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# An Integrative Neuroscientific Approach to Moral Judgment
## -Bridging Universal Moral Grammar and Emotional Moral Sentimentalism-

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【Abstract】 This paper examines two prominent frameworks in moral psychology that aim to explain the foundations of moral judgments: the Universal Moral Grammar (UMG) and the Emotional Moral Sentimentalist (EMS) frameworks. UMG theorists propose that moral judgments are guided by innate, unconscious principles analogous to linguistic grammar, whereas EMS advocates emphasize the role of automatic emotional responses, such as anger or guilt, in shaping moral decisions. By reviewing recent neuroscientific evidence, this paper evaluates the strengths and limitations of each approach and argues that neither framework is fully substantiated by current empirical findings. Instead, it advocates for an integrative perspective that treats UMG principles and emotional processes as complementary, hypothetical models for understanding moral cognition. This approach offers a pathway for more comprehensive investigations into the neural mechanisms underlying moral judgments, addressing the limitations of the ongoing UMG-EMS debate.

【Key words】 Moral Judgment, Universal Moral Grammar, Emotion, Neuroscience, Underdetermination

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## 1. Introduction

What is the foundation of our moral judgments? In moral psychology, two prominent approaches have been proposed to answer this question: (i) the Universal Moral Grammar (UMG) framework and (ii) the Emotional Moral Sentimentalist (EMS) framework. Advocates of the UMG approach argue that moral judgments are unconsciously shaped by a limited set of universal principles, analogous to grammatical rules (Hauser 2006; Cushman, Young, and Hauser 2006; Mikhail 2007; Dwyer, Huebner, and Hauser 2010). They believe that UMG is not explicitly taught but is hardwired or innate in the brain. Conversely, proponents of the EMS framework contend that moral attitudes and decisions are primarily driven by automatic gut reactions or instincts, closely linked to emotions such as anger, disgust, fear, guilt, and others (Damasio 1994; Nichols 2004; Prinz 2007; Sterelny 2010). They argue that emotional responses often precede and shape moral decision-making.

This paper examines two prominent approaches to the nature of moral judgments in light of recent neuroscientific findings. Section 2 introduces the key arguments of the UMG and EMS frameworks, highlighting central issues by contrasting them. Section 3 evaluates whether or not the claims of these frameworks are supported by neuroscientific evidence or compelling reasoning, ultimately demonstrating that both remain underdetermined. Section 4 proposes an alternative approach, treating the claims of both frameworks in moral psychology as working hypotheses for investigating the neural mechanisms underlying moral judgments. Specifically, moral principles in the UMG framework should be decomposed into components that can be mapped onto specific neural structures and functions, while emotional regions of the brain should be linked to broader cognitive processes. The paper argues that an integrative approach to moral judgments is more productive than a competitive debate between the UMG

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and EMS frameworks.

## 2. Key Issues between UMG and EMS

### 1) Universal Moral Grammar and its Critics

The central issue between the two frameworks concerns the basis for the formation of moral judgments. Proponents of the UMG framework present two key arguments: the linguistic analogy and the poverty of moral stimulus argument. First, Dwyer, Huebner, and Hauser (2010) employ a linguistic analogy to explain moral judgment, emphasizing three core features: (i) cross-cultural universality, (ii) innateness, and (iii) modularity. Moral judgments, like linguistic structures, exhibit universal principles across cultures. Despite cultural differences, humans seem to share fundamental moral principles, much like the consistent grammatical rules across languages. Second, the innateness of moral judgments parallels the concept of an innate universal grammar. Both morality and language develop during a critical period, after which the ability to fully acquire them declines, supporting the idea that these abilities are biologically prewired. Third, moral cognition is argued to be modular, functioning independently of other cognitive processes, similar to language. Moral reasoning operates automatically and unconsciously, driven by specialized cognitive mechanisms distinct from general reasoning faculties. This linguistic analogy highlights that moral judgment is governed by universal, innate, and modular structures, akin to the architecture of human language.

Second, the poverty of moral stimulus argument draws directly from Chomsky's original poverty of stimulus argument for Universal Grammar in linguistics. Chomsky (1975) argued that the linguistic input children receive is insufficient to account for the rich and complex grammatical knowledge they acquire. It implies that much of our linguistic ability must be innate,

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structured by a universal grammar that guides language acquisition. Hauser et al. (2010, pp. 490-493) extend this reasoning to the moral domain, arguing that the external moral stimuli individuals encounter—such as moral examples and explicit instruction—are similarly inadequate to explain the complexity and universality of moral judgments. Just as children effortlessly acquire language without detailed external instructions, they develop a sense of moral right and wrong without direct guidance on complex moral principles. This suggests that humans possess an innate moral grammar that, like universal linguistic grammar, fills in the gaps left by incomplete or ambiguous external input. Thus, both linguistic and moral knowledge emerge from an underlying cognitive structure that is biologically prewired and universal across cultures.

Hauser and his colleagues conducted cognitive experiments using the trolley dilemma to uncover the innate and universal principles underlying moral judgments by examining how people from different cultures respond to variations of moral dilemmas (Cushman, Young, and Hauser 2006; Hauser 2007; Mikhail 2007). In their studies, participants were presented with four scenarios: the standard trolley dilemma (pulling a lever to divert a trolley, saving five people by sacrificing one), the footbridge dilemma (pushing a person off a bridge to stop the trolley and save five), the side-track dilemma (diverting the trolley to kill one person without direct physical contact), and the loop case (redirecting the trolley through a loop that ultimately results in killing one person to save five). From these cases, Hauser et al. identified three key moral principles. The *action principle* states that harm caused by direct action (e.g., pushing someone in the footbridge dilemma) is judged more severely than harm caused by inaction (e.g., pulling a lever). The *intention principle* asserts that intentional harm (e.g., deliberately pushing someone) is morally worse than harm that is a foreseen but unintended consequence (e.g., diverting the trolley). Lastly, the *contact principle* emphasizes that physical contact, as in the footbridge

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dilemma, results in harsher moral judgments than harm caused without direct contact. These experiments demonstrated that these principles are not only cross-culturally shared but also operate automatically and unconsciously, suggesting they are innate and modular features of moral cognition, much like Chomsky's concept of universal grammar in language.

Proponents of the EMS framework, notably Prinz (2007, 2008a, 2008b), argue that the UMG framework faces significant challenges in substantiating its claims. First, they contend that UMG theorists must provide compelling evidence that moral principles are not only widespread but also truly cross-cultural, consistently producing similar moral judgments across diverse societies. Prinz (2008, pp. 373-379) suggests that, while some overlap in moral norms may exist, the observed cultural variations in moral practices undermine the claim of universality.

Second, UMG proponents must address alternative explanations for moral judgments beyond the existence of an innate UMG. Prinz (2007, p. 269) posits that morality could stem from other cognitive capacities, challenging the idea that it is exclusively rooted in an innate, pre-wired structure. His critique implies the following: if UMG is a necessary condition for moral judgments, then without UMG, moral judgments would be impossible. However, even if UMG is not necessary, moral judgments could arise through other mechanisms independent of UMG. Thus, Prinz challenges UMG proponents to demonstrate that UMG is indeed a necessary condition for moral judgment.

Lastly, Prinz (2008a, pp. 387-391) contends that for UMG to hold from a modular perspective, it must be shown that moral judgments are domain-specific rather than the product of domain-general cognitive processes. He argues that emotional responses, shaped by cultural and contextual factors, likely play a central role in moral judgment. This suggests that moral reasoning may emerge from broader cognitive and affective mechanisms rather than a specialized moral grammar.

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To summarize, the UMG framework faces significant scrutiny regarding its foundational claims, particularly concerning the existence of a UMG in the brain that meets the criteria of cross-cultural universality, innateness, and domain-specificity. First, while UMG proponents argue that moral principles are universally shared across cultures, there remains uncertainty over whether this universality is genuinely established. Second, the claim of innateness assumes that moral judgments are hardwired into the brain; however, Prinz challenges this by suggesting that morality may emerge from other cognitive capacities, undermining the notion of a strictly innate moral structure. Lastly, the assertion of domain-specificity requires compelling evidence that moral reasoning functions independently of general cognitive processes. Critics argue that emotional responses, shaped by cultural and contextual factors, play a significant role in shaping moral judgments, suggesting that moral reasoning may stem from broader cognitive and affective mechanisms rather than from a specialized UMG. Therefore, the UMG framework remains contentious, requiring further empirical investigation to justify the sufficiency of UMG in explaining moral judgment and to substantiate its claims about the origins and nature of moral cognition.

### 2) Emotional Moral Sentimentalist and its Critics

The EMS framework posits that moral judgments are primarily grounded in gut reactions or emotional responses rather than in strictly rational deliberation based on grammatical rules derived from moral principles. This perspective suggests that our emotional experiences play a crucial role in shaping moral decisions, influencing how we perceive and react to ethical dilemmas. One compelling piece of evidence supporting this framework is the case of Phineas Gage, who, after suffering significant damage to his ventromedial prefrontal cortex (vmPFC), exhibited profound changes in his

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emotional responses and moral reasoning (Damasio, 1994). The vmPFC is essential for integrating emotional signals with cognitive processes, and damage to this area disrupts the ability to make appropriate moral judgments based on emotional feedback. Individuals with vmPFC lesions, as shown in the study by Saver and Damasio (1991), similarly struggle with moral decision-making, often displaying impairments in emotional processing that lead to atypical moral judgments. Additionally, research on psychopaths reveals that they often exhibit abnormalities in key brain regions, including the amygdala, which is crucial for processing emotions like fear and empathy; the vmPFC and dorsolateral prefrontal cortex (dlPFC), which are involved in emotional regulation and higher-order cognitive processes; the anterior cingulate cortex (ACC), which plays a role in emotional regulation and decision making; and the insula, which is important for emotional awareness. These structural abnormalities contribute to the emotional engagement deficits that affect their ability to make moral decisions. Together, these findings highlight the integral role of emotional responses in moral judgments, supporting the claim that our moral judgment is deeply intertwined with our emotional states.

A notable strength of the EMS framework, compared to the UMG framework, is its stronger foundation in neuroscientific evidence. Proponents of the EMS framework do not claim that all moral judgments are solely determined by emotions. Instead, drawing on empirical data, they argue that (i) emotions are essential for children and adolescents to develop moral capacities, and (ii) emotions play a critical role in making moral decisions, particularly in complex or morally challenging situations, such as dilemmas. Importantly, EMS proponents do not assert that emotions are sufficient conditions for moral judgments. Rather, they contend that emotions are necessary conditions for forming moral judgments, as evidenced by cases of brain lesions in areas involved in emotional processing, which often result in impaired moral reasoning or poor

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decision-making.

Proponents of the EMS framework emphasize the role of neural circuits, such as the amygdala and the vmPFC, which are activated not only when we make moral decisions but also when we respond emotionally, as demonstrated by behavioral, neuroimaging, and neuropsychological data. However, Huebner, Dwyer, and Hauser (2010) criticize these data from the EMS framework. First, behavioral experiments in which participants are exposed to disgust (e.g., a dirty desk, foul odor, or hypnotically induced disgust) or positive mood (e.g., a humorous video) showed altered moral judgments, but these effects do not conclusively prove that emotions are necessary for moral judgment. A more significant deficiency is that the behavioral data fail to demonstrate how emotional responses or the activation of emotional areas in the brain can be *transformed* into moral judgments. To support such a claim, experiments would need to show that an emotional response can shift judgments from being non-moral to moral, which has not been sufficiently evidenced.

Second, neuroimaging studies reveal that emotional circuits, including the frontal polar cortex (FPC), medial frontal gyrus, and insular cortex, are active during moral judgments. However, Huebner, Dwyer, and Hauser argue that these findings are just *correlational* and do not prove that emotions causally drive moral judgments. The lack of temporal precision in neuroimaging leaves it unclear whether emotions precede, coincide with, or follow moral computations. Therefore, these data are insufficient to show that emotions are constitutive of moral judgments, and more precise methods are needed to clarify the timing of these processes.

Third, studies of patients with bilateral damage to the vmPFC provide a stronger test of whether emotion is necessary for moral judgment, as vmPFC damage leads to deficits in social emotions and utilitarian moral judgments in high-conflict dilemmas. Huebner, Dwyer, and Hauser argue that although vmPFC patients experience flattened emotions, they still

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make similar moral judgments to controls in most scenarios. This suggests that deviations in high-conflict dilemmas are due to a failure to recognize morally salient features rather than a breakdown in moral processing itself. Thus, moral cognition may remain *intact* even when emotional inputs are compromised, indicating that emotional deficits alter moral judgments indirectly rather than undermining moral reasoning.

To summarize, the key issue in the EMS framework is whether emotions are essential resources for making moral judgments in everyday life. In contrast to the UMG framework, there is relatively more evidence supporting the EMS framework in both psychology and neuroscience. However, advocates of the EMS framework must address critiques from Huebner et al., who argue that empirical data primarily indicate a correlation between emotions and moral judgments rather than establishing a causal relationship. Additionally, proponents of the UMG framework suggest that moral judgments arise from deeper, unconscious moral grammars, positing that emotional responses might be derived from these underlying grammatical processes. Therefore, advocates of the EMS framework should demonstrate that (i) moral judgments cannot be generated in the absence of emotional functions and (ii) there is a temporal order from emotional responses to moral judgments. Addressing these critiques is essential for solidifying the EMS framework's claims and understanding the intricate relationship between emotion and moral decision-making.

## 3. Challenges in Moral Psychology in Evaluating UMG and EMS

### 1) The Identification Problem of UMG

The UMG framework posits that moral grammar is the true source of our moral judgments, suggesting that all humans are universally equipped with

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an innate set of principles guiding their moral decision-making, similar to the inborn capacity for language. However, critics argue that what appears to be universal moral knowledge could actually result from shared cultural influences or emotional responses, rather than an inherent moral grammar. This brings up a critical question: how can we empirically confirm the existence of UMG, independent of these external factors? While the strongest defense of UMG would be to identify its presence through empirical evidence, the challenge lies in confirming whether all humans universally share the same moral principles, whether newborns possess these principles innately, and where these domain-specific principles are located or distributed in the brain. Therefore, the task is to examine whether the three key features of UMG—cross-cultural universality, innateness, and domain-specificity—offer any clues to conjecture its existence. These challenges underscore the difficulty of substantiating the UMG framework and its explanatory power regarding moral judgments.

First, does cross-cultural universality confirm the existence of UMG? Regardless of how a prewired UMG might exist in the brain, it is challenging for cross-cultural universality to definitively establish its presence. Such universality represents a superficial observation, heavily influenced by research interests and methodologies. Bentahila et al. (2021) demonstrate that while universal aspects of morality exist, cultural contexts significantly shape specific moral judgments. Moreover, the three principles proposed by Hauser and his colleagues do not account for all moral principles. For instance, Akiko (2023) found that participants exhibit greater sensitivity to transgressions in culturally valued domains involving in-group members than in interactions with outsiders. This finding indicates that moral decision-making regarding violations is influenced by group membership and cultural values. Therefore, moral decisions may be relative to cultural groups or their memberships, irrespective of the existence of UMG. Consequently, cross-cultural universality cannot decisively confirm

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the existence of UMG.

Can the innateness of UMG be empirically confirmed? This seems unlikely, as establishing the existence of UMG is a prerequisite before considering whether it is innate. The existence of UMG remains a contentious issue, rendering its innateness a secondary concern. For this reason, the poverty-of-stimulus argument appears problematic. Specifically, it faces a fundamental underdetermination problem in its second premise, which asserts that morality cannot be learned solely from external stimuli. Even if external stimuli do not fully account for moral development, this does not conclusively prove the existence of an innate UMG. Instead, it just highlights skepticism toward alternative explanations to the innateness of moral grammar.

One such alternative is the cognitive capacity for gaze monitoring during "face time" in infants and adolescents, which enables individuals to share intentions and ultimately learn complex rules from social relationships and environmental inputs (Dennett 2017 ch. 13). This capacity allows humans to extract regularities and infer moral principles through interaction, observation, and feedback, without requiring a pre-wired moral grammar. Moreover, proponents of the second premise often overlook the nuanced role of cultural and contextual factors in shaping moral reasoning. For example, moral sentimentalist models, such as EMS, demonstrate how emotional responses and social learning mechanisms can generate moral judgments without invoking innateness, as will be discussed later. By failing to rule out these plausible alternatives, the poverty-of-stimulus argument remains underdetermined, leaving the innateness of UMG speculative rather than conclusive.

The remaining feature of UMG is its domain-specificity. The domain-specificity of UMG, grounded in the computational theory of mind, posits that moral cognition operates through distinct modules tailored to specific social challenges, reflecting evolutionary adaptations. This perspective,

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closely related to evolutionary psychology, suggests that moral judgment comprises specialized, rule-based processes that evolved to address issues such as cooperation and conflict resolution. In this view, moral decision-making is not governed by a single, general-purpose mechanism but by domain-specific processes that reflect the selective pressures of human evolution.

However, instead of domain-specific moral capacities, Sterelny (2010, pp. 287-290) emphasizes the significance of *pattern recognition* as a foundational mechanism underlying intuitive moral judgments. He argues that rather than being innate moral grammars that dictate moral decision-making, our moral intuitions arise from a learned capacity to recognize patterns in social interactions and emotional responses. This capacity allows individuals to form rapid, automatic judgments about moral situations based on familiar and experienced templates. Furthermore, moral cognition is more flexible and context-dependent, shaped significantly by cultural and social learning rather than being predetermined by hard-wired, domain-specific structures.

As an alternative to the modular view of individual cognitive capacities, Sterelny (2010, pp. 290-294) highlights two key social factors: *cultural engineering* and *active learning environments*. First of all, he emphasizes that moral development is not merely a product of innate cognitive structures but is profoundly shaped by social and cultural factors—what he refers to as the "evolved apprentice" (Sterelny 2012). Parents and caregivers actively construct children's moral learning environments by organizing experiences, offering guidance, and providing both positive and negative feedback. Unlike linguistic learning, where negative evidence is often absent, children explicitly encounter forbidden acts and moral transgressions. This engineered environment ensures that moral norms are transmitted through a rich, structured social context, thereby reducing the reliance on any hypothesized innate moral grammar.

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Sterelny also shows that children are not passive recipients of moral knowledge. Instead, they actively engage with their social environment, experimenting through trial and error and learning from the emotional responses of others. This moral learning is grounded in emotions such as empathy, disgust, and reciprocity, which scaffold the development of moral cognition. According to Sterelny, these emotional sensitivities are crucial for understanding moral behavior and do not require a domain-specific moral grammar. Rather, they emerge from general social and emotional capacities shaped by experience.

Sterelny's alternatively evolutionary viewpoint, which emphasizes cultural institutions and pattern recognition in line with the EMS framework, is both compelling and persuasive, drawing from diverse anthropological and ethnographic evidence. However, in my view, while Sterelny's arguments may undermine the UMG framework, they do not fully discredit it. His cultural model of human history presents a plausible evolutionary alternative to the computational and modular mind approach proposed by evolutionary psychology. Yet, we cannot reconstruct the past to definitively falsify the UMG framework, and its proponents may continue to make ad hoc modifications to defend their position. Nevertheless, I believe the burden of proof for demonstrating the existence of UMG rests with its proponents. Advocates must show that the influence of emotions on moral judgments is superficial and that emotional responses do not significantly drive moral decisions. Ultimately, the identification problem within the UMG framework remains unresolved.

### 2) The Causal Problem of Emotion and Judgment

Recent neuroscientific studies have examined the brain's role in moral judgment, focusing on identifying the neural circuits involved in decision-making. Research shows that regions such as the frontal polar

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cortex (FPC), medial frontal gyrus, and insular cortex are activated during moral evaluations. Studies involving patients with damage to the vmPFC suggest that this region is crucial for emotional responses related to moral reasoning. Furthermore, functional connectivity between emotional and cognitive regions indicates that both emotional and cognitive processes are engaged in moral decision-making. However, while these findings reveal which brain areas are involved in moral judgments, they do not conclusively determine whether moral reasoning is primarily driven by emotion (supporting the EMS framework) or by an innate moral grammar (supporting the UMG framework).

The EMS framework has received relatively more neuropsychological and neuroimaging support compared to the UMG framework. Advocates of the EMS framework argue that emotions play a foundational role in moral judgments. However, as Hauser et al. emphasize, evidence must go beyond correlation to demonstrate causality. Specifically, the EMS framework requires critical evidence of a causal pathway from emotional responses to cognitive moral judgments. While emotions appear to influence moral judgments, proving that emotional responses directly drive moral decision-making remains challenging. Additionally, establishing a clear temporal sequence in neural processes—demonstrating that emotions precede cognitive moral processing—is essential to supporting the claim that emotions are the primary drivers of moral reasoning. Moreover, the EMS framework faces the overlapping problem: moral judgments may stem from both moral grammar and emotional perceptions, making it difficult to disentangle these processes. Therefore, the EMS framework faces a significant challenge: demonstrating a causal relationship between emotions and moral judgments, rather than merely a correlational link, remains a key obstacle to its validation.

The challenge of establishing a causal pathway from emotions to cognitive moral judgments is exacerbated by the low resolution of neuroimaging data.

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Current neuroimaging techniques, such as fMRI, often lack the spatial and temporal precision needed to capture the rapid dynamics of emotional processing and its influence on moral reasoning. This limitation makes it difficult to identify specific neural circuits involved in the causal relationships between emotional responses and moral judgments. Furthermore, experimental and instrumental limitations in neuroscience hinder the investigation of temporal orders among psychological functional steps. For example, while neuroimaging can reveal which brain areas are activated during moral decision-making, it does not provide a clear sequence of activation or indicate whether emotional responses occur before cognitive evaluations. These methodological constraints pose significant challenges in validating the EMS framework, as establishing the order of operations between emotions and cognitive processes is crucial for understanding the nature of their interaction in moral decision making.

### 3) Challenges of Underdetermination in Moral Psychology

Despite the insights gained from neuroscientific studies, the evidence remains insufficient to decisively support either the UMG or EMS framework. The observed neural activations could be interpreted to favor either perspective: they may represent the workings of an innate moral grammar (UMG) or reflect emotional responses that influence moral decisions (EMS). Additionally, limitations of neuroimaging techniques, particularly poor temporal resolution, hinder our ability to determine whether emotional responses precede or follow cognitive evaluations in moral judgments. Consequently, the current neuroscientific evidence underdetermines the choice between UMG and EMS, as both models can account for the same data without clear empirical support favoring one over the other.

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The debate between UMG and EMS exemplifies underdetermination,

wherein empirical evidence does not definitively establish the correctness of either competing model. Both UMG and EMS provisionally align with the available neuroscientific data, and there is currently no evidence that clearly distinguishes between the two yet. Furthermore, non-empirical criteria, such as theoretical virtues (e.g., simplicity and explanatory power), do not decisively favor one framework over the other. Consequently, the evidence remains underdetermined regarding whether moral judgments are rooted in innate moral grammar or emotional processing, leaving both models equally plausible in light of the current data.

In summary, the debate between UMG and EMS illustrates the challenges of underdetermination in explaining moral judgments through neuroscientific evidence. While both frameworks offer plausible explanations for how the brain generates moral decisions, the current empirical data is insufficient to decisively support either claim. The observed neural activity can be interpreted to support both UMG's innate moral principles and EMS's emotion-based processes. This underdetermination underscores the complexity of psychological claims about moral cognition and highlights the need for a new direction in moral psychology to determine whether moral judgments are primarily shaped by universal cognitive structures or emotional responses.

## 4. An Integrative Framework: UMG and EMS as Mechanism Sketches

### 1) An Integrative Framework

If two moral psychological models, UMG and EMS, cannot be conclusively determined by recent empirical data, how should we proceed in investigating the nature of moral judgments? I remain skeptical that this

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debate in psychology will reach a definitive conclusion. Analogically speaking, psychological models often resemble floating boats that anchor themselves to favorable evidence at lower levels. Both frameworks can grow by adding ad hoc hypotheses to bolster their respective claims. The previous section underscored this issue, highlighting the problem of theory underdetermination, where empirical evidence is insufficient to definitively confirm or reject either model.

As shown previously, when we make moral judgments, both emotional areas, such as the amygdala, vmPFC and insular cortex, and cognitive decision-making areas in the lateral PFC are activated almost simultaneously. This suggests that moral judgments cannot be neatly categorised as either purely emotional or purely rational. Joshua Greene's dual-process model offers a key insight into this complexity, suggesting that moral reasoning involves both deontological (emotion-based) and utilitarian (reason-based) judgments (Greene 2013). Greene's model posits that deontological judgments, which are driven by adherence to moral experiences, rely heavily on emotional processing, particularly involving the vmPFC. On the other hand, utilitarian judgments, which focus on maximising outcomes, are linked to the dlPFC, a region associated with rational decision-making.

Greene's dual-process model implies that moral judgments do not rely solely on either emotional or rational bases, but rather on a dynamic interaction between the two. This provides a possibility to support for an integrative approach between UMG and EMS models. Rather than seeing them as competing frameworks, it is more fruitful to see UMG and EMS as complementary outlines that together provide a more comprehensive understanding of moral cognition. By exploring the ways in which these emotional and rational components interact, particularly through the lens of neuroscience, we can advance our understanding of how moral principles are formed and executed in the brain.

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Building on this foundation, an integrative approach combining UMG and EMS in moral psychology provides a valuable framework for further investigation. As highlighted in the previous section, both UMG and EMS models remain empirically underdetermined, with current evidence failing to definitively favor one framework over the other. Treating both models as working hypotheses in neuroscience allows researchers to rigorously explore the causal pathways connecting emotional regions, such as the amygdala and vmPFC, with cognitive decision-making areas, such as the dlPFC. This approach not only deepens our understanding of moral cognition but also promotes the development of nuanced experimental designs capable of disentangling the contributions of emotional and rational processes in moral reasoning. Integrating insights from both models may therefore lead to a more comprehensive understanding of how these processes interact in the brain, ultimately advancing the fields of moral psychology and neuroscience.

A simple integrative approach is not necessarily superior to individual models such as UMG and EMS. Each model offers unique insights into moral psychology, with their respective strengths illuminating different aspects of moral reasoning. However, there is a compelling rationale for integrating these models, particularly as outlined by Piccinini and Craver (2011). They argue that understanding complex cognitive phenomena often requires drawing on multiple theoretical frameworks that address various facets of the same issue. By leveraging both UMG and EMS, we can capitalize on their respective strengths to form a more nuanced understanding of moral cognition.

Piccinini and Craver (2011, p. 283) propose that psychological models function as functional analyses or mechanism sketches, articulating how components interact within a system to produce specific capacities. A functional analysis outlines the relationships and roles of components without necessarily specifying their underlying structural details. They

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contend that such models can effectively map onto mechanistic explanations, as the components described in these analyses can eventually be linked to their neurological counterparts. This perspective supports treating both UMG and EMS as working hypotheses that guide research to uncover the underlying mechanisms of moral judgments.

Mechanism sketches are particularly valuable in moral cognition research because they offer a structured yet adaptable framework for linking abstract psychological principles with empirical neuroscientific data. For example, UMG's intention principle and contact principle can be incorporated into a preliminary mechanism sketch, mapped onto neural substrates such as the temporoparietal junction (TPJ), which is associated with processing intentionality, and the ventromedial prefrontal cortex (vmPFC), which is essential for emotional regulation. Similarly, EMS emphasizes emotional processes such as guilt and empathy, which correspond to the functional roles of the amygdala and insular cortex. By integrating these components into a mechanism sketch, researchers can examine how moral principles and emotional processes interact to generate moral judgments.

Neuroscientific investigations into moral judgments require functional analyses that identify relevant brain areas and their temporal dynamics during moral reasoning tasks. Treating UMG and EMS as mechanism sketches facilitates this by specifying key components and hypothesizing their interactions. For instance, the UMG framework conceptualizes moral principles as cognitive structures linked to specific neural regions, while the EMS framework emphasizes emotional processes that shape moral cognition. Mechanism sketches thus act as heuristic tools, bridging the gap between psychological theories and neuroscientific data.

Moreover, mechanism sketches address the underdetermination inherent in moral psychology by providing a framework for interdisciplinary integration. Recent neuropsychological, neuroimaging, and psychological research indicates that emotions extend beyond visceral responses to

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external stimuli, encompassing cognitive aspects such as self-concept, regulation, and appraisal (Barrett et al., 2016, Part V). By framing UMG and EMS within mechanism sketches, researchers can refine hypotheses through empirical testing, mapping interactions between cognitive and emotional elements onto specific neural circuits. This iterative process enhances the explanatory power of each framework and supports their synthesis into a cohesive model of moral cognition.

Decomposing UMG principles into their fundamental components and aligning them with the emotional processes central to EMS enables mechanism sketches to foster a comprehensive understanding of moral judgments. This framework provides a robust foundation for investigating the neural mechanisms underlying moral cognition, ensuring that theoretical advancements remain firmly rooted in empirical evidence. The following sections will outline specific directions for studying the neural dynamics of moral judgment, demonstrating how mechanism sketches can guide future research in this domain.

### 2) Neural Foundations of Emotional Development and Cognition

The Mechanism Sketch of EMS model posits that emotions are foundational to moral judgments. This aligns with Sterelny's argument that moral judgments require both biological and social conditions, where emotions play a crucial role in recognizing patterns in social contexts. He suggests that perceptual sensitivity and emotional responses evolved before cognitive moral abilities, emphasizing that humans can identify facial expressions, tones, and gestures, ultimately facilitating moral judgments (Sterelny, 2012). This view aligns with sentimentalism, as posited by thinkers like Prinz, D'Arms, and Jacobson, reinforcing the significance of emotions in moral cognition.

To explore how moral competence arises, we can differentiate between

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two developmental stages. In the first stage, occurring from birth to approximately 24 months, moral norms are shaped primarily through emotional responses rather than explicit principles or exemplars. During this period, children engage in trial-and-error learning, often committing transgressions without understanding societal norms. Emotional reactions, such as sadness from parental disapproval, serve as crucial motivators for norm acquisition. Neuroscientific evidence supports this process; the amygdala and hippocampus are critical for generating emotional responses, while the orbitofrontal cortex evaluates these emotions in terms of rewards and punishments (Rolls, 1999). This connection suggests that emotional evaluations, or valence markers, inform moral judgments and guide behavioral responses based on past experiences.

The second stage of moral development incorporates societal norms and examples, influenced by the growth of language and cognitive abilities. While explicit moral principles become more prominent at this stage, emotions still play a crucial role in shaping moral judgments. For example, witnessing moral transgressions such as robbery can evoke strong emotional responses, processed through both personal and external perspectives. Decety, Michalska, and Kinzler (2012) found that young participants exhibit stronger moral responses characterized by empathic sadness, with connectivity among the amygdala, insula, and temporal regions being notably active. Interestingly, participants of all ages evaluate intentional harm as wrong. That is, older participants demonstrate heightened sensitivity to deserved punishments and malicious intentions compared to younger ones. Additionally, older participants show greater connectivity between the vmPFC and TPJ & pSTS(posterior superior temporal sulcus), suggesting that “mature moral cognition” involves progressive brain development from emotional and empathic concerns to more complex social cognition. Notably, the vmPFC is activated in both emotional and socially cognitive scenarios, while the TPJ is involved in understanding others’

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intentions and engaging in moral reasoning (Young and Saxe 2009). This interplay between emotional processing and cognitive regions implies that moral judgments are influenced not only by direct emotional experiences but also by the capacity to evaluate others' intentions. The integration of these brain regions underscores the intricate relationship between emotion and cognition in moral evaluations, further reinforcing the importance of both in forming moral judgments.

Then, how do we investigate temporally causal connection between emotions and rational cognition, which proponents of the UMG framework point out? LeDoux's Anxious (2016) provides valuable insights into the temporal relationship between emotional and cognitive brain regions during fear and anxiety responses, which offer significant clues for understanding moral judgments as well. His model emphasizes that the amygdala, especially its basolateral nucleus (BA), plays a central role in processing emotional responses to threats. This activation is directly linked to motivational and decision-making areas like the nucleus accumbens (NAcc) and prefrontal cortex (PFC), particularly the vmPFC. These neural circuits suggest that emotional responses, once initiated, engage cognitive areas that influence how individuals assess threats and initiate avoidance behavior, extending the Pavlovian reaction framework into action-based responses.

LeDoux details how the amygdala and its extended structures, such as the bed nucleus of the stria terminalis (BNST), coordinate responses to clear and ambiguous threats, offering a refined understanding of how defensive behaviors develop in response to different threat levels. The pathway between the basolateral amygdala (BA) and the nucleus accumbens (NAcc) is particularly essential, as it activates motivational states that drive action, while the BNST modulates responses to uncertain threats. This integration of emotional and cognitive circuits in LeDoux's model aligns well with my integrative approach, where emotional regions like the

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amygdala and cognitive areas such as the BNST are engaged almost simultaneously during moral decision-making.

Furthermore, LeDoux's work sheds light on how altered threat processing in individuals with anxiety disorders can improve through cognitive therapies. He notes that threat sensitivity and maladaptive avoidance behaviors, often stemming from an overactive amygdala and reduced prefrontal regulation, can be mitigated. These findings suggest that automatic emotional responses are indeed modifiable by deliberate, cognitive processing, indicating a reciprocal causal relationship between emotional and cognitive systems. LeDoux's model, therefore, provides a mechanistic sketch for examining the temporal interactions between these brain regions, suggesting that moral judgments rely on a dynamic interplay between emotion-driven motivational circuits and higher-order cognitive processes.

To summarize, the EMS model can be expanded to illustrate that moral judgments are deeply intertwined with emotional responses and cognitive elaborations throughout development. Recognizing how emotional evaluations shape moral norms and judgments during childhood and adolescence, as supported by anthropological and empirical evidence, enhances our understanding of the neural mechanisms underlying moral cognition. Additionally, LeDoux's model offers an insightful mechanistic sketch that could guide future research into the temporal dynamics between emotional and cognitive regions in the brain. Applying this model to moral cognition may deepen our comprehension of how emotions shape moral decision-making and how cognitive control mechanisms modulate emotional responses, ultimately strengthening and enriching both the UMG and EMS frameworks.

### 3) The Role of Universal Moral Grammar in Social Cognition

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Emotional responses shaped by social interactions during childhood and

adolescence develop in tandem with cognitive capacities. Hauser et al. anticipated that UMG plays an unconscious role in processing moral situations, evaluating behaviors, and guiding decisions about appropriate conduct. Although the neural bases of UMG remain unclear, neuroimaging studies provide meaningful insights into which cognitive areas are involved in moral development. For instance, Decety, Michalska, and Kinzler (2012) demonstrated that adults show greater activity in the dorsolateral prefrontal cortex (dlPFC) and the TPJ/pSTS when viewing moral versus nonmoral transgressions, compared to younger participants. Additionally, Young et al. (2007) found that heightened activation in the TPJ/pSTS is linked to intent attribution during the evaluation of attempted harms. The TPJ/pSTS is well-established as a domain-general area involved in understanding mental states and social cognition (Decety and Lamm, 2007). These findings resonate with a principle in UMG—the "intention principle"—which posits that intentional harm is judged as morally worse than harm that is a foreseen but unintended consequence. Consequently, without adhering strictly to a domain-specific modularity assumption in UMG, we might consider the TPJ/pSTS a core brain area linked to UMG's intention principle.

The "contact principle" in UMG is based on the concept of self, which plays a key role in distinguishing between physical contact and direct contact. This self-related processing is supported by research showing that the vmPFC and posterior cingulate cortex (PCC) are involved in self-referential thought (Bzdok et al., 2012). Conversely, a diminished sense of moral identity, often seen in individuals with psychopathy, is linked to impairments in both moral and emotional reasoning. This highlights the importance of understanding how self-concept is represented in the brain and its impact on moral cognition. Thus, the concept of self within the contact principle suggests specific brain regions that may underlie this cognitive capacity. Overall, each moral principle, treated as

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a working hypothesis, offers a pathway to identify candidate neural components involved in moral judgments.

To summarize, the UMG model offers a valuable framework for investigating the cognitive circuits involved in moral judgments. By breaking down moral principles into specific components—such as formal elicitors like harm, self, agent well-being, and perception of circumstances—researchers can more precisely identify the neural structures associated with each principle. This approach not only clarifies the cognitive mechanisms that drive moral judgments but also highlights the dynamic interplay between emotional responses, cognitive processes, and self-concept in shaping moral reasoning throughout development.

While integrating UMG and EMS models raises concerns about potential irreconcilable or contradictory findings, these risks can be mitigated by adopting an iterative approach. Rather than assuming perfect alignment between the two frameworks, this approach acknowledges their distinct contributions and emphasizes the importance of empirical testing to investigate their interactions. For instance, conflicting results, such as discrepancies in neural activation patterns or behavioral outcomes, can offer valuable insights into the boundaries of each model's applicability. Such conflicts may also reveal previously overlooked factors, including contextual or developmental influences, that mediate the relationship between moral principles and emotional processes. By applying Piccinini and Craver's concept of mechanism sketches, UMG and EMS can serve as provisional, complementary hypotheses that guide research while maintaining their theoretical distinctiveness. This flexible framework fosters a more nuanced understanding of moral cognition and systematically addresses areas of divergence through empirical investigation and theoretical refinement, thereby avoiding the pitfalls of simplistic eclecticism.

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### 4) Some Limitations and Methodological Directions

While neuroscientific methods offer valuable insights into the mechanisms underlying moral judgment, they are accompanied by several inherent limitations that warrant consideration. First, current neuroimaging techniques, such as fMRI, still lack the temporal resolution necessary to capture the rapid interplay between cognitive and emotional processes involved in moral judgment. Although alternatives like MEG and EEG provide better temporal resolution, their limited spatial specificity and constrained applicability to complex tasks hinder efforts to delineate the causal dynamics between rule-based reasoning and emotion-driven responses.

Second, moral cognition involves interactions across multiple, hierarchically organized brain regions, yet current methods struggle to address the distributed and integrative nature of these processes. Although multimodal approaches combining behavioral, neuroimaging, and computational methods show promise, they remain resource-intensive, requiring interdisciplinary collaboration and advanced analytical tools that are not yet widely accessible.

Third, neuroscientific approaches often reduce moral phenomena into discrete variables, oversimplifying the nuanced and context-dependent nature of moral judgments, which are shaped by cultural, social, and individual factors. Standard paradigms, such as the trolley dilemma, provide controlled environments but fail to capture the complexity of real-world moral decision-making, limiting the generalizability of findings to broader theoretical and practical contexts.

To overcome these limitations and advance the study of moral judgment, future research should prioritize several methodological innovations. Experimental designs enabling causal inferences are essential to move beyond the current reliance on correlational data. Techniques like TMS and

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transcranial direct current stimulation (tDCS) can temporarily disrupt activity in specific brain regions, such as TPJ for intention processing or vmPFC for emotional regulation, during moral reasoning tasks. These approaches can help determine whether these regions are necessary for the observed cognitive or emotional functions in moral judgments.

Furthermore, moral judgment research should incorporate scenarios with greater ecological validity. Virtual reality (VR) technology offers a promising avenue for simulating realistic moral dilemmas, enabling participants to engage with lifelike situations that evoke both cognitive and emotional responses. This method enhances the applicability of findings to real-world contexts and provides richer data on cultural and contextual influences. To counter reductionist tendencies in current approaches, longitudinal studies should track the development of moral cognition over time, capturing changes in brain function, emotional maturity, and reasoning processes. Cross-cultural research is equally critical for distinguishing universal moral principles from culturally specific variations. For instance, comparative studies examining emotional salience across different cultural contexts could elucidate how moral principles interact with diverse social norms.

By adopting these methodological innovations, moral neuroscience can address its current limitations and build a more comprehensive understanding of moral cognition. Specifically, these approaches can help (i) uncover causal relationships between cognitive and emotional processes, (ii) identify the temporal dynamics across neural regions, and (iii) bridge the gap between abstract moral theories and empirical findings. This integrated framework has the potential to resolve enduring theoretical debates, such as the relationship between UMG and EMS, while informing broader discussions on the neural basis of moral reasoning in real-world contexts.

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## 5. Conclusion

This paper distinguishes itself from traditional moral psychology theories by proposing an integrative framework that unifies UMG and EMS models through the concept of mechanism sketches. By adopting Piccinini and Craver's approach, this research moves beyond descriptive accounts to offer a structured yet adaptable model that captures the dynamic interplay between emotional responses and cognitive principles. Unlike existing theories that address these components in isolation, this framework emphasizes their interaction in shaping moral judgments while bridging abstract theoretical constructs with neuroscientific correlates. Moreover, its focus on temporal dynamics and iterative refinement incorporates emerging empirical findings, providing novel insights into the neural mechanisms underpinning moral cognition. Moral judgments are influenced not only by emotional circuits but also by cognitive mechanisms, including the understanding of agents' intentions, the self, and situational contexts. This holistic framework underscores the importance of integrating both dimensions to fully address the complexity of moral reasoning.

Future research should prioritize investigating the temporal connections among brain regions implicated in moral judgments. Understanding how regions such as the vmPFC, amygdala, BNST, and TPJ/pSTS communicate over time during moral decision-making processes could illuminate the dynamic interplay between emotion and cognition. Exploring these temporal dynamics will deepen our understanding of how moral judgments are formed, offering more nuanced insights into the developmental trajectory of moral cognition.

In conclusion, integrating the UMG and EMS models as working hypotheses for functional analyses allows for a richer understanding of moral judgments and their neural correlates. This approach not only paves the way for further empirical investigations into the intricate relationship

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between emotions and cognition in moral reasoning but also highlights the necessity of a multi-faceted examination of morality that transcends singular theoretical frameworks.

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## 국문초록

# 도덕 판단에 대한 통합적인 신경과학적 접근

-보편 도덕 문법론과 도덕 감정론의 연결-

김진영*

본 논문은 도덕적 판단의 기초를 설명하는 도덕 심리학의 두 가지 주요 이론인 보편 도덕 문법론(UMG)과 감정 도덕론(EMS) 틀을 분석한다. UMG 이론은 도덕적 판단이 언어적 문법과 유사한 선천적이고 무의식적인 원칙에 의해 형성된다고 주장하는 반면, EMS 이론은 분노나 죄책감과 같은 자동적이고 감정적인 반응이 도덕적 결정을 이끌어낸다고 강조한다. 본 논문은 최근 신경과학적 증거를 바탕으로 두 이론의 강점과 한계를 평가하고, 양쪽 이론 모두 현 증거로는 충분히 뒷받침되지 않음을 지적한다. 도덕 심리학의 경쟁 모형으로서 UMG의 원리와 감정적 과정을 각각 저울질하기보다는 도덕적 인지를 신경과학적으로 이해하는 데 필요한 상호 보완적인 작업 가설적인 모형으로 취급할 것을 제안한다. 이와 같은 통합적 접근 방식은 도덕적 판단의 신경 메커니즘을 탐구하는 데 있어 현재의 논쟁을 넘어서 보다 생산적인 연구 방향을 제공할 것으로 기대된다.

【주제어】 도덕 판단, 보편 도덕 문법론, 감정, 신경과학, 미결정성

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