criminal adjudication. For example, in *Putusan Nomor 465/Pid.B/2019/PN Cbi*, the court acknowledged the defendant's schizophrenia diagnosis and ordered institutional treatment rather than incarceration.²⁵ While this reflects a basic recognition of mental illness as a mitigating factor, the decision was grounded entirely in traditional psychiatric evaluation, without reference to neurological diagnostics such as functional MRI (fMRI) or neuropsychological testing. This omission highlights a critical gap in Indonesian criminal procedure and evidentiary law, where scientific advancements in brain research remain underutilized or misunderstood.

From a socio-legal standpoint, this gap not only limits the defendant's right to a fair and evidence-based trial but also undermines the legitimacy and adaptability of the legal system in responding to contemporary challenges. The failure to consider neuroscientific evidence may reinforce a rigid, positivist model of culpability that overlooks the complex interplay between biology, behavior, and social context. Moreover, it inhibits the development of jurisprudence that aligns with human rights principles, such as proportionality in sentencing and the obligation to protect vulnerable groups, including individuals with cognitive disabilities.

The broader implications for legal scholarship are significant. The interface between neuroscience and criminal law opens new avenues for rethinking

²⁴Hengki Wijaya, "Pendidikan Neurosains Dan Implikasinya Dalam Pendidikan Masa Kini," *Pendidikan Dasar 2*, no. 1 (2018): 1-19.

²⁵Latifah Zahra, "Tanggungjawab Orang Yang Mengidap Skizofrenia Dalam Kasus Penodaan Agama (Studi Kasus: Putusan Nomor 465/Pid.B/2019/PN Cbi)" (Universitas Islam Negeri Syarif Hidayatullah Jakarta, 2024).

foundational legal doctrines, such as responsibility, deterrence, rehabilitation, and even the purpose of punishment itself.²⁶ In this light, the Indonesian legal community is called upon to engage in cross-disciplinary research and institutional reform that promotes the responsible and ethical use of neuroscientific knowledge in legal settings. Doing so would not only contribute to a more humane and scientifically-informed justice system but would also place Indonesian legal scholarship at the forefront of global academic discourse on the intersection of law, science, and society.

C. Brain Damage and Criminal Culpability

The growing integration of neuroscience into legal decision-making in various jurisdictions reflects a shift in the paradigm of understanding criminal culpability. In particular, courts in the United States, Italy, and Germany have increasingly accepted functional magnetic resonance imaging (fMRI) and positron emission tomography (PET) scans as relevant evidence in determining a defendant's mental state and capacity for criminal intent.²⁷ These scientific tools have been used not only to assess competency to stand trial, but also to support claims of diminished responsibility, thereby potentially influencing sentencing outcomes or even leading to alternative forms of rehabilitation.

The underlying rationale is grounded in a more nuanced understanding of mens rea, recognizing that significant brain damage, especially to regions responsible for executive functioning, emotional regulation, and moral reasoning, may impair a person's ability to form intent, control impulses, or appreciate the wrongfulness of their conduct. As such, these jurisdictions have begun to move away from rigid binaries of sanity and insanity, toward a spectrum-based model of criminal responsibility that is more aligned with contemporary medical and psychological knowledge.

In stark contrast, Indonesian criminal law remains firmly rooted in the classical conception of guilt, particularly in the principle of schuld, which posits that criminal responsibility is based on free will, consciousness, and intent. This doctrinal orientation is evident in *Putusan Nomor 1811K/Pid.Sus/2010*, in which the Supreme Court reaffirmed the defendant's individual responsibility without acknowledging the potential mitigating role of brain injury or cognitive dysfunction.²⁸ The ruling reflects an adherence to legal positivism, as espoused by theorists such as those who understand law as a system of rules applied independently of moral or scientific considerations.

²⁶Lucas Noyon et al., "Integrating Neuroscience in Criminal Law," *International Journal of Forensic Mental Health* 18, no. 3 (2019): 281–91; Lucas Noyon et al., "Integrating Neuroscience in Criminal Law: The Dutch Situation as an Example," *International Journal of Forensic Mental Health*, 2019.

²⁷Sakari Melander, "Preventive Turn in Criminal Law," *Peking University Law Journal* 11, no. 1 (2023); Nicole A Vincent, Thomas Nadelhoffer, and Allan McCay, *Neurointerventions and the Law: Regulating Human Mental Capacity* (Oxford: Oxford University Press, 2020).

²⁸Novi Ambar Wati and Syahid Akhmad Faisol, "Pertanggungjawaban Pidana Bagi Terdakwa Pengidap Gangguan Mental Organik Pada Putusan Pengadilan Nomor : 1811K/Pid.Sus/2010," *Law, Development & Justice Review* 7, no. 3 (2022): 250–69.

This positivist orientation results in a narrow interpretation of culpability, one that does not accommodate scientific evidence that could complicate the attribution of criminal intent. While Article 44 of the Indonesian Penal Code (KUHP) does allow for non-liability in cases of severe mental disorder, its application is limited and largely reliant on conventional psychiatric evaluation rather than neuroscientific diagnostics.²⁹ Consequently, the legal framework lacks the conceptual and procedural mechanisms to address cases where brain damage falls short of total insanity but still materially affects behavior and judgment.

This disconnect raises fundamental questions about the Indonesian legal system's responsiveness to scientific progress. It also has serious implications for justice, as defendants with neurocognitive impairments may be held to the same standard of culpability as fully rational actors, potentially leading to disproportionate punishment and violations of due process rights. Furthermore, the absence of regulatory guidelines or judicial training in interpreting neuroscientific evidence creates room for inconsistency and arbitrariness in legal proceedings.

From the standpoint of legal scholarship and reform, this issue highlights the need for a context-sensitive reevaluation of the schuld principle, one that considers developments in neuroscience, psychology, and human rights law. Incorporating neurobiological insights into criminal adjudication would not only enhance the factual accuracy of verdicts but also align the criminal justice system with broader social science discourses on human behavior, social vulnerability, and structural inequality.

D. International Case Comparisons

Empirical observations indicate that courts in several jurisdictions, including Italy and Germany, have begun to incorporate neuroscientific evidence into their assessments of criminal responsibility. In the 2011 case before the Brescia Court of Appeal in Italy, medical testimony confirming amygdala dysfunction was accepted as mitigating evidence in a homicide case. The court considered such neurological impairment as a factor that reduced the defendant's capacity for emotional regulation and impulse control, thereby warranting a reduction in sentencing severity.³⁰

Similarly, courts in Germany have recognized the relevance of neuropsychological assessments, especially when they demonstrate structural or functional impairments in brain regions associated with judgment, self-control, or aggression. For example, in several violent crime cases, German courts have admitted expert evidence based on neuroimaging results, including fMRI and PET scans, to substantiate claims of diminished culpability due to cognitive deficits.

These cases reflect a documented trend in comparative criminal law, where neuroscientific findings are incorporated into legal reasoning, particularly during the

²⁹R Soesilo, *Kitab Undang-Undang Hukum Pidana, KUHP Serta Komentar-Komentarnya Lengkap Pasal Demi Pasal*, 1999.

³⁰Wati and Faisal, "Pertanggungjawaban Pidana Bagi Terdakwa Pengidap Gangguan Mental Organik Pada Putusan Pengadilan Nomor : 1811K/Pid.Sus/2010."

sentencing phase. The use of such evidence typically follows formal procedures involving expert testimony and is supported by a framework that allows courts to weigh clinical diagnoses alongside legal elements such as mens rea and intent.

In contrast, Indonesian court decisions reviewed in this study, such as *Putusan Nomor 1811K/Pid.Sus/2010* did not demonstrate any integration of neuroscientific evidence. Even in cases involving defendants with a history of traumatic brain injury or severe mental disorder, courts relied solely on traditional psychiatric evaluations, with no reference to or inclusion of neurobiological data such as brain scans or cognitive function reports.

No Indonesian ruling examined during this research involved the procedural admission of neuroscientific tools such as functional imaging or neurological testing, nor did any verdict indicate judicial familiarity with neurocognitive terminology or diagnostic standards used in other jurisdictions. This comparison reveals a jurisdictional gap in the practical application of neuroscience within the courtroom setting, with Indonesia showing low institutional uptake of such scientific advances.

E. Deficiencies in the Indonesian Legal Framework

The Indonesian legal system formally acknowledges mental illness as a potential ground for exoneration through Article 44 of the Criminal Code (KUHP). However, the scope of its application remains narrowly construed, often limited to visible or traditionally defined psychiatric disorders. In *Putusan Nomor 144/PID. B/2014/PN. CJ*, for instance, the defendant's prior traumatic brain injury (TBI) was not accompanied by supporting neurological diagnostics.³¹ Despite indications of cognitive dysfunction, the absence of neuroscientific evidence meant the court proceeded with standard criminal liability assessments, reflecting a procedural gap in the evidentiary approach.

This case illustrates a broader deficiency in the Indonesian judicial system's capacity to integrate developments in neurocognitive science. While psychiatric evaluations are occasionally admitted, neuroscientific methods such as neuroimaging, cognitive profiling, or expert neurological testimony are virtually absent. This is due, in part, to the lack of procedural standards or legal instruments governing the submission and interpretation of such evidence in court proceedings. The absence of these mechanisms potentially undermines the right to a fair trial (*fair trial*) and violates the principle of proportionality in sentencing, especially in cases where neurocognitive impairments materially affect the defendant's volitional or cognitive capacities.

Moreover, no institutional mechanisms or judicial training programs currently exist to equip judges and prosecutors with the tools to understand or critically assess neurobiological data. As a result, the utilization of neuroscience in the courtroom

³¹I. Dewa Made Suartha, I. Dewa Agung Gede Mahardika Martha, and Bagus Hermanto, "Between Mental Illness, Criminal Policy Reform, and Human Rights: Discourse on Reformulation of The Article 44 Indonesia Criminal Code," *International Journal of Criminal Justice Sciences* 17, no. 1 (2022).

remains ad hoc and inconsistent, further complicated by the absence of interprofessional collaboration between legal and medical experts. This situation limits the judiciary's ability to evaluate culpability in a manner that reflects the complex interplay between mental health and criminal behavior, ultimately reinforcing a normative framework that presumes full rationality in all defendants.

This systemic rigidity becomes more apparent when Indonesia is compared with other jurisdictions that have institutionalized the admissibility and interpretive use of neuroscientific evidence in criminal trials. Table 1 provides a comparative snapshot of how selected countries approach such evidence and its legal impact on judicial decisions.

Table 1.
 Comparative Approaches to Neuroscientific Evidence in Criminal Justice Systems

Country / Jurisdiction	Case Example	Type of Neuroscientific Evidence	Impact on Judgment	Special Notes
Indonesia	Putusan Nomor 465/Pid.B/2019/PN Cbi	Psychiatric evaluation (no neuroimaging)	Transfer to a psychiatric hospital	No neuroscience; limited to traditional psychiatry
Indonesia	Putusan Nomor 144/PID. B/2014/PN. CJ	History of traumatic brain injury (no proof)	No significant influence on the court decision	No guidelines for neurological evidence
United States	<i>State v. Waldroup</i> (2007)	fMRI, PET Scan	Mitigated sentence; brain disorder defense	Neuroscience used to reduce criminal responsibility
Italy	Brescia Court of Appeal (2011)	Amygdala dysfunction (neuroimaging evidence)	Murder sentence reduced	The Supreme Court recognized scientific evidence as mitigating
Germany	Various state court cases	Neurology + psychiatry	Graded responsibility evaluation	Progressive approach toward biological determinism

As shown above, Indonesia lags behind in both the procedural acceptance and substantive application of neuroscientific findings in criminal proceedings. This lack of development stands in stark contrast to the more nuanced and scientifically informed frameworks embraced by countries like Germany and Italy, where courts routinely integrate expert neurobiological assessments to determine degrees of culpability and shape sentencing. These comparisons highlight the normative and evidentiary

deficiencies in Indonesia's legal system, further underscoring the need for legal reform aligned with modern scientific standards.

In contrast, several jurisdictions have adopted rehabilitative or alternative sentencing frameworks for defendants with neurocognitive disorders, ranging from mandatory treatment programs to specialized diversion courts. Indonesia currently lacks any explicit juridical basis for such alternatives, even when credible scientific evidence indicates that a neurocognitive condition contributed to the criminal conduct. This legal vacuum contributes to punitive outcomes that neither address the root cause of criminal behavior nor fulfill the goals of rehabilitative or restorative justice.

These findings underscore an urgent need for substantive and procedural criminal law reform grounded in contemporary scientific understanding. Bridging the normative and evidentiary gaps outlined above is essential not only for achieving individualized justice but also for aligning Indonesia's legal practice with fundamental human rights principles and international standards.

The results reveal a significant gap between scientific advancements and the capacity of Indonesian criminal law to accommodate neurocognitive evidence, as demonstrated by the case law and comparative analysis discussed earlier. This disconnect not only raises normative questions about the fairness of adjudicating individuals with diminished neurocognitive function but also exposes systemic deficiencies within the judiciary's current understanding and application of scientific evidence. In the following discussion, we examine how these empirical findings contribute to broader debates about criminal liability, culpability, and the pressing need for legal reforms in Indonesia.

While Indonesian law formally acknowledges mental incapacity, primarily through provisions such as Article 44 of the KUHP, which allows for exoneration based on mental illness, there remains a significant deficiency in conceptual understanding and procedural mechanisms to effectively integrate modern neuroscientific evidence into judicial decision-making. In contrast, jurisdictions in Europe and North America have begun adopting advanced neuroscientific tools, such as functional magnetic resonance imaging (fMRI) and positron emission tomography (PET) scans, recognizing their potential to provide nuanced insights into defendants' cognitive capacities and impulse control.³² This evolution moves legal systems beyond the traditional binary of sanity versus insanity toward a more graduated model of criminal responsibility, facilitating more tailored sentencing and just evaluations that reflect underlying neurobiological impairments.

Despite these advancements abroad, Indonesian courts continue to rely predominantly on conventional psychiatric evaluations, which often lack the empirical rigor and precision of contemporary neurodiagnostic methods. Case studies such as *Putusan Nomor 465/Pid.B/2019/PN Cbi* and *Putusan Nomor 144/PID. B/2014/PN. Cj* illustrates that, although neurological impairments were indicated, neuroscientific

³²F. X. Jones, O. D., Jones, O. D., & Shen, "Law and Neuroscience in the United States," *International Neurolaw: A Comparative Analysis*, 2011, 349–80.

evidence has yet to be meaningfully incorporated into judicial reasoning. The absence of clear procedural guidelines and standardized protocols for admitting and interpreting such evidence results in inconsistent judicial practices and a missed opportunity to align the Indonesian legal system with current scientific knowledge. This disparity highlights an urgent need for legal reform to develop an integrated neurolegal framework that balances scientific insights with established legal principles, thereby enhancing the accuracy of culpability assessments while protecting the rights and dignity of cognitively impaired defendants.

Moreover, the doctrinal rigidity of the Indonesian criminal justice system substantially constrains its ability to assimilate interdisciplinary insights, especially from contemporary neuroscience. Rooted deeply in classical legal positivism, the system maintains a largely binary approach to culpability focused primarily on the presence or absence of intentionality and mental illness while neglecting the nuanced gradations of cognitive impairment illuminated by modern science.³³ Although historically coherent, this rigidity risks overlooking critical factors influencing human behavior and decision-making capacity, potentially compromising the fairness and accuracy of legal outcomes. To address these limitations, Indonesian criminal law would benefit from adopting a more flexible, gradient model of responsibility, recognizing culpability as existing along a continuum where varying degrees of cognitive dysfunction can mitigate legal responsibility. Such a model better reflects the complex realities of brain function and acknowledges that conditions such as traumatic brain injury, developmental disorders, or neuropsychiatric illnesses may impair capacities for self-control, judgment, and moral reasoning.

Adopting this model aligns Indonesian law with contemporary scientific understanding and promotes normative fairness by enabling individualized, context-sensitive assessments that balance societal protection with the rights of defendants.³⁴ This theoretical shift resonates with Niklas Luhmann's systems theory, which views law as a dynamic social system that must adapt to external complexities and evolving knowledge domains. According to Sandberg,³⁵ legal systems cannot remain static but must respond to scientific and societal developments to maintain legitimacy and effectiveness. From this perspective, integrating neuroscientific findings into Indonesian criminal law is both a practical necessity and a systemic imperative for modernizing and humanizing legal processes. Achieving this, however, requires doctrinal reform paired with procedural guidelines to educate legal professionals, establish standards for the admissibility of evidence, and foster collaboration between legal and neuroscientific experts.

³³Ruth Groff, *Critical Realism, Post-Positivism And The Possibility Of Knowledge* (London: Routledge, 2004).

³⁴Zainal Abidin et al., *Menyelisik Keadilan Yang Rentan: Hukuman Mati Dan Penerapan Fair Trial Di Indonesia*, ed. Fathan Qorib and Anggara, *Sustainability (Switzerland)*, vol. 11 (Jakarta: Institute for Criminal Justice Reform, 2019).

³⁵Walter Glannon, "The Limitations and Potential of Neuroimaging in the Criminal Law," *Journal of Ethics* 18, no. 2 (2014).

At the same time, the integration of neuroscientific evidence raises profound ethical and human rights concerns that demand careful consideration to safeguard justice and individual dignity. Chief among these is privacy: brain data derived from neuroimaging constitutes highly sensitive personal information vulnerable to misuse. Defendants may feel coerced into invasive examinations without fully informed consent, and improper handling or unauthorized disclosure could lead to broader societal harms such as surveillance or discrimination. Therefore, judicial use of such evidence must be governed by stringent privacy protections, including clear protocols on data collection, storage, access, and destruction. Additionally, the risk of stigmatization is significant, as labeling individuals neurologically “deficient” can reinforce stereotypes and social exclusion. This “neurostigma” may lead legal actors to treat neurological differences as deterministic markers of criminal propensity, ignoring the complex interplay of environmental, social, and psychological factors.³⁶ Such stigmatization could undermine defendants’ autonomy and equal standing before the law, exacerbating marginalization rather than promoting rehabilitation or understanding.

Furthermore, the legal system must remain vigilant against “neuroessentialism”, the reduction of complex human behaviors solely to brain scans or neurological metrics that disregard social, cultural, and moral contexts. This reductionism risks fostering deterministic judgments that overlook free will, personal responsibility, and broader societal influences. Without rigorous standards and interdisciplinary scrutiny, neuroscientific evidence may be misinterpreted or overvalued, thereby distorting legal outcomes. Consequently, integrating neuroscience into legal processes requires a robust framework of rights-based safeguards and ethical standards. These should encompass informed consent procedures, protections against misuse, education for legal professionals on the interpretation and limits of neuroscientific data, and mechanisms ensuring balanced consideration of both scientific and social factors. Embedding these protections will preserve the integrity of the justice system, uphold human rights, and foster trust in the responsible use of emerging technologies.

Legal scholars such as Stephen J. Morse and Nicole Vincent caution against simplistic translations of neuroscience into determinations of legal responsibility. Morse emphasizes the resilience of legal categories grounded in behavioral criteria, while Vincent underscores the importance of regulatory and rights-based safeguards for neurointerventions.³⁷ Integrating their insights, the present article advocates a balanced approach: neuroscience should inform, not supplant, normative judgments about culpability. In practical terms, courts should treat neurocognitive evidence as one admissible category among others, subject to rigorous expert cross-examination,

³⁶Farah, “Neuroethics: The Ethical, Legal, and Societal Impact of Neuroscience.”

³⁷Stephen J. Morse, *Neuroscience, Free Will, and Criminal Responsibility*, in *Free Will and the Brain: Neuroscientific, Philosophical, and Legal Perspectives*, ed. Walter Glannon (Cambridge University Press, 2015).

standardized interpretive protocols, and explicit judicial instructions about evidentiary limits to avoid neuroessentialism or determinism.³⁸

Applying neuroethical principles to Indonesian practice suggests three policy priorities:

1. Adopting evidentiary guidelines that define when neurodiagnostic tools (e.g., validated neuropsychological tests) may be admissible and how to weigh their probative value;
2. Establishing multidisciplinary assessment panels (neurology, psychiatry, and forensic psychology) for complex cases; and
3. Piloting specialized sentencing alternatives (treatment diversion or mandated rehabilitation programs) with procedural safeguards to protect consent and privacy.

This research makes a significant contribution to the interdisciplinary discourse at the intersection of law, neuroscience, and ethics, particularly within the Indonesian criminal justice system. By bridging doctrinal legal analysis with contemporary neuroethical and scientific insights, it offers a nuanced critique of Indonesia's legal framework, highlighting doctrinal rigidity and procedural gaps while exploring the normative and ethical implications of incorporating neuroscientific evidence. The comparative analysis with practices in Europe and North America highlights technological and regulatory disparities, encouraging engagement with evolving scientific and ethical standards. In doing so, this study expands the conceptual boundaries of criminal responsibility, invites reconsideration of classical positivist doctrines in light of scientific complexity, and underscores the importance of interdisciplinary dialogue in shaping just and effective legal policies. Ultimately, it enriches socio-legal scholarship and promotes a more informed, humane, and adaptive criminal justice system capable of meeting contemporary challenges.

Despite these contributions, the study faces limitations. The reliance on a limited number of Indonesian judicial decisions may restrict generalizability across the entire criminal justice system, and the scarcity of published neuroscientific evidence admitted in courts limits empirical validation of procedural critiques. The absence of primary data from legal practitioners and neuroscientists leaves gaps in understanding practical challenges and stakeholder perceptions. Furthermore, while the comparative analysis provides valuable insights, it may oversimplify the complexities involved in transferring legal and scientific frameworks across diverse cultural and institutional contexts.

Future research should deepen empirical understanding of how neuroscientific evidence is perceived and applied within Indonesia's legal system through qualitative

³⁸Nicole A. Vincent, "Neuroimaging and Responsibility Assessments," *Neuroethics* 4, no. 1 (2011): 35-49; Colleen M. Berryessa, Federica Coppola, and Gerardo Salvato, "The Potential Effect of Neurobiological Evidence on the Adjudication of Criminal Responsibility of Psychopathic Defendants in Involuntary Manslaughter Cases," *Psychology, Crime and Law* 27, no. 2 (2021).

studies involving judges, prosecutors, defense attorneys, and forensic experts. Interdisciplinary collaborations among legal scholars, neuroscientists, and ethicists are crucial for developing culturally sensitive guidelines for the admissibility and interpretation of neurodiagnostic data. Comparative studies might further explore how various legal traditions balance scientific findings with normative principles, particularly within Southeast Asia. Additionally, investigating public attitudes toward brain-based evidence and its implications for justice and responsibility would provide valuable insights. Given the rapid advancements in neurotechnology, ongoing scholarship must ensure that ethical, human rights, and procedural standards evolve in tandem with scientific progress to maintain the legitimacy and effectiveness of the justice system.

C. Conclusion

This study reveals a fundamental gap between the Indonesian criminal justice system and contemporary advances in neuroscience. While jurisdictions such as Italy, Germany, and the United States have begun to incorporate neurocognitive evidence through fMRI, PET scans, and expert neurological testimony, Indonesian courts still rely almost entirely on conventional psychiatric assessments. This rigidity reflects a narrow interpretation of the *schuld* principle, which remains rooted in classical notions of free will and moral agency, often neglecting the scientific complexities underlying cognitive impairment and behavioral control.

The findings highlight both procedural and conceptual shortcomings in Indonesia's legal framework, including the absence of standardized evidentiary protocols, limited judicial understanding of neuroscientific data, and minimal interdisciplinary collaboration. These deficiencies risk producing unjust outcomes in cases involving defendants with diminished cognitive and moral capacities. From a neuroethical perspective, incorporating neuroscientific insights is not merely an evidentiary enhancement but a normative necessity to uphold proportionality, fairness, and substantive justice in criminal adjudication.

To address these challenges, this study recommends three key reforms: first, establishing clear procedural standards for the admissibility and interpretation of neuroscientific evidence; second, developing capacity-building initiatives for judges, prosecutors, and legal practitioners in neurocognitive science; and third, fostering collaboration among legal experts, neuroscientists, and mental health professionals. Implementing these reforms would bridge the gap between law and science, strengthen the legitimacy of judicial decision-making, and foster a more humane, individualized, and evidence-based approach to criminal justice in Indonesia.

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