

Emotions and Cognition in the Moral Brain: A Neuroscientific Review of the Dual-Process Theories of Decision Making

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ABSTRACT

Moral decision-making is a pivotal human process that requires a harmonious balance between emotion, reasoning, and social context. With recent advances in cognitive neuroscience, it has been revealed that moral judgements are driven by multiple brain systems, including the amygdala, ventromedial prefrontal cortex (vmPFC), and dorsolateral prefrontal cortex (dlPFC). Together, these regions interact to evaluate dilemmas individuals may face and guide one's behavior. This literature review synthesizes findings from functional imaging, lesion, and studies to address an overarching question: Are moral judgements primarily driven by emotion or rational processes? Evidence suggests that emotional responses, supported by the vmPFC and limbic structures, are more associated with rapid, intuitive moral judgements, whereas cognitive mechanisms in the dlPFC are utilized for more deliberate, or high-conflict decisions (Qu et al., 2022). The interplay between these two forces bolsters the dual-process theory of moral cognition, where emotion and rationality coexist rather than be opposing forces. Understanding this interplay provides insight and vital information regarding ethical behaviors, legal responsibilities, and artificial intelligence systems that are devised to mimic human's moral capacities.

Keywords: moral decision-making; ventromedial prefrontal cortex; dorsolateral prefrontal cortex; amygdala; emotion regulation; dual-process theory; moral dilemmas; fMRI; Neuroethics; empathy; cognitive control; moral cognition.

INTRODUCTION

Moral decision-making, the process of differentiating right from wrong, has long been a fascination by many philosophers, psychologists, and neuroscientists. For many years, philosophers such as Immanuel Kant and David Hume debated whether moral reasoning is yielded from rational thought or emotions. Looking upon research done at Stanford university regarding these philosophers, researchers found that Kant argued that morality comes from logical reasoning and universal laws of morality, while Hume made the position that emotions and passions guide human morality (Johnson et al., 2024; Cohon, 2018). In recent years, advances in neuroscience have brought newfound insight into this debate by identifying the neural systems that support moral reasoning.

At its core, moral decision-making serves as a complex interaction between emotion and cognition. It ultimately involves the evaluation of actions, intentions, and outcomes in the presence of many societal values. Neuroscientific research suggests that moral choices are not made from a single center in the brain but rather by an entire network that includes regions responsible for both emotion—the amygdala and ventromedial prefrontal cortex (vmPFC)—and cognitive regions such as the dorsolateral prefrontal cortex (dlPFC). The historical separation between rational and emotional processes is increasingly being argued against, as systems that combine many neural networks are integral to decision-making (Kirman, 2010).

Thus, understanding how these systems interact with each other is vital not only for theorizing models of decision making but also for practical applications of it. So, this paper aims to explore the basis of moral-decision making and address the central question: Are moral judgements primarily driven by emotion or rational processes? To do this, the literature review will examine the following (1) the underlying neural systems that are essential to moral cognition, (2) evidence from neuroimaging and lesion studies, (3) integration through dual-process theory, and (4) the implications for both ethics and society.

METHODOLOGY

A wide-spread literature review was conducted to identify many studies investigating neural mechanisms that are needed for moral decision-making. Searches were performed using databases such as PubMed, Scopus, and Google Scholar. Search terms such as “moral decision-making neuroscience,” “moral reasoning fMRI,” and “dual-process theory,” “ventromedial prefrontal cortex moral judgement,” “dorsolateral prefrontal cortex moral cognition,” “amygdala moral emotion,” “utilitarian moral dilemmas brain activation,” and “vmPFC lesion moral behavior” were chiefly used in locating sources. Studies published in the last 25 years were prioritized, and the usage of sources containing human-based studies, systematic reviews and meta-analysis were incorporated. This yielded roughly 30-40 viable studies, and after screening their abstracts for relevance and completing further reading, the sources that correlate best with my essential question were enlisted for this literature review.

This methodology ultimately ensured a balanced representation for both the emotional and cognitive models of moral decision-making. Additionally, incorporating lesion and neuroimaging studies

allowed for a greater understanding and more comprehensive review of the brain's role in moral cognition.

Underlying Neural Mechanisms of Moral Judgement

Moral judgement incorporated a vast network of brain regions that are responsible for emotion processing, ranking of values, and cognitive control. Rather than operating through a single center, research has shown that moral decision-making is reliant on the combination of multiple neural systems that process emotional, social, and executive information, which includes but is not limited to the amygdala, vmPFC, dlPFC, and anterior cingulate cortex (ACC) (Moll et al., 2003; Bzdok et al., 2012).

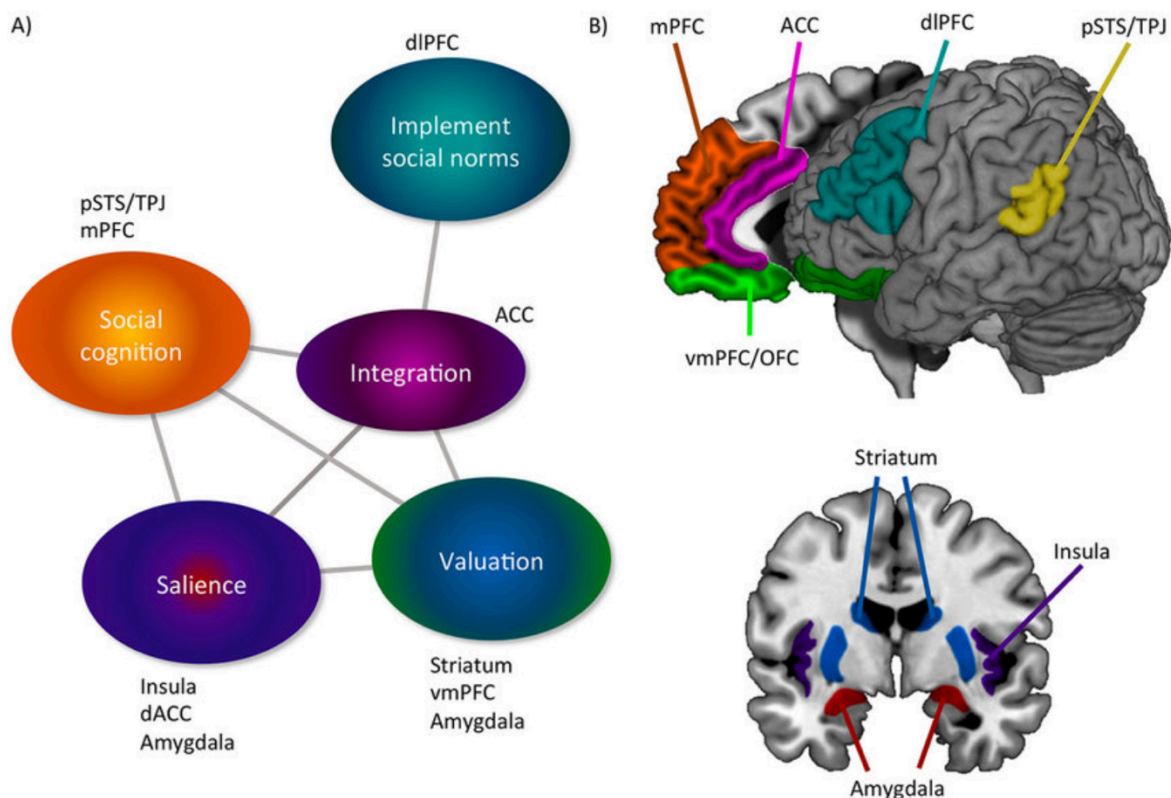


Figure 1: Key brain regions implicated in moral decision-making, including the ventromedial prefrontal cortex (vmPFC), dorsolateral prefrontal cortex (dlPFC), temporoparietal junction (TPJ), amygdala, and anterior cingulate cortex (ACC). This reflects the distributed nature of the moral network and its interplay (Decety & Yoder, 2017).

Emotion-Based Systems

The amygdala is central in processing emotional stimuli and being in control of emotional responses such as empathy, guilt, and aversion to harm. When individuals are confronted with personal dilemmas—situations that involve physical harm or a strong emotional tie—the amygdala exhibits heightened activity, suggesting that emotional processes in the amygdala are highly associated with moral decisions (Greene et al., 2001).

The vmPFC, which is closely connected to the amygdala and limbic structures, is essential for converting emotional signals into decision-making. It aids in evaluating the social and emotional consequence of a choice by assigning values to actions and guiding behavior that is consistent with feelings of empathy and compassion (Moll et al., 2003). Damage to the vmPFC can yield diminished emotional responses, leading to more utilitarian choices that prioritize outcomes over certain emotional considerations (Koenigs et al., 2007; Schneider & Koenigs, 2017). Furthermore, recent EEG evidence indicates that bodily signals, particularly cardiac interoceptive processing, influence moral-decision making at the neural level. Differences in heartbeat-evoked brain responses have been shown to distinguish utilitarian from deontological judgements, suggesting that internal bodily states contribute to how moral conflicts are emotionally evaluated (Cui & Nakano, 2024).

Cognition-Based Systems

Conversely, the dlPFC and ACC are associated with rational, deliberative reasoning and monitoring conflict. The dlPFC contributes to weighing competing moral principles by applying logical reasoning and overriding impulsive reactions (Greene et al., 2004). Moreover, the ACC detects conflict between emotional impulses and rational goals, which facilitates cognitive control during moral dilemmas that require rational judgement (Bzdok et al., 2012).

Integrated Network

Neuroscientific evidence points to the claim that emotional and cognitive systems operate in a dynamic balance rather than opposing each other. The vmPFC and amygdala provide rapid, intuitive evaluations of moral stimuli, whereas the dlPFC and ACC contribute to slower but more context-dependent analysis. This interplay and bond between these two systems creates the foundation of the dual-process theory or moral decision-making, which is where emotion and reasoning collaborate to produce effective moral decisions (Greene, 2007).

Evidence from Neuroimaging and Lesion Studies

Functional neuroimaging findings

Functional magnetic resonance imaging (fMRI) and position emission tomography (PET) studies have been instrumental in revealing how different brain regions are recruited during moral reasoning. In a landmark study conducted by Joshua Greene in 2001, it was revealed that emotionally charged, personal moral dilemmas activated the vmPFC, amygdala, and posterior cingulate cortex—regions that are associated with emotion and social responses. In contrast, “impersonal” dilemmas that require more reasoning

activated the dlPFC and parietal cortex, which reflects controlled cognitive evaluation. Functional neuroimaging further reveals how moral dilemmas, including high emotional conflicts, engage these systems in a variety of different ways, sometimes even opposing each other (Chib et al., 2012). Neuroimaging studies also suggest that moral judgement relies on partially distinct neural systems depending on the type of evaluation being made. Cheng et al. (2021) found that judgements about moral right and wrong scenarios engage prefrontal and temporal regions differently than moral aesthetic evaluations, which indicates that moral cognition involves multiple neural networks rather than a singular processing system.

Lesion and Clinical Evidence

Lesion studies have provided evidence linking specific brain regions to moral cognition. Koenigs et al. (2007) found that patients with bilateral vmPFC damage made significantly more utilitarian moral judgments than healthy controls, which suggests that the vmPFC normally constricts cold, outcome-based reasoning through emotional empathy. This aligns with the hypothesis that the vmPFC is in control of “moral emotions” such as guilt and compassion.

Furthermore, individuals with psychopathy, characterized by reduced empathy and emotional sensitivity, exhibit diminished amygdala activation during moral judgement tasks (Glenn et al., 2009). Similarly, patients with frontotemporal dementia (FTD)—which often involved degeneration of the vmPFC—show impaired social and moral behavior, which includes a reduced concern for moral formalities (Mendez, 2009).

As a whole, neuroimaging and lesion evidence creates a model in which the vmPFC-amygdala system supports emotional intuitions, while the dlPFC-ADD system mediates cognitive control. This interaction determines where a person’s moral response is guided by an immediate affect or by deliberate, rational reasoning. Noninvasive brain stimulation studies (tDCS/TMS) also demonstrate that briefly changing activity in prefrontal brain areas can alter people’s moral decisions, which suggests that these regions are directly involved in moral judgement (Riva et al., 2018; Young et al., 2010; Chib et al., 2012). The comprehensive synthesis of structural and functional studies ultimately highlights the vmPFC, amygdala, and temporoparietal junction as central locations for integrating emotional and cognitive components in decision making (Pascual et al., 2013).

Dual-Process Theory and Integration

The dual-process theory provides a framework for understanding how emotion and reason are joined together to contribute to moral decision-making. Proposed by Greene et al. (2001, 2007), the model posits two parallel and interacting systems:

1. System 1: emotional/intuitive processing: fast, automatic, and evolutionary older; driven by emotional responses originating in the amygdala and vmPFC. Produces immediate judgements based on empathy, disgust, or avoidance of physical harm
2. System 2: controlled/deliberative processing: slow, effortful, and rational; dependent on the dlPFC and parietal regions. It is engaged in cost-benefit analysis and ethical reasoning.

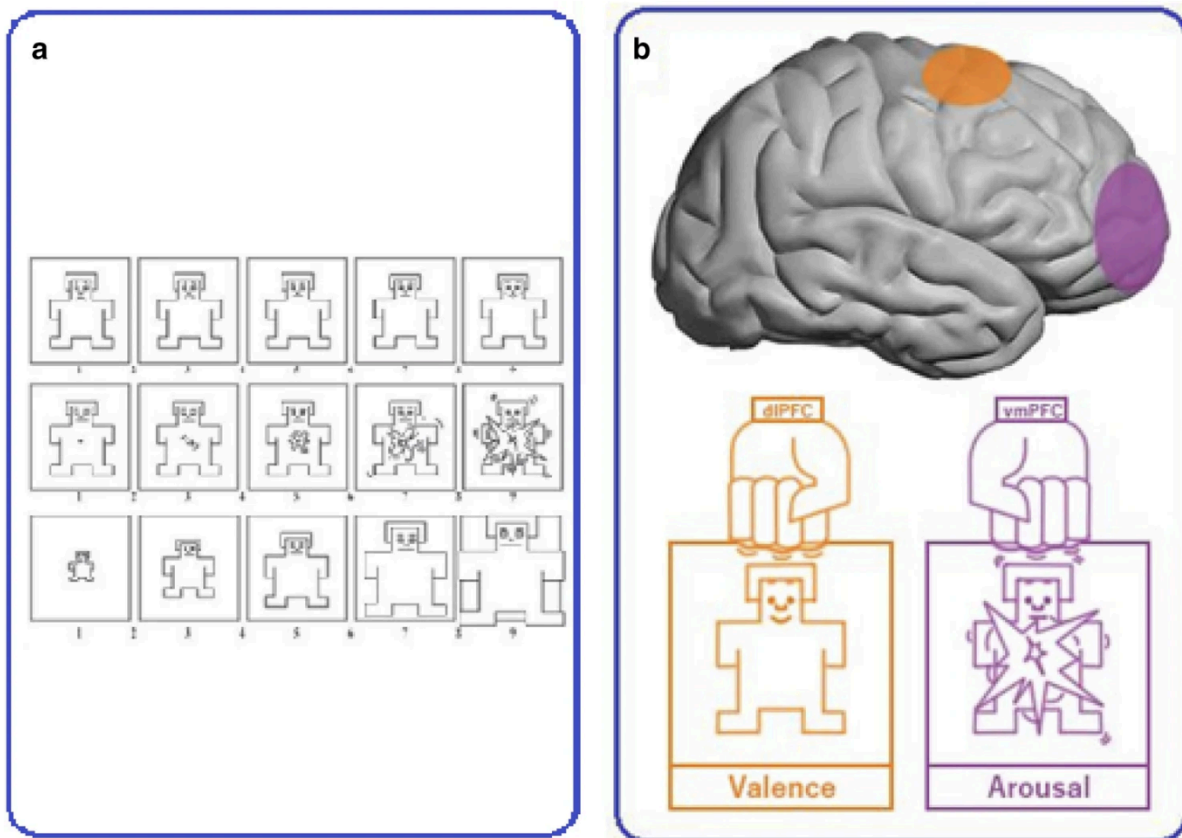


Figure 2: Diagram illustrating the dual-process model of moral judgement, distinguishing emotional and cognitive neural systems (Nejati et al., 2021).

According to this proposed model, moral judgement arises from a competition or integration between these two systems. In low-conflict scenarios, emotional responses and instincts dominates. However, when dilemmas involved competing moral values—such as sacrificing a life to save many more—the cognitive system engages to resolve the conflict. Recent neuroimaging findings further demonstrate that a person’s ability to reflect on their own thinking and the strength of their moral beliefs both affect how the brain will respond to complex social decision, suggesting that self-reflection, in a way, can shape emotional moral judgement (Cao et al., 2024).

Experiment Evidence Supporting Dual-Process Models

Transcranial magnetic stimulation (TMS) experiments have provided support for dual-process framework. Young et al. (2010) demonstrated that temporary disruption of the right temporoparietal junction (rTPJ)—a region that is associated with perspective-taking and moral reasoning—altered participant’s moral judgements, which reduced their sensitivity to intent and emotional context. Similarly,

disrupting dlPFC activity decreased utilitarian decision-making, indicating that cognitive control regions are necessary for overriding emotional intuitions. Furthermore, time-based scenarios also support the model: when individuals are forced to make moral decisions quickly, they rely more heavily on emotional processing, while extended reflection yields greater cognitive modulation and usage (Greene et al., 2004). This time-based model of experimentation blends with the research found regarding confidence in moral decision-making. Studies on moral confidence show that subjective certainty about moral decisions involves distinct neural patterns linked with cognitive evaluation, suggesting that how confident people feel about a moral choice may itself reflect underlying neural mechanisms of moral reasoning (Schooler et al., 2024). Ultimately, confidence can waver depending on how long someone ponders decisions, which yields the resulting section of the brain that's used more heavily. Nonetheless, though, recent neurocomputational research suggests that moral-decision making is best understood as a process in which emotional and cognitive inputs are integrated rather than competing. Computational models show that the brain assigns weights to factors such as harm, fairness, and personal benefit, allowing moral judgements to emerge from dynamic neural systems rather than a simple emotion-reason divide (Qu et al., 2022).

Critiques and Refinements

While dual-process theory does capture emotion-reason interplay, newer models have emerged that emphasize that these systems are not strictly opposing. Instead, moral cognition emerges from a mixture of interaction and integration within many brain networks (Shenhav & Greene, 2014). Emotional and cognitive signals constantly influence one another, and their relative weight depends on the context, personality, and cultural factors.

Functional connectivity studies have also demonstrated increased coupling between the vmPFC and dlPFC: they correspond with more balanced moral decisions—those that consider both empathy and rational outcomes (Shenhav & Greene, 2014). Moreover, dorsal and medial prefrontal structures may contribute to both emotional and cognitive components in context-dependent ways (Riva et al., 2018). This integrated view aligns with many other theories, which view moral cognition as a dynamic coordination between emotion and control units rather than just a binary process.

IMPLICATIONS FOR ETHICS, LAW, AND ARTIFICIAL INTELLIGENCE

Ethical Implications

The neuroscience of moral decision-making can challenge longstanding philosophical debates about free will, moral responsibility, and ultimately, the origin of ethical behavior. If emotions and automatic neural processes play a central role in moral reasoning, it raises questions about the extent to which moral judgements are consciously controlled. Studies showing that vmPFC and amygdala activity can predict moral preferences suggest that many moral evaluations occur subconsciously, before rational deliberations occur (Greene, 2007). This evidence supports the idea that moral intuition is not entirely voluntary; rather, it can be biologically embedded.

Moreover, understanding the emotional basis of morality can inform efforts to cultivate empathy, compassion, and pro-social behavior (Koenigs et al., 2007). Training that can enhance emotional awareness, such as mindfulness or empathy, could strengthen the neural networks involved in moral emotions, fostering more ethical decision-making in the real world (Decety & Cowell, 2014). For instance, high-stress contexts, such as life-threatening situations, have been shown to amplify emotional reactivity and impair deliberative control systems like the dlPFC, leading to decisions that favor self-preservation over standard moral judgement. This highlights how stress hormones can shift the balance between emotion and reason in the brain, thereby giving researchers a gateway to possibly better understand and promote certain emotional behaviors in individuals (Yang, 2025).

Legal Implications

The integration of neuroscience into legal reasoning yields complex ethical dilemmas regarding responsibility and culpability. Individuals with vmPFC lesions or disorders affecting emotions, such as psychopathy or frontotemporal dementia, often exhibit impaired moral judgement and reduced empathy. This raises a riveting question: should moral responsibility be pardoned if the neural systems supporting morality are compromised?

While individuals argue for a more neuroscientific informed approach to sentencing, others caution that moral activity cannot be reduced to brain activity alone. Nonetheless, neuroscientific evidence is increasingly used in courtrooms to explain behavioral abnormalities or support claims of diminished responsibility. A balanced integration of neuroscience and law could yield a fairer and more individualized approach to justice while maintaining accountability.

Applications to Artificial Intelligence

Understanding how the brain makes moral decision, additionally, has profound implications of artificial intelligence (AI) and machine ethics. As AI systems are increasingly deployed, such as in vehicles or in medical settings, developers must design algorithms that are capable of making ethical decisions. Insights from the dual-process model can inform moral reasoning in AI by simulating emotional weighting and contextual reasoning.

Neuroethicists caution, though, that while machines can be programmed to follow ethical guidelines, they lack empathy that guides human morality (Wallach & Allen, 2009). True moral cognition requires the interplay between emotional and rational judgement—an integration that current AI models lack. It's important to note a significant discovery that moral decisions involve weighing personal benefit against ethical costs through probabilistic valuation processes in the medial prefrontal cortex. Bayesian modeling reveals how justifications and outcome expectations influence moral flexibility, offering mechanistic insight into why individuals may rationalize questionable behavior under certain conditions (Sai et al., 2025). While this insight can aid in guiding novel AI systems, greater research and discoveries need to occur to solidify an AI mechanism. Thus, as neuroscience continues to uncover how the brain balances these systems, it may guide the development of more transparent and ethically aligned AI frameworks (Wallach & Allen, 2009).

FUTURE DIRECTIONS

While significant progress has been made, the neuroscience of moral decision-making remains an evolving field with a myriad of unanswered questions. Future research should broaden its scope to beyond traditional lab-based settings by examining how culture, religion, and development can shape the neural basis of morality. Studies that revealed patterns of vmPFC-dIPFC activation generalize diverse populations and can be ignoring pivotal insights. Simultaneously, advances in computational neuroscience offers opportunities to model moral cognition as an essential tool in predicting differences in empathy and moral sensitivity. Noninvasive brain-stimulation studies, too, further support the roles of the prefrontal regions in moral evaluation, demonstrating that modulating medial prefrontal activity can alter sensitivity to different moral dilemmas (Darby & Pascual-Leone, 2017). In tandem, recent work examining moral evaluation in social contexts shows that considerations of fairness and social status shape neural responses during moral judgement. Activity in prefrontal and limbic regions varies depending on perceived social hierarchy, indicating that moral decisions are influenced not only by abstract principles but also by relational and contextual factors (Wu et al., 2025). So, to strengthen the validity of the interplay of emotion and reason, further moral evaluations should be conducted to make more linkages between neural networks and moral behavior, and additionally, understanding the neural mechanisms underlying moral reasoning more thoroughly can possibly guide more future therapies and interventions to enhance empathy and ethical awareness.

CONCLUSION

Moral decision-making emerges from a complex interplay between emotion and reason within the human brain. Evidence from neuroimaging and lesion studies further supports the dual-process theory, in which emotional systems and deliberative cognitive systems interact dynamically to produce moral judgements. The amygdala and ventromedial prefrontal cortex (vmPFC) mediate emotional components of morality, such as empathy, guilt, fear. In contrast, the dorsolateral prefrontal cortex (dlPFC) and anterior cingulate cortex (ACC) provide cognitive control and rational reasoning.

This integration allows humans to navigate their dilemmas and any confrontations in life more flexibly, balancing compassion with rationality. Neuroscience reveals that morality is not solely rational nor emotional but rather a synthesis of both systems. As this field advances, it holds profound implications for understanding ethical behavior, shaping legal and educational policy, and informing the design of responsible AI systems. Ultimately, the study of moral decision-making emphasizes the essence of what it means to be human—our ability to effectively reason, feel and act with awareness.

REFERENCES

- Bzdok, D., Schilbach, L., Vogeley, K., Schneider, K., Laird, A. R., Langner, R., & Eickhoff, S. B. (2012). Parsing the neural correlates of moral cognition: ALE meta-analysis on morality, theory of mind, and empathy. *Brain Structure and Function*, 217(4), 783–796. <https://doi.org/10.1007/s00429-012-0380-y>

- Cao, Q., Cohen, M. S., Akram Bakkour, Leong, Y. C., & Decety, J. (2024). Moral conviction interacts with metacognitive ability in modulating neural activity during sociopolitical decision-making. *Cognitive Affective & Behavioral Neuroscience*, 25. <https://doi.org/10.3758/s13415-024-01243-3>
- Cheng, Q., Wen, X., Ye, G., Liu, Y., Kong, Y., & Mo, L. (2021). Neural underpinnings of morality judgment and moral aesthetic judgment. *Scientific Reports*, 11(1), 18232. <https://doi.org/10.1038/s41598-021-97782-7>
- Chib, Vikram S., De Martino, B., Shimojo, S., & O'Doherty, John P. (2012). Neural Mechanisms Underlying Paradoxical Performance for Monetary Incentives Are Driven by Loss Aversion. *Neuron*, 74(3), 582–594. <https://doi.org/10.1016/j.neuron.2012.02.038>
- Cohon, R. (2018, August 20). *Hume's Moral Philosophy* (Stanford Encyclopedia of Philosophy). Stanford.edu. <https://plato.stanford.edu/entries/hume-moral>
- Cui, S., & Nakano, T. (2024). Interoceptive Brain Processing Influences Moral Decision Making. *Human Brain Mapping*, 45(18). <https://doi.org/10.1002/hbm.70108>
- Darby, R. R., & Pascual-Leone, A. (2017). Moral Enhancement Using Non-invasive Brain Stimulation. *Frontiers in Human Neuroscience*, 11. <https://doi.org/10.3389/fnhum.2017.00077>
- Decety, J., & Cowell, J. M. (2014). The complex relation between morality and empathy. *Trends in Cognitive Sciences*, 18(7), 337–339. <https://doi.org/10.1016/j.tics.2014.04.008>
- Glenn, A. L., Raine, A., & Schug, R. A. (2009). The neural correlates of moral decision-making in psychopathy. *Molecular Psychiatry*, 14(1), 5–6. <https://doi.org/10.1038/mp.2008.104>
- Greene, J. D. (2007). *The Secret Joke of Kant's Soul*. <https://static.squarespace.com/static/54763f79e4b0c4e55ffb000c/t/5484abb5e4b0213f74375bce/1417980853923/the-secret-joke-of-kants-soul.pdf>
- Greene, J. D., Nystrom, L. E., Engell, A. D., Darley, J. M., & Cohen, J. D. (2004). The Neural Bases of Cognitive Conflict and Control in Moral Judgment. *Neuron*, 44(2), 389–400. <https://doi.org/10.1016/j.neuron.2004.09.027>
- Greene, J. D., Sommerville, R. B., Nystrom, L. E., Darley, J. M., & Cohen, J. D. (2001). An fMRI Investigation of Emotional Engagement in Moral Judgment. *Science*, 293(5537), 2105–2108. <https://doi.org/10.1126/science.1062872>
- Johnson, R., & Cureton, A. (2024). *Kant's Moral Philosophy* (Stanford Encyclopedia of Philosophy/Fall 2024 Edition). Stanford.edu. <https://plato.stanford.edu/archives/fall2024/entries/kant-moral/>
- Kirman, A., Livet, P., & Teschl, M. (2010). Rationality and emotions. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 365(1538), 215–219. <https://doi.org/10.1098/rstb.2009.0194>
- Koenigs, M., Young, L., Adolphs, R., Tranel, D., Cushman, F., Hauser, M., & Damasio, A. (2007). Damage to the prefrontal cortex increases utilitarian moral judgements. *Nature*, 446(7138), 908–911. <https://doi.org/10.1038/nature05631>
- Mendez, M. F. (2009). The Neurobiology of Moral Behavior: Review and Neuropsychiatric Implications. *CNS Spectrums*, 14(11), 608–620. <https://doi.org/10.1017/s1092852900023853>
- Moll, J., de Oliveira-Souza, R., & Eslinger, P. J. (2003). Morals and the human brain: a working model. *NeuroReport*, 14(3), 299. https://journals.lww.com/neuroreport/abstract/2003/03030/morals_and_the_human_brain_a_working_model.1.aspx

- Nejati, V., Majdi, R., Salehinejad, M. A., & Nitsche, M. A. (2021). The role of dorsolateral and ventromedial prefrontal cortex in the processing of emotional dimensions. *Scientific Reports*, *11*(1), 1971. <https://doi.org/10.1038/s41598-021-81454-7>
- Pascual, L., Rodrigues, P., & Gallardo-Pujol, D. (2013). How does morality work in the brain? A functional and structural perspective of moral behavior. *Frontiers in Integrative Neuroscience*, *7*. <https://doi.org/10.3389/fnint.2013.00065>
- Qu, C., Julien Bénistant, & Dreher, J. (2022). Neurocomputational mechanisms engaged in moral choices and moral learning. *Neuroscience & Biobehavioral Reviews*, *132*, 50–60. <https://doi.org/10.1016/j.neubiorev.2021.11.023>
- Riva, P., Manfrinati, A., Sacchi, S., Pisoni, A., & Romero Lauro, L. J. (2018). Selective changes in moral judgment by noninvasive brain stimulation of the medial prefrontal cortex. *Cognitive, Affective, & Behavioral Neuroscience*, *19*(4), 797–810. <https://doi.org/10.3758/s13415-018-00664-1>
- Sai, L., Wang, C., Yating Lv, & Bellucci, G. (2025). Neurocomputational mechanisms of personal benefits and justifications in moral decision-making. *Communications Biology*, *8*(1), 906–906. <https://doi.org/10.1038/s42003-025-08256-9>
- Schneider, B., & Koenigs, M. (2017). Human lesion studies of ventromedial prefrontal cortex. *Neuropsychologia*, *107*, 84–93. <https://doi.org/10.1016/j.neuropsychologia.2017.09.035>
- Schooler, L., Mesude Okhan, Hollander, S., Gill, M., Yoonseo Zoh, Crockett, M. J., & Yu, H. (2024). Confidence in Moral Decision-Making. *Collabra Psychology*, *10*(1). <https://doi.org/10.1525/collabra.121387>
- Shenhav, A., & Greene, J. D. (2014). Integrative Moral Judgment: Dissociating the Roles of the Amygdala and Ventromedial Prefrontal Cortex. *Journal of Neuroscience*, *34*(13), 4741–4749. <https://doi.org/10.1523/jneurosci.3390-13.2014>
- Wallach, W., & Allen, C (2009). *Moral machines: Teaching robots right from wrong*. Oxford University Press.
- Yang, M. (2025). The Cognitive Neuroscience of Moral Decision-Making in Extreme Situations: High-Stress or Life-Threatening Scenarios. *Brain Matters*, *8*(1), 72–76. <https://ojs.library.illinois.edu/index.php/brainmatters/article/view/1074?>
- Yoder, K. J., & Decety, J. (2017). The neuroscience of morality and social decision-making. *Psychology, Crime & Law : PC & L*, *24*(3), 279–295. <https://doi.org/10.1080/1068316X.2017.1414817>
- Young, L., Camprodon, J. A., Hauser, M., Pascual-Leone, A., & Saxe, R. (2010). Disruption of the right temporoparietal junction with transcranial magnetic stimulation reduces the role of beliefs in moral judgments. *Proceedings of the National Academy of Sciences of the United States of America*, *107*(15), 6753–6758. <https://doi.org/10.1073/pnas.0914826107>