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Influence Of Neural Behaviour On Decision Making

Shahima Roushon
Phd Scholar
Dept. Of Business Administration, Assam University, Silchar

Dr. H. R. Laskar
Phd Supervisor
Dept. Of Business Administration, Assam University, Silchar

Abstract
Decision-making is a fundamental cognitive process that shapes human behavior and plays a crucial role in various aspects of life. Making decisions is something we all do every day, from what to eat for breakfast to big life choices, i.e., ranging from personal choices to societal policies. It involves selecting one option among several alternatives based on preferences, values, and available information. Recent developments in neuroscience have shed light on the complex interactions between brain systems and decision-making processes, whereas older models have frequently concentrated on rational thought and utility maximization. The aim of this study is to provide an overview of the influence of neural behavior on decision-making, drawing upon contemporary research findings and theoretical frameworks. A key aspect of this exploration involves understanding the roles of both the conscious mind, which involves deliberate reasoning and thoughtful analysis, and the subconscious mind, which operates automatically and often outside of conscious awareness. By examining the interplay between these two aspects of the mind, we can gain a deeper understanding of how they jointly influence decision-making processes.

Keyword: *Decision making, Neural behaviour, Conscious decision, Sub-conscious decision*

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I. Introduction

The decision-making process is a complex and multifaceted phenomenon that has been the subject of extensive research in various fields, including neuroscience, psychology, and cognitive science. Understanding how the brain processes information and guides behaviour can provide valuable insights into human decision making and the factors that influence it. Recent studies have shed light on the influence of neural behaviour on decision-making, particularly in the context of adolescent development (Blakemore & Robbins, 2012). The neural mechanisms underlying decision-making have been a focal point in cognitive and behavioral neuroscience research.

Recent developments in neuroimaging methods have provided significant advances in our knowledge of the neural processes that underlie decision-making. Researchers have shed light on the cognitive processes underlying human decisions by pinpointing particular brain networks and areas that are engaged in decision-making using real-time brain activity observation.

The purpose of this research is to investigate the neural mechanisms that underlie the conscious and subconscious minds' interaction when making decisions. Research aims to provide greater insights into the neurological basis of decision making by examining how these processes interact. This will ultimately lead to improved decision-making strategies that combine intuitive and rational parts for optimal outcomes in a variety of real-world situations.

II. Neural Basis Of Decision Making

The neural basis of decision making involves interaction of different brain areas and neurotransmitter systems. The amygdala, basal ganglia, and prefrontal cortex are important brain regions. The prefrontal cortex facilitates planning and reasoning and is in charge of making conscious, logical decisions. Through reward processing and habit formation, the basal ganglia impact subconscious decision making. The amygdala incorporates emotional data and influences decisions by balancing cognitive and emotional impulses. Neurotransmitters that affect mood, motivation, reward signalling, impulse control, and mood regulation, such

as dopamine and serotonin, impact these processes. Gaining knowledge of these brain processes can help us better understand how and why decisions are formed.

III. Need And Importance Of Both Conscious And Sub-Conscious Mind In Decision-Making

Decision making, a fundamental cognitive function, depends on the complex interaction of the conscious and subconscious minds. Rational analysis and purposeful cognitive processes are characteristic of the conscious mind, which forms the foundation of logical decision making. It enables people to critically analyze situations by comparing different solutions to preset standards and long-term goals. By using logical thinking and cognitive evaluations, people can make well-informed decisions by minimizing risks and optimizing results through purposeful analysis made possible by the conscious mind.

On the other hand, the subconscious mind, which functions below the level of conscious awareness, provides implicit knowledge and intuitive insights that have a significant effect on decision-making. Subconscious insights, which provide immediate and instinctive responses to stimuli, influence decision-making. They are derived from emotions, acquired associations, and past experiences. Due to these subconscious processes' inherent automaticity and speed, people can make quick decisions under pressure or in time-sensitive situations, bypassing conscious thought and relying instead on intuitive judgments to solve problems effectively.

Understanding the functions of the conscious and subconscious minds is essential for making effective decisions. The conscious mind provides analytical rigor to decision-making, assisting in choice evaluation, outcome prediction, and alignment with long-term objectives. The subconscious mind influences perceptions and risk-taking behavior by providing emotional direction and intuitive knowledge. Integrating conscious reasoning with subconscious insights allows for a balanced approach, considering both rational and emotional factors.

The interplay between consciousness and subconsciousness shows how complicated decision-making is and how crucial it is to integrate both for best results. **The aforesaid background put forward the following research questions:**

1. What are the evolutionary advantages of having both conscious and subconscious decision-making processes?
2. How do conscious and subconscious decision-making processes interact in the brain?
3. Which brain regions are primarily involved in subconscious decision making?
4. How do the conscious and subconscious mind differ in their approaches to decision making
5. How do the conscious and subconscious mind influence decision-making?

IV. Review Of Earlier Research Works

Krishanu Kumar Das (2021) in his article examined the connection between consciousness and the subconscious mind, investigating how consciousness evolved and its role in guiding molecular reactions. It also explores the subconscious mind, discussing its potential power and autonomy. By reviewing different sources, the paper aims to clarify the functions of both the conscious and subconscious mind, while also touching on unilateral neglect in patients with brain damage and the three domains of the mind: conscious, subconscious, and unconscious. Swami Vivekananda's spiritual insights on consciousness are also referenced, adding a unique perspective to the scientific exploration of the mind.

Priya, Shreya Sureka, Dr. Divya Jain**.** (2021) analyses the profound influence of the subconscious mind on human behavior and life, highlighting its enigmatic and powerful nature. It emphasizes how individuals are often unaware of the subconscious forces shaping their actions and beliefs. Drawing from historical and contemporary research, the paper underscores the significance of understanding and harnessing the potential of the subconscious mind. It suggests that deeper comprehension of the subconscious can propel humanity forward at an extraordinary pace, possibly even unlocking connections to the universe through phenomena like dreams and déjà vu. The conclusion emphasizes the importance of belief in leveraging the power of the subconscious for personal growth and achievement, echoing the sentiments found in motivational literature.

Lei Zhang and Jan Glascher. (2020) explores how individuals navigate decision-making amidst conflicting personal experiences and social influences. Through real-time multiplayer reward learning tasks and advanced brain imaging techniques, they reveal that while people often conform to group decisions in the face of dissent, their confidence surges when encountering confirming information. This research uncovers distinct neural pathways for direct valuation through experience in the ventromedial prefrontal cortex and vicarious valuation through observation in the anterior cingulate cortex, highlighting the integration of social information processing in decision-making circuits. The discovery of a novel social prediction error in the putamen underscores the pivotal role of brain networks in mediating social influence on decision-making.

Mubarak Ali (2019), The paper examines the growing trend of neuromarketing, where retailers strive to influence consumers' subconscious minds through persuasion techniques. Brands employ tactics like nudging

and baiting to create irresistible choices in appealing environments, shifting away from traditional purchasing methods. Contemporary consumers are swayed by engaging displays both online and offline, driven by factors such as likeability and scarcity. The study explores the psychological intricacies of modern buying behavior, emphasizing the transition from rational decision-making to subconscious manipulation. While neuroimaging tools reveal insights into consumer behavior, ethical concerns persist regarding subconscious manipulation. However, understanding these cognitive processes through neuroscience facilitates tailored marketing strategies that leverage emotional connections. The paper advocates for empirical analysis to objectively evaluate the impact of brands on the subconscious mind, suggesting broader applications beyond product marketing.

H.S. Azman1, M.K.M. Amin1 and S. Wibirama (2019) explores the relationship between cognitive consumer purchase behaviors and their effects, focusing on the emerging field of Neuromarketing. employing objective tracking of gazing behavior via the Tobii TX300 eye tracker. Contrary to traditional survey-based methods, this study quantitatively analyses subconscious decision-making processes. Experimenting with online clothing collections as stimuli, the research reveals that participants' gazing behavior is significantly influenced by bold, highlighted, and large elements of the stimuli, indicating subconscious decision-making. Notably, the duration of eye fixation on a product does not consistently correlate with purchasing decisions, suggesting the complexity of consumer behavior beyond visual attention. In conclusion, the study underscores the importance of understanding the eye-mind relationship in consumer decision-making, offering insights for marketers and entrepreneurs to enhance product usability and address consumer preferences effectively.

Decision-making is the complex process of choosing a course of action from various alternatives while considering their potential outcomes and consequences over time. The prefrontal cortex (PFC) is traditionally thought to be the only important participant in decision-making (DM), but new research contradicts this theory. Y. Broche-Pérez et al.'s (2016) paper offers an in-depth overview of the brain regions involved in decision-making. A more complex neural network that includes both cortical and subcortical regions is highlighted by the authors. Cortical regions such as the orbitofrontal cortex (OFC), anterior cingulate cortex (ACC), and dorsolateral prefrontal cortex (DLPFC) play significant roles, supported by subcortical structures like the amygdala, thalamus, and cerebellum. The research shows the interconnectivity of cortico-cortical and cortico-subcortical networks by synthesizing evidence from several locations that demonstrates their combined role in decision-making. Also, the study outlines the importance of specific brain circuits in decision-making under uncertainty, highlighting the role of important areas like the insula, posterior cingulate cortex, ventromedial prefrontal/medial orbitofrontal cortex, ventral striatum, anterior cingulate cortex, and dorsolateral prefrontal cortex. The authors make a crucial claim that any damage to this brain network’s components affects decision-making, adaptation to new situations, and overall well-being. They highlight how interactions between cortical and subcortical regions influence decision-making, offering valuable insights into human thought and behavior.

Daeyeol Lee and Hyojung Seo (2016) in their research, investigated human decision-making within social interactions, focusing on deviations from game theory predictions and underlying neural mechanisms attributed to cognitive limitations and dynamic changes during iterative encounters. The study suggests that some brain circuits used for decision-making are general and work the same for both individual and social decisions. But specific brain regions like the medial prefrontal cortex (mPFC) and temporal parietal junction (TPJ) might be specialized for social decision-making. Additionally, this research addresses challenges in studying neural basis of strategic decision making, proposing integration of computational tools and exploring overlap between neural systems in social and non-social decision making to enhance understanding of human behaviour.

The research paper by Botvinick and Braver (2015) explores the intricate relationship between motivation and cognitive control, emphasizing the impact of motivational factors on decision-making processes. Through an interdisciplinary approach encompassing cognitive psychology, social cognition, and neuroscience, the authors advocate for a reward-based decision-making framework to understand control functions. The paper highlights the crucial role of neuroscientific evidence in elucidating the mechanisms underlying the interaction between motivation and cognitive control, paving the way for further integration of behavioral and neuroscientific research.

The study by Chang et al. (2015) investigates the neural mechanisms of social decision-making in the primate amygdala by recording extracellular activity from amygdala neurons in rhesus macaques. They found that a subset of neurons in the basolateral amygdala (BLA) showed value-dependent modulations during decision-making tasks involving rewards for self, others, or both. The research utilized hierarchical Bayesian models to infer population statistics, providing robust insights into the neural processes underlying social decisions.

Joshua I. Gold and Hauke R. Heekere. (2014) in their study examines the neural mechanisms underlying perceptual decision-making, emphasizing the integration of sensory evidence with costs and benefits in decision processes. It discusses the application of sequential-sampling models to understand decision-making across various sensory domains, highlighting the distinction between sensory evidence and decision variables in

the human brain. Additionally, the paper explores the neural representations of value-based decisions, showcasing the accumulation of net value over time to guide choices. Overall, the study bridges the gap between perceptual and value-based decision-making, offering insights into a common framework for understanding different decision-making processes

The study by J.M. Martínez-Selva et al**.** (2014) provides a comprehensive overview of the somatic marker hypothesis and its application in understanding decision-making processes, particularly through the Iowa Gambling Task (IGT). The main findings suggest that ventromedial prefrontal cortex plays a central role in decision-making by integrating sensory, mnemonic, and emotional information relevant to the task. Alongside the involvement of other key brain regions such as the amygdala and cingulate cortex. Bechara's proposition of two interacting system, is discussed, emphasizing the critical role of the ventromedial prefrontal cortex and its subsystems in integrating affective, executive, and inhibitory processes essential for decision-making.

Edmund T. Rolls (2014) delves into the details of conscious and unconscious decision-making in "Computational Processes Related to Conscious Processing and Reasoning." He outlines two routes to action: explicit, conscious reasoning, and implicit, unconscious processes for well-learned actions. Rolls introduces the Higher Order Syntactic Thought (HOST) computational theory of consciousness, highlighting its role in solving the credit assignment problem in multi-step plans. He suggests that qualia emerge as a consequence of evolving a HOST processing system. Neurally plausible decision-making models based on probabilistic neural networks are discussed, raising questions about free will. Rolls also examines the threshold for accessing conscious processing systems, suggesting its adaptive value in filtering sensory noise. This paper challenges conventional notions about the necessity of oscillations in consciousness implementation.

The study by Nicholas Shea. (2013) delves into the intersection of psychology, cognitive neuroscience, and philosophy to explore how neural mechanisms of decision-making can shed light on voluntary choices. It addresses objections about the subpersonal nature of neural data and the multiple realizations of mental properties in the brain, presenting case studies to support empirical generalizations connecting subpersonal and personal-level phenomena. The paper emphasizes the importance of understanding the relationship between neural processes and voluntary decision-making, highlighting implications for clinical approaches to issues like drug addiction and schizophrenia. Overall, it offers a compelling argument for the relevance of neural data in explaining personal-level phenomena, bridging the gap between subpersonal properties and voluntary actions.

Sarah-Jayne Blakemore & Trevor W Robbins (2012), highlighted adolescents often make poor decisions that have significant consequences such as accidents, since they are affected by their emotions and their peers. This conduct is associated with the delayed maturation of brain areas that regulate impulses, like the prefrontal cortex, which further contributes to their inclination for taking risks. According to studies, adolescents react to rewards uniquely than other age groups do. During mid-adolescence, there is increased brain activity associated with rewards, particularly in areas like the ventral striatum. Increased signals linked to reward prediction could be the cause of this heightened response in the brain's reward system during reward anticipation. Adolescents' ability to make decisions may be impacted by the complex networks of decision-making networks that form in their developing brains, with various components maturing at different speeds.

Travis A. Jarrell et al. (2012). The research paper delves into the intricate neural connectivity of the C. elegans male mating network, emphasizing the importance of a comprehensive structural description for understanding nervous system function. By employing spectroscopy to analyze the O star population of nearby Galactic open stellar clusters, the study achieves a more complete binary detection, shedding light on intrinsic multiplicity properties. The paper also discusses attractor dynamics in the male mating network, highlighting how decision-making and behavioral switching are intertwined, showcasing the genetic specificity and reproducibility of neural connectivity.

Van Gaal et al. (2012) studied the impact of unconscious information processing on cognitive control and decision making, shedding light on how subliminal stimuli impact brain regions and cognitive functions. It discusses the significance of awareness in cognitive control processes, proposing that the manner in which control operations are signaled, whether explicitly or implicitly, can yield different outcomes. The study's outcomes emphasize the power of unconscious information processing beyond traditional models of consciousness, indicating that cognitive control functions can be initiated by fast, unconscious information processing reaching the prefrontal cortex.

The research paper by James K. Rilling and Alan G. Sanfey. (2011) delves into the intricate neural mechanisms underpinning social decision-making, emphasizing the pivotal role of various brain regions in processes such as trust, reciprocity, altruism, fairness, and social norm conformity.It also highlights the involvement of reward systems, pain processing, mentalizing, and emotion regulation in shaping social decisions, with a particular focus on the prefrontal cortex's contribution to prudent decision-making in stable social environments. The authors stress the need to explore cross-cultural variations in these neural models and suggest investigating the overlap between social and individual decision-making mechanisms to create a

comprehensive decision-making model. Overall, the paper provides a comprehensive overview of the neural substrates of social decision-making, shedding light on the complex interplay between brain regions and social behaviors.

The research paper titled Anxiety and Decision-Making by C.A. Hartley and E.A. Phelps. (2011) explores the relationship between anxiety and decision-making from a neuroeconomic perspective, highlighting the overlap in neural systems involved in fear, anxiety, and economic choices. It discusses how cognitive biases associated with anxiety can influence decision-making processes, emphasizing the impact of anxiety on attention to negative outcomes and the tendency to avoid potential losses. The paper suggests that techniques for altering fear and anxiety may also lead to changes in decision-making, pointing towards a complex interplay between anxiety and choice.

Alexander Ya Temkin (2011) in this paper examines consciousness, conscious, and subconscious thinking, suggesting that the control of thinking happens indirectly through something called the "metric space" over the mind, which leads to a quantum-style understanding of logical thinking called "quantum mind." By introducing representations similar to those used in quantum mechanics, the authors define personality using math, which helps explore how symmetry properties affect thinking. They emphasize the importance of understanding how thinking is controlled for developing theories of human cognition, proposing that the mind follows quantum principles, with cognitive processes influenced indirectly by probabilities in the metric space. While this perspective offers intriguing insights into consciousness and cognition, further research is needed to validate its ideas.

The paper by Peters and Büchel (2011) explores the neural mechanisms of inter-temporal decision-making, focusing on understanding variability in healthy individuals and psychiatric conditions. It discusses trait effects, such as interindividual differences in reward valuation, cognitive control, and prospection, and how these contribute to behavioural variations. Additionally, it delves into state effects, highlighting interventions that can mitigate impulsive decision-making. The authors emphasize the potential for novel treatment approaches based on modulating influences, despite the ongoing unravelling of precise neural mechanisms behind these interventions.

The paper by Xue et al. (2010) provides a comprehensive overview of advanced brain imaging techniques like EEG and fMRI in decision-making research, highlighting recent developments in multivariate analysis and data integration. It delves into various topics within neuroeconomics, focusing on decision under uncertainty, intertemporal choice, and game theory, showcasing how these techniques advance our understanding of human decision-making. Additionally, it discusses the challenges in interpreting brain activity, emphasizing the importance of pattern analysis approaches to enhance the selectivity of brain responses and improve confidence in cognitive process inference. The paper also touches on hyperbolic discount functions and the association between brain activity in the dorsal MPFC and risk preference, demonstrating the integration of functional imaging measures with decision models.

This study by Polezzi et al. (2010) delves into the neurocognitive underpinnings of risky decision-making by analyzing EEG data during a gambling task. The research uncovers distinct brain responses in individuals with varying risk attitudes across different decision contexts, shedding light on the neural mechanisms involved in processing outcomes during risk-taking behaviors. Through EEG and source analyses, the study identifies the posterior cingulate cortex's involvement in risky decision-making, contributing significantly to understanding the brain correlates of risk assessment and decision-making processes.

The research paper by Rolls, Grabenhorst, and Deco, (2010) presents a neuronal spiking attractor-based model of decision-making, highlighting how decision confidence emerges as an intrinsic property of the model. The model accurately predicts larger neuronal and fMRI BOLD responses on correct trials compared to error trials, showcasing the impact of spiking noise on decision-making processes. Through an fMRI study on olfactory decision-making tasks, the authors confirm the model's predictions, demonstrating a linear relationship between BOLD signal and discriminability on correct and error trials. This study provides a comprehensive understanding of decision-making processes, confidence, and the influence of spiking-related noise on neural activity and fMRI signals.

The research paper titled "Neural Correlates of Social Decision Making and Relationships: A Developmental Perspective" by Guroglu et al. (2009) explores the neural mechanisms underlying social decision-making and relationship development. The paper discusses the importance of social competence in well-being, focusing on the developmental changes in brain regions associated with social interactions. It explores studies on fairness, trust, and reciprocity in social decision-making, highlighting the role of brain regions like the insula, medial PFC, and, Temporal Parietal Junction (TPJ). By investigating intention considerations and perspective-taking skills, the authors aim to enhance understanding of the neural basis of social relationships, emphasizing the significance of developmental trajectories in the social brain network.

The research paper "Separate Neural Mechanisms Underlie Choices and Strategic Preferences in Risky Decision Making" by Venkatraman et al. (2009) investigates the neural mechanisms behind decision-making

strategies in risky scenarios. Through behavioral experiments and fMRI analysis, the study reveals that different brain regions are involved in processing choices that maximize gains or minimize losses, with the dorsomedial prefrontal cortex playing a key role in predicting individual variability in strategic preferences. The findings suggest that decision-making reflects a complex interplay among brain systems coding for various computations, highlighting the importance of understanding how the brain integrates reward valence and probability information to inform decision strategies. Overall, this research sheds light on the intricate neural processes underlying adaptive decision-making behaviors.

Wunderlich et al. (2009), in his research paper explores how the human brain makes decisions based on actions. Wunderlich et al. The study involved healthy subjects, and brain areas like the ventromedial prefrontal cortex and parietal cortex were found to be activated during decision-making processes. The findings suggest that the dorsomedial prefrontal cortex and anterior cingulate cortex play crucial roles in comparing action values. The study provides insights into the neural computations underlying action-based decision-making in the human brain.

In this study, Takezawa, M. (2009) explores the impact of organizational culture on strategic decision-making through two questionnaire studies involving economic and social faculty students. It reveals significant differences in cultural attitudes between the two groups, with economic students being more competitive and results-oriented. The study demonstrates that organizational culture attitudes influence strategic decisions made by participants. However, limitations such as small sample size and time constraints are acknowledged, potentially affecting the generalizability of the findings.

The research paper by David Shanks and Ben Newell (2009) challenges the prevailing notion that decisions are predominantly influenced by unconscious factors, advocating for a shift towards recognizing the role of conscious decision-making processes. The authors emphasize the importance of proving conscious influences and call for future research to explore the various ways in which awareness can intervene in decision making, stressing the need for reliable and immediate awareness assessment methodologies.

The research paper by William Kristan (2008) explores decision-making circuits in neuronal systems, comparing invertebrate and primate models. It delves into the complexity of decision-making processes, highlighting how choices are made both consciously and unconsciously in various species. The paper discusses the role of command neurons in initiating behaviors and emphasizes the distributed nature of decision-making within neuronal circuits, challenging the idea of a single mechanism for decision-making. It also suggests potential cross-influences between the psychological-cognitive and neuroethological-behavioral approaches to studying decision-making, advocating for a comprehensive understanding of decision processes across different species. Overall, the paper provides valuable insights into the diverse mechanisms underlying decision-making in neuronal circuits.

H.R. Heekeren, S. Marrett and Leslie G. Ungerleider, (2008), presents recent neuroimaging studies that delve into understanding the neural mechanisms underlying perceptual decision making across different sensory modalities like somatosensation, vision, and audition. The study has identified distinct brain systems responsible for sensory evidence accumulation, detection of perceptual uncertainty, motor planning, and performance monitoring during decision-making tasks. The research suggests that decision-making processes do not follow a strictly hierarchical model but rather interact in a parallel and heterarchical manner. It also discusses the investigation of brain regions such as the supplementary eye field, rostral cingulate motor area, inferior frontal gyrus, and anterior insula, aiming to elucidate their contributions to accurate decision making under varying levels of attention and task complexity.

The research paper by Xiao-Jing Wang (2008) presents a comprehensive overview of decision-making processes in recurrent neuronal circuits, highlighting the role of slow recurrent synaptic excitation and fast feedback inhibition in forming categorical choices and accumulating evidence for decision-making. The paper discusses the dissociation of decision threshold from a general decision rule, the impact of reward-dependent synaptic plasticity on adaptive choice behavior, and the unified framework for understanding perceptual decisions and value-based economic choices. Wang's work sheds light on the neural mechanisms underlying decision-making across species and emphasizes the importance of investigating decision processes at the biophysical and synaptic levels.

In the paper "Brain Mechanisms of Emotion and Decision-Making" by Edmund T. Rolls, (2006) the author explores how emotions, defined as states elicited by rewarding and punishing stimuli, are intricately linked to decision-making processes in the brain. Rolls emphasizes the role of the orbitofrontal cortex in processing sensory stimuli related to rewards and punishments, highlighting its importance in rapid stimulus-reinforcement learning. The paper provides valuable insights into the neural mechanisms underlying emotions and decision-making, offering a comprehensive understanding of how the brain evaluates stimuli to guide behavior. Edmund T. Rolls' research significantly contributes to unravelling the complex interplay between emotions, cognition, and decision-making processes in the human brain.

Alan E. Rorie and William T. Newsome, (2005). The fMRI study by Heekeren and colleagues' sheds light on the role of the left dorsolateral prefrontal cortex (DLPFC). They found that a part of the brain called the left dorsolateral prefrontal cortex (DLPFC) helps to make decisions based on what we see. They found that this area seems to play a role in combining sensory information to make decisions about what we perceive. This area does two important things: first, the activity in DLPFC matches the activity in the visual parts of the brain when we're seeing things. Second, when the visual information is clear, DLPFC is more active compared to when it's unclear. The researchers suggest that studying both humans and monkeys doing similar tasks could help understand if their brain activity during decision-making is similar to humans. If it is, researches could identify the cortical area in the monkey brain that corresponds to DLPFC in humans. This integrated approach combining monkey and human experiments, along with imaging and electrophysiological studies, promises to provide deeper insights into the higher functions of the primate brain.

A.N. McCoy Æ M. L. Platt (2004), their study focuses on the neural mechanisms underlying decision-making in visually guided behavior, particularly in oculomotor decision-making. It integrates economic theory with neurophysiological techniques to reveal how the nervous system updates decision-making strategies based on changing reward contingencies. Neuronal activity in various brain regions, including the parietal cortex, prefrontal cortex, basal ganglia, superior colliculus, and midbrain dopaminergic neurons, encodes expected value, reward prediction errors, and relative value or salience of environmental features. This complex network orchestrates the selection and performance of actions, ultimately contributing to adaptive behaviors. Specifically, neurons in parietal and prefrontal cortices encode expected value and orienting value signals, while midbrain dopamine neurons signal reward prediction errors. The activation of this network provides insights into the broader understanding of decision-making processes, particularly in dynamically changing environments.

Luke J. Chang and Alan G. Sanfey in their research explores the influence of emotions on decision-making by integrating insights from psychology, economics, and neuroscience. It examines two decision-making systems: a rapid, automatic one, and a slower, controlled one, with emotions often associated with the automatic system. Positive moods may promote risk aversion, while negative emotions such as sadness can impact decision-making. The paper discusses extensively studied negative emotions like fear and disgust, which affect behavior through distinct processing pathways. Overall, the research delves into neural evidence that distinguishes between expected and immediate emotions in decision-making, providing insights into the complex relationship between emotions and choices.

V. Research Gap And Scope For Future Research

Despite a lot of efforts by researchers to understand decision-making and the brain's neural mechanisms, there are still key gaps that need to be addressed. This review has identified that brain regions like the prefrontal cortex, orbitofrontal cortex, cortical and subcortical regions, and amygdala play roles in decision-making, but the neural pathways and interactions between these regions during both conscious and subconscious decision processes are not fully understood. Moreover, the subconscious mind has an impact on our decisions. We have yet to fully grasp the precise mechanisms through which it exerts this influence.

Further research is required to unveil how subconscious processes mould our choices and which neural circuits come into play. Another aspect that warrants exploration is how emotional (often subconscious) and rational (conscious) processing merge during decision-making. It's crucial for us to delve deeper into how these processes interplay at the level necessary to shape our decisions effectively. Furthermore, while neurotransmitters such as dopamine and serotonin are known to influence decision-making, their specific functions in conscious and unconscious processes are not well defined. Investigating how these chemicals impact different types of decision-making could shed light on this aspect further.

It is evident from this review that there is a gap, on how variations in brain structure and function affect decision making processes. The future researcher may study the following research objectives:

1)The evolutionary advantages of having both conscious and subconscious decision-making processes.
2)How conscious and subconscious decision-making processes interact in the brain.
3)How the conscious and subconscious mind approach decision making.
4)How the conscious and subconscious mind influence decision-making processes.

The new research into these topics may enable a more personalized approach to enhance decision-making skills. Filling the gaps in knowledge will expand our understanding of how conscious and unconscious aspects of mind promote or inhibit rational decision making and could lead to practical applications in various fields.

VI. Discussion And Conclusion

This study explores the neural influences on decision making, emphasizing the different functions of the conscious and subconscious minds as well as the underlying neural mechanisms. Despite, significant advancements has been made in understanding decision-making processes, there are still crucial gaps remain. Whereas important brain regions like the amygdala, basal ganglia, and prefrontal cortex are linked to decision-making, exact neuronal routes and interactions between these regions are still unclear. The mechanisms by which the subconscious mind influences decisions are not fully understood, nor is the integration of emotional and rational processing. Additionally, the roles of neurotransmitters like dopamine and serotonin, the timing of neural activations, and individual differences in brain function require further investigation. Addressing these gaps will enhance our understanding of decision making and its applications in various fields, like, psychology, neuroscience, and behavioural economics.

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