

# Breaking the Cycle: Neurocriminology and The Future of Terrorism Deradicalization in Indonesia

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## Abstract

This article explores neurocriminology as a new interdisciplinary approach to understanding crime, punishment, and recidivism, with a focus on terrorism and deradicalization in Indonesia. It relies on [Andrea L. Glenn and Adrian Raine's work \(2014\)](#) as a theoretical basis. The paper places their neurocriminological perspective within Indonesia's social-science-based criminology tradition. A review of existing literature highlights a significant gap between global progress in neurocriminology and its limited development and use in Indonesia. The analysis suggests that combining neuroscientific and biosocial insights could enhance our understanding of criminal behavior. As a result, there is potential to improve deradicalization efforts through better risk assessment, targeted interventions, and the prevention of terrorist recidivism. The goal of this article is to introduce a more comprehensive framework for deradicalization policies in Indonesia, reshaping the country's approach to crime and terrorism while strengthening theoretical foundations for evidence-based policymaking.

**Keywords:** Neurocriminology, Terrorism, Deradicalization

## Introduction

We often hear the phrase “*the face looks like a criminal's.*” Many people are familiar with Cesare Lombroso (1835-1909), an Italian criminologist who proposed that criminal behavior is inherited and that certain physical features can identify a “criminal man.” Lombroso was known for his ability to identify criminals using a biological approach during his time. However, the development of theories and the growth of knowledge have not been able to accurately account for the diversity of criminal behavior, especially when it comes to physical appearance, leading many of these theories to be disproven. The book *Criminological Theory: Context and Consequences* ([Lilly et al., 2015](#)) discusses the early integration of neuroscience into criminological theory. Lombroso, as an early biological theorist, and others gained prominence not because of the political and social climate but because of their focus on biology, particularly Darwinism, which was highly popular in the late 19th century. In the early 20th century, Social Darwinism enabled this theory to link criminality to a form of biological inferiority. Nonetheless, biology was gradually overshadowed by other natural sciences, such as physics.

A discussion of this development would be valuable. The author was inspired by Adrian Raine's work, who began a study of brain and nervous system structures linked to antisocial behavior, recidivism, and crime. Raine's 2013 book, titled *The Anatomy of Violence: The Biological Roots of Crime*, was highly successful, including the article that published the research results, titled "Adrian Raine Says He Can

Predict if You'll Be a Criminal" ([Barker, 2013](#)). The main research question of this study is: How do people become violent? Adrian Raine's research aims to find factual answers to this fundamental question. The follow-up proposal builds on the author's research by examining the connection between neuroscience and criminology in Indonesia.

## Literature Review

### The Role of Neuroscience in Criminology

Today, we are captivated by the rapid advances in neuroscience. How could we not be? The television program CSI: Crime Scene Investigation, which emphasizes biotechnology in forensic investigations, has been divided into two segments. Furthermore, the animated film Big Hero 6, winner of the Academy Award for Best Animated Feature, introduced the significance of neuroscience in advancing electrical engineering and brain control, highlighting their importance for scientific progress. Additionally, the CBeebies channel broadcasted "Nina and Neuron," an introductory program for young children that demonstrates the crucial role of the nervous system in shaping social behavior and fostering curiosity using simple language. This development should be acknowledged as a noteworthy contribution to the relatively small community of criminologists with an interest in bio-oriented studies.

In the late 1970s, Lee Ellis (1977), as cited in [Lilly et al. \(2015\)](#), published an article in The American Sociologist titled "The Decline and Fall of Sociology, 1977-2000." Ellis highlighted several challenges facing social science disciplines and advocated a scientific methodology to improve outcomes. A select group of criminologists, including Ellis, began focusing on biological or biosocial approaches to address the limitations of early biological criminology. Although this publication ([Lilly et al., 2015](#)) does not conform to the ideological frameworks of natural or social sciences and was authored to present theoretical perspectives within a social context, one of the authors (Cullen, 2009) has proposed that biosocial criminology constitutes a "broader and more powerful" paradigm than sociological criminology and is poised to become a central paradigm in the twenty-first century.

Following the above, there has been increasing discussion about identifying a defendant's brain, neural structures, and even their DNA as a basis for scanning the public for potential offenders with similar structures. Neuroscience, as discussed in [Lilly et al. \(2015\)](#), is presented as a second approach to biosocial theory. Over the past two decades, neuroscience has made remarkable progress. The term "brain decade" is popular, marking a return to a natural-scientific perspective based on observations of the brain's structure. Neuroscience is a branch of science that studies the structure of the brain and the nervous system. Neuroscience research has developed significantly in other countries. Neuroscience is often associated with medicine, mainly because its terminology and discussions focus on the brain's structure. The field is advancing rapidly, with many empirical and experimental studies examining human behavior and brain function. Neuroscience is a multidisciplinary science that can be combined with other fields.

[Agifianto Eko Putra \(2008\)](#), an Indonesian neuroscientist, describes various topics studied in neuroscience, including structure, function, evolutionary history, development, genetics, biochemistry, physiology, pharmacology, informatics, computational neuroscience, and nervous system pathology. It is traditionally considered a branch of the biological sciences. The methods used by neuroscientists have evolved from biochemical and genetic analysis of individual nerve cells and their molecular components to understanding perceptual imagery and motor activity in the brain. Today, many interdisciplinary research collaborations exist within neuroscience, involving fields such as sociology, neuro- and cognitive psychology, computer science, statistics, physics, medicine, and even criminology.

From a neuroscience perspective, biosocial criminologists focus on the possibility that structural anomalies in the brain can lead to dysfunction associated with criminal behavior. Adrian Raine, a lecturer in the Department of Criminology at the University of Pennsylvania, is regarded as the founder of the new field of neurocriminology. Raine (2013) states that neurocriminology is a new way to provide a comprehensive understanding of crime as a phenomenon.

“Neurocriminology seeks to apply principles, methods, and insights garnered from the field of neuroscience to the study of what causes crime, as well as how to predict, prevent, and manage criminal behaviour and its consequences.” ([as cited in Berryessa & Raine, 2017, p. 78](#))

Therefore, Raine's thesis emphasizes that studying brain structure and its impact on individual criminal behavior is crucial. Adding a neuroscience perspective is necessary to investigate violent and antisocial behavior through various experimental studies examining the influences of the brain, nervous system, and social environment.

### **The University of Pennsylvania's Neurocriminology Findings**

Advancements in neuroscience have deepened our understanding of how biology impacts both good and bad behavior. The article “Neurocriminology: Implications for the Punishment, Prediction, and Prevention of Criminal Behavior” ([Glenn & Raine, 2014](#)) aims to apply neuroscience techniques and principles to understand better, predict, and prevent crime. This focus is important because it benefits the economy by lowering crime rates and enhancing social benefits. From a neurocriminology perspective, the University of Pennsylvania's research explores the link between abnormal neurobiology and criminal behavior, considering genetic and environmental factors that may contribute to this abnormality.

[Glenn & Raine \(2014\)](#) aim, through their studies, to answer the question: What are the implications of predicting future crime to protect society? Does this apply to prevent violent crime? What are the consequences if criminals are punished? Raine and Glenn argue that a neurobiological basis can answer these questions, leading to a new scientific revolution in neuro-criminology. Additionally, Raine and Glenn claim that many studies discuss the relationship between antisocial behavior and biological function. However, most studies show only inverse correlations and do not identify the specific genes or environmental factors that mediate this relationship. This is because most studies define antisocial behavior and crime broadly without distinguishing between violent and non-violent offenders. The analytical method used is meta-analysis, which summarizes quantitative research results by estimating effect sizes ([Crombie & Davies, 2009](#)).

[Glenn & Raine \(2014\)](#) consider several aspects to answer this research, which are:

#### **1. Genetic**

Results from over 100 behavioral gene studies with diverse designs suggest that several genes are linked to aggressive and antisocial behavior. Adoption studies specifically distinguish genetic influences from complex factors and provide evidence of heritable effects on antisocial and aggressive behaviors. This stage of research also focused on identifying specific genes that increase the risk of antisocial behavior. Several gene variants were found to gradually raise this risk. The meta-analysis concluded that none of these variants were significantly associated with aggressive behavior, with only 5% validity at the significant level.

Additionally, it is equally important to recognize that the environment plays a critical role in shaping antisocial behavior, particularly by increasing violence during early childhood. The discovery of this

genetic aspect demonstrates that the social environment can influence gene function, particularly in specific brain regions. This finding challenges the traditional view of biological determinism.

## **2. Influence of pre-pregnancy and post-natal period**

This study reveals the correlation between anti-social behavior and violence, based on the possible life patterns of offenders from pre-pregnancy to postpartum. This paper also summarizes research findings showing that nicotine and alcohol use during pregnancy increases the likelihood of becoming a violent offender in adulthood. The results of this study have been supported by research involving subjects across several continents.

## **3. Hormone and neurotransmitter**

This aspect utilizes medical instruments to examine the neural nodes within the brain's structure, the specific layers responsible for associations with violent behavior, and the characteristics of hormones and the nervous system.

## **4. Psychophysiology**

In this regard, the researcher summarized the observations from different groups, focusing on the possibilities arising from the psycho-physiological systems, specifically the heart and liver.

## **5. Visualization of the brain and nervous system**

In this section, biosocial criminologists examine how structural brain anomalies, particularly in the frontal lobe, may be linked to brain dysfunction that can result in criminal behavior. This lobe includes two regions: the dorsolateral and orbitofrontal areas. Raine and Glenn proposed that deficits in the orbitofrontal lobe are key factors in deviance, violence, crime, and personality disorders, including antisocial and aggressive behavior.

Studies by [Glenn & Raine \(2014\)](#) rely on these aspects, which are still scarce. Still, their findings claimed a will to provide early warnings of crime risk, and biological factors can easily predict which individuals are likely to commit crimes or offenses in the future.

On the other hand, neurocriminology faces legal challenges stemming from the role of science in society. This research aims to help address societal problems, including deviations and offense management within the criminal justice system. Raine and Glenn never imagined that changes in the legal and criminal justice systems would be based on this science, as neuroscience has advanced significantly over the past two decades and has multidisciplinary applications. Implications for sentencing include the need for a deeper examination of the neurobiological basis for policymaking. Complex issues in punishment, such as prison overcrowding and recidivism, are also related to this research's findings. [Song & Lieb \(1993\)](#) summarized studies *on recidivism, specifically the effects of incarceration and the length of time served, and concluded that the time served could be shortened without increasing post-release recidivism.*

[Glenn & Raine \(2014\)](#) suggest that offenders with orbitofrontal abnormalities might not be fully responsible for their malicious behavior. Contrary to US regulations, accountability in individuals requires two conditions: sufficient rational capacity and lack of external pressure. Rationality here means that offenders are aware of their actions and their consequences, making it unfair to hold responsible those with neurobiological disorders. Those with neurological issues cannot be treated the same as offenders who understand their actions' consequences, which involves treatment, rehabilitation, and resocialization grounded in neuroscience.

Regarding implications for crime forecasting, it is assumed that biological factors can predict future violence based on social variables. Although it may seem counterintuitive, the neuroscience of crime perspective supports the need to add value by incorporating neurobiology into crime forecasting studies.

Whether factors like biology are causal or just unrelated correlates, they can still improve the accuracy of risk assessments for newly released prisoners. This is important as a way to prepare for potential threats or anomalies that may develop more quickly among prisoners who will soon be released. The implication of this theory for preventing criminal behavior is that, if neurocriminology offers straightforward insights into how to reduce future crime, it could be highly appealing within the context of law and society, encouraging consideration of rehabilitation in criminal punishment.

### **Objectives**

The objective of this paper is to identify opportunities for developing Raine's perspective on criminology in Indonesia. Although its scientific foundation aligns with Psychiatry and Psychology, the Department of Criminology at the University of Indonesia is rooted in social sciences. The author emphasizes the importance of increased awareness of neuroscience or biosocial criminology, which is currently a topic of global scientific debate. The neurocriminological perspective provides a strong and increasingly vital framework for understanding and addressing complex criminal phenomena, including terrorist recidivism, and, specifically, for implementing deradicalization. This presents significant potential for development in Indonesia by analyzing the implications of punishment, predicting, and preventing terrorist recidivism. Moreover, although neuroscience continues to grow, it remains underrepresented in publications and applications across other disciplines, hindering its development in Indonesia. Along these lines, by breaking away from traditional medical domains of neuroscience, this article serves as an initial step to demonstrate that neuroscience can also function as a complementary tool to better understand, predict, and prevent criminal behavior, including informing interventions in deradicalization policies in Indonesia.

### **Methodology**

This article emphasizes a conceptual and comparative analysis to critically evaluate the foundations and implications of neuroscience in criminological discourse. It adopts an interpretive and analytical approach, grounded in Adrian Raine's neurocriminological perspective. The data collection method used in this research is a literature review. Data are gathered from various academic sources, including foundational books and journals published in reputable online databases. To enhance the perspectives and understanding of neurocriminology, the author also incorporated various media articles to observe how neuroscience and neurocriminology concepts are interpreted, especially in Indonesia.

This paper also aims to explore neurocriminology as a method that can enhance understanding of punishment, prediction, and recidivism prevention in the context of terrorism. Ultimately, this approach enables a critical synthesis of diverse theoretical perspectives. It opens new avenues for interdisciplinary collaboration between neuroscience and criminology in academic and policy discussions, especially for addressing terrorist deradicalization.

### **Findings and Discussion**

#### **Neurosciences in Indonesia**

Neuroscience in Indonesia remains relatively unfamiliar to the public. Many people do not fully understand its core focus. Its complex terminology often creates the impression that this field is mainly confined to the medical community. However, that is not true; as mentioned earlier, neuroscience is not purely a natural science, as it involves communities, social relationships, technology, and history. A

small number of people still see neuroscience as a pseudoscience lacking validity. Some advocates are actively publishing scientific work to support this field. Muhammadiyah Chairman Din Syamsudin founded the Muhammadiyah Neuroscience Agency (BNM) in 2013 to promote scientific development that benefits society; neuroscience is seen as a promising breakthrough for fostering a healthy future generation ([Universitas Muhammadiyah Riau, 2013](#)). BNM, created in partnership with the Muhammadiyah hospital network, aims to serve the community by holding seminars and workshops for pregnant women during the birthing process, which is believed to significantly influence the development of the brain and nerves in future babies.

The Indonesian Association of Early Childhood Educators and Education Personnel (Himpaudi) and the Indonesian Applied Neuroscience Association hosted an international seminar and workshop on neuroscience as a foundation for child development and education ([Koran Sindo, 2015](#)). The seminar emphasized different aspects of children's growth as a form of deficiency. It can be addressed based on the children's levels of brain and nerve maturity. Surya University also established the Indonesia Brain Research Center (IBRC), which aims to connect Indonesian scientists with the international research community through their studies. Irawan Satrioutomo, Director of IBRC, stated, “*Neuroscience development in the world is very significant. However, the development of neuroscience research and education in Indonesia is still far behind. For this reason, we feel the need to establish a brain research center in Indonesia*” ([Nodia, 2013](#)).

Following the application of neuroscience in education, the Graduate School of Universitas Muhammadiyah Prof. DR HAMKA (UHAMKA) hosted a seminar titled “Neuroscience for Elementary Education” on July 20, 2024 ([Timprosps Uhamka, 2024](#)). The seminar aimed to start integrating neuroscience into Indonesia's elementary education. Gea Pandhita, a neuroscience expert, shared insights on how children's brain development influences learning—in this seminar also explained practical neuroscience applications in the curriculum, highlighting adaptive teaching methods based on recent neuroscience research. They developed AR-supported neuroscience-based learning media. Participants tested this technology and learned about the eye-tracker, a tool for recording eye movements, and EEG, a tool for measuring brain activity. The seminar demonstrated how neuroscience can enhance curricula and improve elementary education in Indonesia.

The latest applications of neuroscience in Indonesia are still focused on education, working with learning management system platforms. A talk show held on April 25, 2025, by CheckIT Labs titled “AI & Neuroscience: The Future of Learning and Innovation” aims to explore the potential of Artificial Intelligence (AI) and neuroscience for more personalized and adaptive learning ([Haetami, 2025](#)). The main speakers are Myriam Da Silva, CEO of CheckIT Learning, and Wiwin Windrati, a performance storyteller and educator. The talk show highlighted how technology can support teaching methods, helping educators create classes that better match students' attention spans. With the help of Cleo AI, developed by CheckIT Learning, students can retain information more effectively through scheduled repetition of learning materials. Additionally, the tools enable personalized learning by adjusting content to students' interests, performance, and individual goals.

In the medical and academic fields, the President of the Republic of Indonesia, Prabowo Subianto, officially established the Integrated Service Building and the Neuroscience Institute at the National Brain Center Hospital ([Kemenkes, 2025](#)). This milestone marks a significant step forward in the nation's efforts to improve neurological and brain health services. The hospital functions as a research center for neuroscience while also providing patient care, offering services in the Autism Centre, Epilepsy Centre,

Rehabilitation Centre, and Stroke Centre ([Tempo, 2025](#)). It demonstrates how the highest levels of government finally recognize the critical importance of understanding the brain's role in broader fields, including public health and behavioral science. From an educational perspective, Indonesia has not yet created a dedicated university-level neuroscience program. However, some universities, such as the University of Indonesia and Andalas University, have begun offering neuroscience-related courses in their biomedical science programs.

### **Neurocriminology: A New Perspective on Terrorist Deradicalization**

In 2012, the Indonesian Government introduced a blueprint for a deradicalization program. The National Counterterrorism Agency (BNPT) is responsible for overseeing the successful implementation of this program. The deradicalization program is implemented in two settings: (1) outside the prison for former terrorist convicts and their families who are susceptible to radicalism; and (2) inside the prison system for terrorism convicts classified as core and militant ([Ulyana & Riyansyah, 2021](#)). The process in prison includes identification, rehabilitation, reeducation, resocialization, and monitoring and evaluation. All religious, economic, legal, political, and psychosocial approaches have fostered a tolerant mindset ([Khamdan, 2015](#)). [Meliala \(2016\)](#), in one of his psychopathology lectures, stated that terrorists are dangerous offenders who quickly relapse; their dangerousness puts others or society at risk as victims. The indication of dangerousness suggests that terrorists are in a high-risk condition. Unfortunately, this indication has not been thoroughly studied in psychology, treatment, and classification, which calls for precise prediction.

Social, psychological, economic, and religious approaches are not the complete answer to terrorist recidivism. With the same patterns and activities, they still believe that their understanding of violence and jihad is the only way to live. At the same time, they have followed the deradicalization program. The current approach focuses solely on the religious aspect. Additionally, [Garland \(1990\)](#), in his book *Punishment and Modern Society*, cites Foucault, noting that perpetuating the pattern of rulers and subordinates does not help reduce problems in prisons. For example, perpetuating power by bringing in outside religious experts for self-demystification often proves ineffective on certain groups they oppose, such as the lower class against the upper class.

Therefore, biosocial experts can be involved in precisely analyzing the appropriate neuroscience treatment to identify potential harm if terrorist inmates do not undergo a comprehensive deradicalization program ([Garland, 1990](#)). He stated that:

"a variety of perspectives - each one employing a different angle of approach and a shifting focus of attention - then there is no in-principle reason why they should not be brought together to help us understand a complex object in all its various aspects and relations." ([as cited in Smandych et al., 1991, p. 13](#))

Garland, known as an expert in the sociology of punishment, called for more approaches to analyzing problems in prisons. In line with research by Adrian Raine, [Treiber \(2011\)](#) explains that criminological theory is often poorly informed about neuroscientific mechanisms and about the causes of crime and repeated deviations. [Treiber \(2011\)](#) argues that situational action theory (SAT) helps define crime as moral behavior that occurs when perceptions of rules, right or wrong, or authority's definition of evil or non-evil behavior break down. According to Treiber, SAT does not explain why someone might shoot another person, especially when the background is unrelated to the crime itself, but this can be understood

through neurocognitive science. Treiber also claims that even secondary deviant behavior can be accurately detected through neurotransmitter activity.

Similarly to [Treiber \(2011\)](#), examined that dysfunction in the limbic system of the human brain is shown to correlate with crimes committed, including indicators of psychopathy in the social environment. The limbic system in the brain plays a role in determining human behavior, including emotions, vengeance, lust, and other deadly sins. Under high pressure and stress, the brain's nerves may urge the individual to fight. The hypothalamic-pituitary-adrenal (HPA) axis is the neuroendocrine system that responds to stress and other forms of pressure. [Rudo-Hutt et al. \(2011\)](#) found that hormones and neurotransmitters are linked to environmental and social factors in analyses of antisocial behavior. Hormones associated with antisocial behavior include cortisol and testosterone. Cortisol plays a role in the body's stress response, directing energy in reaction to pressure in the brain.

Regarding prison deradicalization programs, neuroscience approaches, genetic databases, and other elements, they are practical for obtaining accurate measurements. Combining these methods with the existing interdisciplinary approach could provide additional treatment options within Indonesia's deradicalization efforts. The debate about which domain should be prioritized for problem-solving should not be a major concern. Expanding this research area can undoubtedly broaden perspectives and foster experimentation in the field. While some universities abroad have attempted to explore neuroscience further to assess its relevance and correlation—especially concerning this proposal, which focuses on the rate of terrorist recidivism—it raises the question, as an unbiased academic, of why the model mentioned above has not been discussed in relation to the deradicalization program for terrorist prisoners in Indonesia. The author believes that Indonesia, through the National Counterterrorism Agency (BNPT), should pursue this direction in developing deradicalization models.

### Concluding thoughts

This article review underscores that the breakthroughs in neurocriminology, when situated within a postmodern paradigm, open new horizons for criminological development in Indonesia. By moving beyond a purely social orientation and embracing interdisciplinary integration—including neuroscience, medicine, biology, sociology, psychology, and biomedicine—criminology can evolve into a more holistic and evidence-based discipline. Neurocriminology's unique contribution lies in its ability to integrate diverse scientific perspectives while remaining relevant to social relations, thereby offering both theoretical enrichment and practical utility in crime prevention.

Within the Indonesian context, where deradicalization policies have often been framed through religious, economic, and ideological lenses, such as Pancasila, incorporating criminological and neuroscientific insights provides a more comprehensive framework for forecasting risks, designing interventions, and preventing terrorist recidivism. Thus, the conclusion affirms that integrating social science, neuroscience, and criminology not only advances academic discourse but also strengthens national strategies for justice, security, and community resilience. This closure reflects the multidimensional nature of the discussion—epistemological, social, medical, and policy-oriented—while positioning neurocriminology as a transformative field capable of reshaping Indonesia's approach to crime and terrorism in the years ahead.

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