



Can a Brain Scan Reclassify Murder? Neuroevidence and the Boundary between ‘Amd, Shibh al-‘Amd, and Khaṭa’

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ABSTRACT

This study examined whether neuroevidence could alter the juridical classification of homicide in Islamic criminal law. It used a non-empirical qualitative design based on a focused narrative conceptual review of Islamic criminal-law scholarship on intentional homicide, quasi-intentional homicide, accidental killing, criminal intent, and responsibility, together with selected neurolaw and neuroscience literature on volition, executive control, and neurocognitive impairment. The analysis clarified the relevant concepts, compared the two literatures, and interpreted the juridical significance of neuroevidence. It found that intentional homicide, quasi-intentional homicide, and accidental killing did not form a neurological continuum and that executive-control impairment did not itself negate homicidal intent. Brain findings also remained separated from the offender's historical mental state by a substantial inferential gap. The study proposed a four-level model distinguishing capacity, intention, act classification, and penal consequence. It concluded that neuroevidence could contribute to reclassification only indirectly when tied to a doctrinally relevant proposition, while quasi-intentional homicide should not become a residual category for impaired control.



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INTRODUCTION

The encounter between neuroscience and criminal law is often framed as a problem of new evidence entering an old doctrinal system. That description is incomplete. Neuroevidence does not merely add another source of proof; it can destabilize the categories through which legal systems describe agency, intention, control, and responsibility. Brain imaging has been invoked to support claims about impaired executive function, abnormal impulse regulation, psychopathology, and diminished culpability, while legal scholarship has repeatedly cautioned that a neural abnormality does not translate automatically into a legally exculpatory mental state (Aharoni et al., 2008; Meynen, 2013; Maoz & Yaffe, 2016; Slobogin, 2017). The problem is especially acute in homicide because the legal consequence often turns on distinctions among forms of culpable killing rather than on a binary opposition between responsibility and no responsibility.

Islamic criminal law provides an unusually demanding setting for this problem. Classical juristic treatments of homicide distinguish forms of killing by reference to the actor's conduct, intention, instrumentality, causal relation to death, and the legal consequences that follow. The familiar analytical triad of intentional killing (*'amd*), quasi-intentional killing (*shibh al-'amd*), and accidental killing (*khaṭa'*) captures an important core of the doctrine, although the *madhāhib* differ in taxonomy and in the details by which cases are allocated among categories (Anderson, 1951; Peters, 2006). In particular, the *Hanafi* tradition develops additional classifications beyond a simple tripartite scheme, while other schools organize homicide differently around intent, means, and causal structure. The triad used in this

article is therefore an analytical focus rather than a claim that all classical jurists adopted an identical three-part code.

The doctrinal difficulty begins when contemporary neuroevidence is introduced into this classificatory architecture. Suppose a defendant deliberately selects a victim, retrieves a weapon, approaches the victim, and inflicts the fatal injury, but neuroimaging and neuropsychological evidence indicate significant dysfunction in neural systems associated with inhibition or executive control. Should that impairment alter the classification of the killing? The intuitive temptation is to treat reduced control as reduced intent and then to move the conduct downward from *'amd* toward *shibh al-'amd* or even *khaṭa*'. That move is conceptually hazardous. Neuroscience distinguishes, however imperfectly, processes associated with volition, inhibition, planning, affective regulation, and action selection (Haggard, 2008; Aron et al., 2014). Islamic homicide doctrine, by contrast, does not simply ask how neurologically "normal" an offender was. It asks what kind of act was done, with what legally relevant intention, by what means, and under what conditions of responsibility.

The modern neurolaw literature offers a further warning. Structural and functional abnormalities have been reported in populations characterized by serious violence, antisociality, or psychopathy, including findings involving prefrontal and paralimbic systems (Raine et al., 1997; Bufkin & Luttrell, 2005; Kiehl, 2006; Yang & Raine, 2009; Glenn & Raine, 2014). More recent synthesis continues to associate prefrontal dysfunction with violence-related behavioral regulation, while also emphasizing heterogeneity and the limits of individual prediction (Romero-Martínez et al., 2026). Such associations do not identify the mental state of a particular person at the historical moment of a killing. Functional imaging measures indirect physiological correlates of neural activity, and inferring a specific cognitive state from activation in a region is vulnerable to the well-known problem of reverse inference (Poldrack, 2006; Logothetis, 2008). The inferential distance from "abnormal brain pattern" to "absence of homicidal intent" is therefore substantial.

The central gap lies precisely here. Islamic criminal-law scholarship has examined intention and homicide classification, and neurolaw scholarship has examined brain evidence, mens rea, insanity, culpability, and sentencing. Yet the two conversations have rarely been integrated at the level that matters most for homicide classification: whether neurocognitive impairment should alter the juridical characterization of the killing itself. Existing discussions can too easily collapse three separate questions: whether the actor possessed the capacity to be held responsible; whether the actor formed the legally relevant intent; and whether the physical and mental configuration of the killing satisfies a particular homicide category. These questions may overlap, but they are not interchangeable. Recent Indonesian scholarship illustrates the same unresolved boundary from two directions. Work on neurocriminology has emphasized the need to distinguish biological vulnerability from legal culpability and to specify evidentiary standards before neuroscientific findings are translated into responsibility judgments (Kadir et al., 2025; Kadir & Mappaselleng, 2026), while neurogenetic analysis has similarly shown that a biological correlate of aggression does not by itself determine the juridical status of fault or intent (Kadir, 2025).

This article therefore asks two questions. First, what juridical role, if any, should neuroscientific evidence play in distinguishing *'amd*, *shibh al-'amd*, and *khaṭa*? Second, should neurocognitive impairment affect the existence of homicidal intent, the actor's capacity for responsibility, the voluntariness or control of conduct, or only the penal consequences of a killing that remains intentional? The article develops a simple proposition: capacity deficit, intention deficit, and act-classification deficit are analytically distinct. Its novelty is not the claim that neuroscience is relevant to Islamic criminal law. It is the narrower claim that neuroevidence must be assigned to the correct juridical level before it can have classificatory significance. A brain scan may contribute to an evidentiary account of impairment, but it should not function as a doctrinal shortcut from abnormality to reclassification.

RESEARCH METHODS

This study uses a non-empirical qualitative design based on a focused narrative conceptual review. It does not test neuroimaging, evaluate defendants, code court files, or estimate the prevalence of neurological abnormalities among offenders. The literature is used as conceptual material for clarifying the relationship between neurocognitive impairment and the juridical classification of homicide.

Sources were selected purposively from two bodies of scholarship. The first consists of Islamic criminal-law works addressing homicide, *qisās*, intention, and the distinction among ‘*amd*, *shibh al-‘amd*, and *khata*’, with attention to the fact that the classical schools do not formulate every boundary identically (Anderson, 1951; Peters, 2006; Kamali, 2019; Ropei, 2021; Al-Nasiri, 2026). The second consists of peer-reviewed neurolaw and neuroscience literature concerning criminal responsibility, *mens rea*, volition, executive control, neuroimaging, violence, and the courtroom use of neuroscientific evidence (Jones et al., 2013; Farahany, 2016). Preference was given to sources that directly clarify either the doctrinal categories or the inferential limits of neuroevidence.

The analysis proceeds through three modest operations: conceptual clarification, cross-literature comparison, and integrative interpretation. First, the study identifies what work the principal homicide categories perform in Islamic criminal law and separates homicide classification from general capacity for responsibility. Second, it compares those concepts with neuroscientific claims concerning inhibition, volition, executive dysfunction, and brain abnormality. Third, it asks at which juridical level a neuroscientific finding could be relevant: capacity, formation of intent, control or voluntariness, classification of the lethal act, or penal consequence. No systematic-review protocol, meta-analysis, bibliometric procedure, statistical analysis, or empirical causal claim is employed. The resulting conclusions are conceptual and jurisprudential: they specify conditions under which neuroevidence may be relevant without claiming that a scan can itself diagnose ‘*amd*, *shibh al-‘amd*, or *khata*’.

RESULTS AND DISCUSSION

Homicide Classification Is Not a Neurological Gradient

The first task is to resist a deceptively simple model in which ‘*amd*, *shibh al-‘amd*, and *khata*’ are imagined as three points on a psychological scale running from full intent to partial intent to no intent. Classical doctrine is more structured than that. Intent matters, but jurists also use the character of the assault, the means employed, the relation between the intended act and the resulting death, and school-specific presumptions concerning lethal instruments. The law of *qisās* consequently links intentional killing to a configuration of wrongful agency rather than to a free-floating measure of subjective intensity (Anderson, 1951; Peters, 2006; Kamali, 2019). A recent transsystemic analysis of intentional homicide reaches a parallel conclusion: distinct culpability structures should not be flattened into a single continuum, because the consequence intended and the actor’s awareness of death perform different classificatory work across legal traditions (Kadir, 2026a).

This is particularly important for *shibh al-‘amd*. In a common juristic formulation, the actor intentionally attacks the victim but does so in a manner or with an instrument not ordinarily treated as lethal, and death follows without the lethal intention that characterizes ‘*amd*. The precise tests vary across schools, and modern summaries often simplify a complex doctrinal history. Even so, *shibh al-‘amd* is not best understood as a premodern equivalent of contemporary diminished capacity. It is a juridical category organizing the relationship among intentional assault, lethal means, and unintended death. Ropei’s discussion of intention in Islamic homicide law likewise shows how external circumstances, including the weapon and antecedent hostility, can function as legal indicators of intent rather than as direct windows into an inner mental state (Ropei, 2021).

Khata’ is further removed from the idea of a neurologically weakened intention. Accidental killing concerns a legally significant mismatch between what the actor intended and the death that occurred, or an error affecting the object or act, depending on the doctrinal formulation. An offender who intentionally aims a lethal attack at a known person does not ordinarily become an accidental killer merely because his inhibitory control was impaired. The category addresses mistake or accident in the action-intention structure, not simply a lower quality of self-regulation.

The consequence is decisive for neuroevidence. A neural finding cannot be mapped onto the homicide taxonomy as if more impairment necessarily means a lower category of culpability. That would transform a multidimensional legal classification into a biomedical severity scale. The classical categories do not ask whether the defendant’s brain was optimally regulated. They ask whether the fatal conduct was intentional in the legally relevant sense and how the act, means, target, and result relate to one another. This preserves a distinction between explanation and classification: neuroscience may help explain why an offender acted, yet the legal category depends on whether that explanation negates or alters a doctrinally required element. This separation between explanatory context and legal classification is also consistent with socio-legal homicide analysis showing that victim-offender

relationships and situational patterns illuminate the social form of killing without reproducing the elements through which criminal law ultimately classifies the offense (Kadir, 2026b).

Capacity Deficit Is Not Intention Deficit

The most important distinction for the present inquiry is between the capacity to be responsible and the formation of a particular intent. Modern criminal law has long struggled with the difference between mens rea and excuses based on mental disorder, and neurolaw scholarship repeatedly emphasizes that evidence relevant to one is not automatically relevant to the other (Meynen, 2013; Maoz & Yaffe, 2016; Slobogin, 2017). The same analytical discipline is necessary in Islamic criminal law.

A person may possess impaired executive control while still forming a coherent intention to kill. Executive functions are involved in inhibiting responses, shifting behavior, planning, and regulating action. The right inferior frontal and associated fronto-basal-ganglia networks, for example, have been studied as components of response inhibition (Aron et al., 2014). Research on volition similarly decomposes voluntary action into questions such as whether to act, what action to perform, and when to perform it (Haggard, 2008). None of these findings entails that impairment in one component eliminates goal representation or purposive action as a whole.

This matters because violent behavior has heterogeneous neurobiological correlates. Studies have reported prefrontal, temporal, limbic, and network abnormalities in violent, antisocial, psychopathic, or homicidal samples (Raine et al., 1997; Bufkin & Luttrell, 2005; Wahlund & Kristiansson, 2009; Fabian, 2010). Meta-analytic work has found reduced prefrontal structure or function across antisocial groups (Yang & Raine, 2009), and lesion-network research suggests that some lesions associated with acquired criminal behavior are functionally connected to networks implicated in moral decision-making and value-based processes (Darby et al., 2018). These findings are scientifically important, but they do not establish a one-to-one pathway from neural dysfunction to the absence of a legally defined intention.

Accordingly, neurocognitive impairment should first be assigned to the question it actually bears upon. If the evidence concerns a profound disorder that undermines the actor's basic capacity for legally accountable agency, the relevant inquiry is responsibility or excuse. If the evidence concerns impulse regulation, it may bear on control. If it concerns memory or perception, it may affect factual reconstruction. Only if it provides reliable evidence that the actor did not form the specific intention required for the homicide classification should it alter the intent analysis itself. This is the core of the proposed distinction: capacity deficit $\neq$ intention deficit. The same caution appears in Indonesian neurocriminal-law scholarship, where neurobiological or neurogenetic vulnerability is treated as a challenge to the architecture of culpability rather than as an automatic substitute for the legal inquiry into fault (Kadir, 2025; Kadir et al., 2025).

The distinction also prevents anachronistic translation. It would be easy to label *shibh al-'amd* a category of "partial intent" and then fit executive dysfunction into it. But the historical doctrine does not require this psychological reading. A person with poor impulse control who deliberately uses a conventionally lethal method against an identified victim can remain within the doctrinal structure of *'amd* even if the impairment becomes relevant elsewhere. Conversely, a neurologically typical person can commit *shibh al-'amd* if the act-result configuration satisfies that category. Classification follows juridical elements, not neurological normality.

From Brain Abnormality to Historical Mental State: The Inferential Gap

A second problem concerns proof. Even when the legal question is correctly identified, a brain scan must still support the relevant inference. Neuroimaging has extraordinary descriptive power, but its courtroom meaning is constrained by what the technique measures and by the difference between population-level associations and individual historical states. Functional MRI relies on hemodynamic signals rather than direct observation of intention, while structural imaging identifies anatomy rather than the content of a past decision (Logothetis, 2008).

Poldrack's account of reverse inference is especially important here. The fact that a region is active or abnormal does not deductively establish that a specific cognitive process was present or absent because most regions participate in multiple processes and because the selectivity of brain-behavior mappings varies (Poldrack, 2006). In homicide adjudication the problem is magnified by temporal distance. The legally relevant question concerns what the defendant intended at the moment of the fatal

act. A scan obtained days, months, or years later may document a stable lesion or atypical structure, but the move from that fact to a precise historical mental state requires additional behavioral, clinical, and contextual evidence.

Neurolaw has therefore moved away from the simplistic proposition that “the brain made him do it.” Greene and Cohen famously argued that neuroscience may affect legal intuitions even when existing doctrine can in principle accommodate the new facts, while Roskies cautioned against assuming that neuroscientific explanation itself dissolves responsibility (Greene & Cohen, 2004; Roskies, 2006). Mobbs et al. similarly identified both the promise and the limitations of connecting brain evidence to responsibility (Mobbs et al., 2007). Roache’s question whether brain scans can prove offenders unaccountable captures the problem sharply: neural evidence can be probative without being dispositive (Roache, 2014).

For Islamic homicide law, the appropriate evidentiary rule should therefore be one of mediated relevance. Neuroevidence should enter the analysis through the specific proposition it can support: documented lesion, impaired inhibition, neurocognitive disorder, or another clinically grounded finding. It should then be combined with the ordinary evidence of conduct—weapon choice, preparation, target selection, repeated acts, concealment, statements, and surrounding circumstances—before any conclusion is drawn about *qasd*. This is compatible with the classical tendency to infer intention through legally observable indicators rather than to demand impossible direct access to the offender’s interior state (Ropei, 2021). A comparable classificatory discipline has been proposed in research on gendered homicide, where labels such as honor killing or intimate partner femicide should not displace the separate assessment of mens rea, participation, and offense elements (Kadir, 2026c).

The danger of bypassing this mediation is a neuro-essentialist error: treating the brain image as a privileged representation of the “real” offender while discounting conduct. Experimental literature gives reason for caution. Neuroscientific and biomechanical explanations can affect judgments about culpability or punishment, but the direction and magnitude of the effect vary (Aspinwall et al., 2012; Gurley & Marcus, 2008; Greene & Cahill, 2012). Schweitzer et al. found that neuroimages did not independently change mens rea verdict-related outcomes beyond verbal expert evidence in their experiments, although neuroscience could influence perceived control capacity (Schweitzer et al., 2011). Other work shows that neuroscience may mitigate or aggravate depending on the penal rationale presented (Perricone et al., 2022). Judges’ evaluations of expert reports can likewise be affected by neuroscientific material (Moulin et al., 2018). This concern is reinforced by recent work on neuroscientific evidence in Indonesian criminal adjudication, which identifies the absence of clear standards for validity, limits, and legal relevance as a source of epistemic risk when biological findings are translated into culpability claims (Kadir & Mappaselleng, 2026).

These findings do not tell Islamic law what its doctrine should be. They expose a procedural risk: vivid scientific evidence can exert persuasive force disproportionate to its juridical specificity. The broader “seductive allure” literature shows that neuroscientific information can make explanations seem more satisfying even when the additional neural detail is logically irrelevant (Weisberg et al., 2008). A disciplined Islamic-law analysis should therefore ask not whether the scan looks impressive, but which element of *‘amd*, *shibh al-‘amd*, or *khata’* the evidence actually tends to prove or disprove.

A Four-Level Model of Neuroevidentiary Relevance

The conceptual synthesis supports a four-level model. The levels are not empirical stages and do not purport to codify any particular jurisdiction. They are a jurisprudential device for preventing category mistakes.

Level one is capacity. Neuroevidence may indicate a serious impairment relevant to whether the person possessed the minimal cognitive or volitional capacities assumed by responsibility. This is the level most closely associated with insanity-type reasoning in modern law, though Islamic legal doctrines of capacity have their own conceptual vocabulary and cannot simply be equated with modern psychiatric defenses. The key point is structural: if the defect concerns the agent’s general capacity, it should be analyzed there rather than silently rewritten as absence of homicidal intent.

Level two is intention. Here the question is narrower: did the actor form the intention that the relevant homicide category requires? Neuroevidence is relevant only if it assists that specific inquiry. A disorder affecting inhibitory control may explain why an actor failed to resist an intention already formed. That is different from evidence showing that the actor could not understand the target,

appreciate the nature of the act, or form a purposive lethal objective. Aharoni et al. argue that courts must specify the legal criterion first and only then ask whether neuroscience can provide information about it (Aharoni et al., 2008). That sequencing is exactly what Islamic homicide analysis requires.

Level three is act classification. Even where mental impairment is established, the legal classification of the killing depends on how intention interacts with the conduct and means. A deliberate lethal attack should not be reclassified solely because a scan reveals executive dysfunction. Conversely, evidence that genuinely undermines lethal intent could matter, but it would still have to be interpreted together with the instrument, manner of assault, target selection, and the relevant *madhhab*'s doctrinal test. This level is where the proposed "neuro-evidentiary reclassification" problem is resolved: reclassification is permissible only when neuroevidence changes a juridically constitutive fact, not merely when it makes the offender's psychology appear abnormal.

Level four is penal consequence. Neuroevidence may be relevant to mitigation, individualized punishment, treatment, or discretionary responses even when it does not alter the homicide category. Contemporary practice demonstrates that biological evidence is frequently introduced at sentencing and can influence punishment (Farahany, 2016; Khalid et al., 2024; Thomaidou et al., 2025). In Islamic criminal law, the architecture of *qisās*, *diyyah*, pardon, and discretionary state authority differs fundamentally from modern sentencing grids, but the analytical lesson remains useful: evidence can be legally relevant to consequence without rewriting the ontology of the offense.

This four-level model explains why the article's title requires a qualified answer. A brain scan can contribute to reclassification only indirectly. It cannot itself convert '*amd*' into *shibh al-'amd* or *khaṭa*'. It must first support a proposition about capacity, intention, or another legally constitutive fact, and that proposition must then satisfy the relevant doctrinal test. The scan is evidence about a person; the homicide category is a legal judgment about an act, mind, means, result, and responsibility taken together.

Why Shibh al-'Amd Should Not Become a Neuroscientific Residual Category

The strongest implication concerns *shibh al-'amd*. Emerging technologies often create pressure to place difficult cases into intermediate legal categories. Because *shibh al-'amd* stands between intentional and accidental killing in many pedagogical accounts, it can become an attractive residual category for defendants who were neither fully "normal" nor fully incapable. That would be a doctrinal mistake.

The category should not absorb every case of impaired control. Doing so would gradually redefine *shibh al-'amd* from a juristic classification of a particular act-intent-result configuration into a general mitigation doctrine. It would also create an asymmetry: defendants with visible neurological abnormalities could obtain a homicide reclassification even when similarly situated defendants with functionally equivalent but non-imaged impairments could not. Such a result would privilege technological visibility rather than juridical relevance.

Neuroscience itself gives no reason for this move. The relationship between frontal dysfunction and violent behavior is probabilistic and heterogeneous, and contemporary neurocriminology explicitly recognizes the interaction of biological, psychological, and environmental factors (Glenn & Raine, 2014). Studies of psychopathy and aggression identify distributed neural systems rather than a singular "violence center" (Kiehl, 2006; Wahlund & Kristiansson, 2009). Even the strongest recent imaging synthesis cannot establish that a particular defendant lacked the intention required for a particular killing merely because a group-level pattern is present (Romero-Martínez et al., 2026).

A more defensible principle is doctrinal non-substitution: neuroevidence may inform a fact that doctrine already treats as relevant, but it should not substitute a neuroscientific construct for the doctrine itself. "Executive dysfunction," "reduced inhibitory control," and "abnormal prefrontal activation" are scientific descriptions. They are not synonyms for *shibh al-'amd*. The legal interpreter must translate cautiously, element by element, and remain willing to conclude that a scientifically meaningful impairment has no classificatory effect.

The Broader Jurisprudential Payoff

The analysis has implications beyond brain scans. Islamic criminal law increasingly encounters scientific evidence that describes behavior through risk, cognition, genetics, psychiatry, or neurobiology. The temptation in each domain is to treat scientific sophistication as legal specificity. Neurolaw shows why that is unsafe. Jones et al. describe the growing interface between law and

neuroscience, while Farahany's empirical work demonstrates that neurobiological evidence has already entered a wide range of criminal cases rather than remaining a theoretical possibility (Jones et al., 2013; Farahany, 2016).

The deeper jurisprudential point is that causal explanation and normative attribution answer different questions. Neuroscience may explain the mechanisms through which an intention was formed, an impulse became harder to resist, or a decision process was altered. Criminal law asks whether those facts satisfy standards for attribution, excuse, classification, and consequence. Sapolsky's account of frontal biology and criminal justice pressed the legal system to confront the biological conditions of behavior, but later neurolaw has shown that biological causation does not itself settle the normative structure of responsibility (Sapolsky, 2004; Slobogin, 2017).

Islamic homicide law is well positioned to preserve this distinction if its categories are interpreted with doctrinal precision. The classical law already separates forms of killing through structured legal characteristics rather than through a single psychological continuum. The challenge is not to modernize those categories by attaching a brain region to each of them. It is to determine when contemporary evidence genuinely bears on the juristic facts that make one category different from another.

The resulting position is neither neuro-skeptical nor neuro-deterministic. Neuroevidence should not be excluded merely because classical jurists did not possess MRI or fMRI. Nor should it be elevated into a privileged mechanism for reading *qasd*. Its value depends on fit: fit between the scientific proposition and the legal element, between group evidence and individual inference, and between impairment and the specific doctrinal consequence claimed. Where that fit is weak, the proper conclusion is evidentiary modesty rather than doctrinal reclassification.

CONCLUSION

A brain scan cannot, by itself, reclassify murder in Islamic criminal law. The proposition sounds conservative, but its basis is not hostility to neuroscience. It follows from a more precise account of what homicide categories and neuroevidence each do.

The distinction among '*amd*, *shibh al-'amd*, and *khaṭa*' is not a neurological scale from normal intention to impaired intention to no intention. These categories organize legally relevant relationships among intention, action, means, target, causation, and result, with important differences among the classical schools. *Shibh al-'amd* in particular should not be reconstructed as a catch-all category for diminished executive control. A defendant can have a capacity or control deficit and still form the lethal intention required for '*amd*'; equally, a neurologically unremarkable defendant can fall within *shibh al-'amd* because of the juridical configuration of the assault. The article therefore proposes a four-level discipline for neuroevidence: capacity, intention, act classification, and penal consequence. Evidence should be placed at the level corresponding to the proposition it can actually support. Only when neuroevidence reliably alters a fact constitutive of the homicide category should reclassification even become possible. Otherwise, its relevance may lie in responsibility, mitigation, treatment, or another consequence rather than in the identity of the offense.

This produces the article's central conceptual contribution: capacity deficit $\neq$ intention deficit $\neq$ act-classification deficit. The distinction protects Islamic homicide law from a category error in which scientific evidence about impaired regulation is mistaken for legal evidence of absent intent. It also provides a broader method for engaging future neurotechnology: specify the doctrinal element first, identify what the science can actually establish, and permit legal translation only where the two genuinely meet.

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