



# Applying Neuroscience to Investor Behaviour in the Indian Stock Market

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## Abstract

This interdisciplinary study combines neurofinance with the analysis of Indian retail investor behaviour to uncover the neural underpinnings of financial decisions. Departing from traditional rationality assumptions, the paper explores the impact of neuroscientific tools, such as functional magnetic resonance imaging (fMRI) and electroencephalography (EEG), on understanding biases prevalent in the Indian stock market. The investigation focuses on loss aversion, emotional influences, herding behaviour, and biased learning, offering nuanced insights into the intricate interplay between neural processes and market dynamics. By integrating real-world data with neuroscientific findings, the study provides a comprehensive understanding of investor decision-making, paving the way for targeted interventions and policy enhancements.

**Keywords:** *neurofinance, Indian retail investors, loss aversion, emotions, herding behaviour, biased learning, and financial decision-making.*

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839

## Introduction

Traditional financial models have long operated under the assumption that investors act rationally, making optimal choices in the market. However, real-world observations of Indian retail investors reveal a departure from this rational behavior, showcasing various systemic biases and heuristics that defy the ideals of perfect rationality. To delve into the biological underpinnings of these behaviors, an interdisciplinary field known as neurofinance emerged in the early 2000s, seamlessly integrating finance, psychology, and neuroscience (Peterson, 2014). This innovative approach seeks to unravel the neural drivers of financial behavior in both individuals and markets, leveraging neuroscientific tools and theories.

Unlike traditional behavioral finance approaches that identify financial anomalies and propose models incorporating psychological factors like heuristics and

biases, neurofinance takes a step further. It goes beyond treating the brain as a mere "black box" and offers a biological explanatory power that is absent in pure behaviorist models (Miendlarzewska et al., 2017). By delving into the intricacies of neural computations shaping financial decisions, neurofinance provides a mechanistic understanding that opens the door to designing interventions aimed at improving financial outcomes based on neurocognitive insights.

The rise of neurofinance is intricately linked to technological advances that have facilitated brain monitoring in decision-relevant contexts. Cutting-edge techniques such as functional magnetic resonance imaging (fMRI) enable the measurement of neural activity indirectly through blood oxygenation signals. Electroencephalography (EEG) records electrical brain waves with remarkable temporal precision. Complementary to these,



physiological measures like skin conductance offer insights into the peripheral nervous system. Together, these tools empower researchers to localize, time, and establish connections between specific brain processes and financial behaviors (Peterson, 2014).

In this paper, the exploration begins with a focus on the neural basis of financial risk perception and loss aversion among Indian investors. Behavioral studies have consistently highlighted the pronounced loss aversion and risk sensitivity exhibited by Indian investors, where losses weigh disproportionately heavier than gains (Sharma & Wadhwa, 2009). Neurofinance steps in to provide a more nuanced understanding by identifying distinct neural circuits involved in financial risk perception and reward valuation. Expected rewards activate the ventral striatum, scaling with anticipated returns, while potential losses engage the anterior insula, signaling negative arousal (Kuhnen & Knutson, 2005). This differential responsiveness of neural circuits helps shape risk preferences and may offer insights into the cultural factors that contribute to loss aversion.

Moving forward, the paper delves into the role of emotions and emotional regulation in Indian market decisions. While the literature portrays Indian retail investors as susceptible to emotional biases, neurofinance sheds light on the dual nature of emotions in investing. Intense emotions can indeed miscalibrate judgments, but at the same time, emotional neural signals facilitate learning and guide profitable behaviors by attaching motivational significance to outcomes (Miendlarzewska et al., 2017). The amygdala, known for integrating emotional inputs into decision-making, and dopamine circuits, which leverage prediction errors to update value representations, play pivotal roles. This nuanced understanding suggests that emotions, when appropriately regulated, may provide adaptive inputs for investors, offering a potential avenue for intervention.

Further exploration involves herding behavior and social influence from a neuro perspective. Studies have indicated that Indian investors tend to exhibit herding behavior during market volatility, following perceived crowd

wisdom (Lakshman et al., 2013). Neurofinance suggests that brain networks supporting mentalizing about other people's beliefs and intentions contribute to such social influence. Synchronized medial prefrontal cortex activity, associated with theory of mind, facilitates anticipating crowd behavior during market bubbles (De Martino et al., 2013). Oxytocin, a neurochemical enhancing mentalizing, has also been linked to increased herding (Huei-Chuan et al., 2014). By measuring Indian trader brain activity and connectivity, researchers can test whether excessive mentalizing underpins herding, providing valuable insights for optimizing social learning during investing.

Lastly, the paper explores the neurocognitive drivers of biased learning and expectations among Indian investors. Robust extrapolative expectations and confirmation bias have been identified in behavioral studies (Chandra, 2008; Nagpal & Kumar, 2007). Neurofinance attributes such biases to distorted learning mechanisms, including aberrant striatal learning signals and failures in integrating discordant information by the ventromedial prefrontal valuation regions (Chau et al., 2014; Frydman et al., 2014). Measuring Indian trader dopamine activity and cortical connectivity could pinpoint the sources of bias, paving the way for targeted interventions to address these cognitive distortions.

In conclusion, this comprehensive exploration emphasizes the potential of neurofinance in modeling the complex psychology of Indian retail investors. The integration of neuroscience, psychology, and finance not only unveils the biological underpinnings of financial behaviors but also offers practical avenues for intervention and optimization. As neurofinance techniques advance, bridging lab experiments with real-world data in the Indian market becomes crucial for testing concepts and refining our understanding of investor decision-making processes. While challenges remain, the promise of elucidating the brain processes behind Indian investor psychology marks a significant stride toward comprehending and navigating the intricacies of financial markets.

### **Neural Mechanisms of Risk Processing and Loss Aversion**

A prominent observation derived from behavioral studies illuminates the pronounced loss aversion and heightened risk sensitivity among Indian investors, where losses hold a disproportionate weight compared to gains (Sharma & Wadhwa, 2009). In the pursuit of comprehending the neural underpinnings of these behavioral tendencies, the field of neurofinance has provided valuable insights. Neuroscientific evidence points toward the involvement of distinct neural circuits in mediating financial risk perception as opposed to reward valuation, thereby shedding light on the intricacies of loss aversion.

The orchestration of these neural circuits becomes evident when considering expected rewards, which stimulate the ventral striatum and scale with anticipated returns. Conversely, potential losses engage the anterior insula, signaling negative arousal (Kuhnen & Knutson, 2005). The responsiveness of these circuits plays a pivotal role in shaping individuals' risk preferences. Furthermore, the roots of loss aversion may extend to the emotional amplification of prospective losses versus gains by the amygdala, providing a neuroscientific explanation for the observed behavioral bias. This reluctance among Indian investors to realize losses manifests in their propensity for speculative attempts to break even, as highlighted by Sharma and Wadhwa (2009). Neurofinance models, incorporating the concept of differential neural sensitivity to risk versus reward, contribute mechanistic explanations for such behavioral patterns. The cultural context adds another layer to the understanding of loss aversion, suggesting that it might be intertwined with cultural factors emphasizing public shame associated with failure.

The prospect of conducting brain imaging studies on Indian investors during actual market decisions emerges as a promising avenue for testing hypotheses derived from behavioral and neuroscientific insights. This empirical approach could assess whether anticipated and realized losses

disproportionately activate neural circuitry associated with loss sensitivity, such as the anterior insula, relative to regions associated with reward. Such a neural characterization would not only validate existing loss aversion models but also provide tangible intervention targets aimed at rebalancing neural risk attitudes.

In delving deeper into the neural correlates of loss aversion, it becomes crucial to consider the broader implications of these findings. Loss aversion, rooted in both behavioral and neural mechanisms, has substantial ramifications for financial decision-making. Understanding how the brain processes losses and gains in the financial domain offers a unique vantage point for refining interventions and strategies aimed at optimizing investor behavior.

Moreover, the intersection of neural processes and cultural influences in the context of loss aversion suggests a multifaceted approach to intervention strategies. It implies that addressing loss aversion among Indian investors requires not only cognitive interventions to rebalance neural responses but also an acknowledgment and consideration of cultural nuances that contribute to this behavioral bias.

In a broader context, these findings contribute to the ongoing dialogue around the integration of neuroscience into finance. The synergy between behavioral observations and neural explanations marks a significant step toward a more comprehensive understanding of investor behavior. As technological advancements in neuroimaging continue, the practical applications of neurofinance in refining financial models, designing targeted interventions, and fostering more informed decision-making among investors become increasingly evident.

In conclusion, the intricate interplay between behavioral tendencies and neural processes, particularly concerning loss aversion among Indian investors, underscores the significance of incorporating neurofinance into the study of financial decision-making. This integrated approach not only refines our understanding of why certain biases persist but also opens new avenues for developing interventions



that address both cognitive and cultural dimensions. As the field continues to evolve, the potential for transformative impacts on financial practices and policies becomes increasingly apparent, offering a more nuanced and effective framework for navigating the complexities of investor behavior.

#### **Role of Emotions in Indian Investor Choices**

In exploring the behavioral landscape of Indian retail investors, the literature suggests a susceptibility to emotional biases, wherein factors like nationalist pride, admiration for CEOs, and brand affinity play a significant role in influencing stock selection (Kumar, 2007). However, the advent of neurofinance has brought forth a more nuanced understanding of the interplay between emotions and investment decisions.

The portrayal of Indian retail investors as being influenced by emotional biases raises questions about the impact of sentiments such as nationalist pride and brand affinity on their decision-making processes (Kumar, 2007). An interdisciplinary field, neurofinance, offers valuable insights into the intricate relationship between emotions and financial choices. Contrary to viewing emotions solely as potential distortions, neurofinance suggests that intense feelings can serve a dual role, both miscalibrating judgments and, conversely, enabling learning and guiding profitable behaviors by attaching motivational significance to outcomes (Miendlarzewska et al., 2017).

At the neural level, the amygdala, a key player in processing emotions, is identified as an integral component in the decision-making process. It integrates emotional inputs, influencing the cognitive aspects of decision-making. Additionally, dopamine circuits, crucial for reward-related learning, leverage prediction errors to continually update value representations. This neural perspective provides a more comprehensive understanding of how emotional signals are integrated into the cognitive processes that underpin decision-making in the financial domain.

The nuanced role of emotions in investing, as suggested by neurofinance, implies that

emotions can offer adaptive inputs for Indian investors when experienced in moderation. However, the literature posits that these emotions may excessively hijack choices when heightened, potentially leading to suboptimal decisions. To test this hypothesis, an intriguing avenue for research involves measuring the brain activity and physiological responses of Indian traders during significant market events. This empirical approach could provide valuable insights into the neural mechanisms at play during heightened emotional states, offering a more granular understanding of how emotions impact decision-making.

Furthermore, the concept of emotion regulation emerges as a potential strategy to optimize investing behavior. Techniques such as reappraisal, which involves reinterpreting emotional stimuli to influence emotional responses, could be explored as a means to attenuate excessive reactions while preserving useful affective signals. Understanding how Indian investors regulate their emotions in the face of market events can contribute to the development of targeted interventions aimed at fostering more adaptive and rational decision-making.

In delving deeper into the neural and emotional dimensions of investment choices, it becomes evident that emotions are not solely impediments to rational decision-making. Instead, they form an integral part of the cognitive processes that guide investors. This holistic perspective, bridging behavioral observations with neuroscientific insights, offers a more refined understanding of the complex interplay between emotions and investment decisions.

As the field of neurofinance continues to advance, the practical implications of integrating emotional and neural considerations into financial models and interventions become increasingly apparent. The synergy between traditional behavioral observations and the nuanced insights provided by neurofinance holds promise for developing strategies that acknowledge the role of emotions in decision-making while aiming to enhance the overall quality of financial choices.



In conclusion, the portrayal of Indian retail investors as susceptible to emotional biases finds a deeper dimension through the lens of neurofinance. This interdisciplinary approach not only highlights the potential distortions caused by heightened emotions but also recognizes the adaptive role that emotions play in guiding profitable behaviors. By measuring neural activity, exploring emotion regulation techniques, and understanding the neural underpinnings of emotional biases, researchers and practitioners can pave the way for more targeted interventions that align with the complex psychology of Indian investors.

### **Social Influence and Herding**

In the realm of Indian investment dynamics, herding behavior stands out as a notable phenomenon, particularly during periods of market volatility when investors tend to set aside their private opinions in favor of aligning with perceived crowd wisdom (Lakshman et al., 2013). The emergence of neurofinance as an interdisciplinary field sheds light on the neural underpinnings of such social influence, highlighting the role of brain networks associated with mentalizing about others' beliefs and intentions.

Neurofinance investigations have revealed that synchronized activity in the medial prefrontal cortex, a region linked to theory of mind, plays a pivotal role in anticipating crowd behavior, especially during market bubbles (De Martino et al., 2013). This insight provides a neural basis for understanding the mechanisms behind herding behavior among Indian investors. However, a nuanced perspective is crucial, as excessive mentalizing, or hyper-mentalizing, can potentially contribute to the spread of irrational exuberance. Intriguingly, studies indicate that oxytocin, a neuropeptide known for enhancing mentalizing capabilities, is also associated with increased herding behavior (Huei-Chuan et al., 2014).

This neurofinance-informed understanding suggests that brain systems supporting social cognition may play a pivotal role in the propagation of herding tendencies within Indian markets. To empirically test this hypothesis, measuring the prefrontal activity

and connectivity of Indian traders during market events becomes a crucial avenue of exploration. Such neuroscientific investigations could provide valuable insights into the extent to which excessive mentalizing contributes to herding behavior, offering a deeper understanding of the neural mechanisms at play during investment decisions.

Moreover, the prospect of dampening social cognition tendencies through brain stimulation presents an intriguing avenue for optimizing social learning during investing. By targeting and modulating specific brain systems associated with social cognition, it may be possible to mitigate unfounded herding tendencies. This potential intervention aligns with the broader goal of leveraging neurofinance insights to enhance decision-making processes among Indian investors.

As neurofinance continues to advance, the practical implications of integrating neural perspectives into the understanding of investor behavior become increasingly evident. The synergy between behavioral observations and neuroscientific insights holds promise for developing targeted interventions that address the root neural causes of financial phenomena, such as herding behavior. The application of brain stimulation techniques to optimize social learning underscores the potential for neurofinance to not only explain observed behaviors but also to shape and enhance decision-making processes.

In summary, the phenomenon of herding behavior among Indian investors takes on a new dimension when viewed through the lens of neurofinance. The exploration of neural networks associated with mentalizing provides a compelling narrative for understanding the social influence that underlies herding. The integration of empirical measurements of prefrontal activity and connectivity in Indian traders during market events offers a pathway to validate neurofinance hypotheses. Furthermore, the prospect of using brain stimulation to modulate social cognition tendencies opens up innovative possibilities for optimizing





decision-making in the complex landscape of Indian financial markets.

### **Biased Learning and Expectations**

Within the landscape of Indian investor behavior, a distinctive pattern emerges, characterized by robust extrapolative expectations and a tendency to chase trends and previous high performers (Chandra, 2008). This inclination is further underscored by a demonstrated confirmation bias, wherein investors selectively favor information that aligns with their pre-existing beliefs (Nagpal & Kumar, 2007). Neurofinance, as an interdisciplinary field at the intersection of finance, psychology, and neuroscience, provides a valuable lens through which to comprehend and explain these behavioral biases, shedding light on the underlying distorted learning mechanisms.

Fundamental to neurofinance's explanatory power is the exploration of how dopamine circuits, integral to the brain's reward system, encode reward prediction errors to update an individual's value beliefs. However, within the context of Indian investors, there is evidence to suggest that aberrant signals in the striatal learning processes can give rise to biased extrapolation. This bias manifests as the connection of unrelated gains into what might be termed as a false perception of "hot hands" in the market (Chau et al., 2014).

Moreover, the ventromedial prefrontal valuation regions, critical for processing and evaluating information, exhibit notable failures in integrating discordant information during instances of confirmation bias (Frydman et al., 2014). This failure to reconcile conflicting data contributes to the persistence of preconceived notions and reinforces the confirmation bias observed in Indian investors. Understanding these neural processes becomes pivotal in unraveling the intricacies of biased learning mechanisms that characterize investment decisions in India.

To delve deeper into the neural underpinnings of these biases, measuring the dopamine activity and cortical connectivity of Indian traders during market activities emerges as a critical avenue of investigation. Such neuroscientific inquiries seek to localize the specific sources of bias within the brain,

offering a more granular understanding of how these distorted learning mechanisms manifest at the neural level. The goal is to uncover the neural computations that drive biased extrapolation and confirmation bias among Indian investors.

Importantly, the identification of these neural processes opens the door to potential de-biasing routes. By targeting and modulating the specific neural circuits associated with biased learning, interventions can be designed to recalibrate these processes and promote more objective, informed decision-making. This aligns with the broader objective of neurofinance, which seeks not only to elucidate the neural basis of financial behaviors but also to leverage this understanding for practical applications in improving decision outcomes.

In summary, the distinctive patterns of extrapolative expectations and confirmation bias observed among Indian investors find explanation and elaboration through the lens of neurofinance. The exploration of aberrant striatal learning signals and failures in integrating discordant information offers a nuanced understanding of the neural mechanisms at play. The prospect of measuring dopamine activity and cortical connectivity in Indian traders provides a tangible pathway to validate and localize these biases. Furthermore, the identification of potential de-biasing routes through targeted neural interventions holds promise for enhancing the rationality and objectivity of investment decisions within the Indian financial landscape.

### **Conclusion**

In essence, the amalgamation of neurofinance with the study of Indian retail investor behavior unveils a promising avenue for expanding our understanding of the underlying drivers in this domain. The application of neuroimaging techniques holds the potential to validate proposed neural distortions associated with prevalent phenomena such as loss aversion, emotional miscalibration, herding, and biased learning. The real-time detection of traders' brain states emerges as a valuable prospect,



offering the opportunity for preemptive interventions in instances where emotions or irrationality may be influencing decision-making.

The distinctive strength of neurofinance lies in its capacity to provide a biological explanatory framework for the deviations of Indian investors from perfect rationality. Beyond merely describing behavioral effects, neurofinance delves into the neural roots of these behaviors, offering a key foundation for the design of optimized interventions and policies informed by neurocognitive insights.

As the field of neurofinance continues to progress, a pivotal next step involves larger-scale studies that seamlessly blend controlled lab experiments with real-world data from Indian markets. This integration is crucial for testing conceptual frameworks in the dynamic and complex context of India's retail investment landscape. While challenges persist in translating these insights into tangible outcomes, the ongoing elucidation of the brain processes governing Indian investor psychology represents an indispensable initial stride.

This study will pave a path to further research in neurofinance which can help investment advisors and financial planners, technology developers in finance and neuroscience, market analysts and researchers, investor advocacy groups, behavioral economists and psychologists.

In summary, the collaborative synergy between behavioral finance and neuroscience, epitomized by neurofinance, holds the promise of groundbreaking conceptual advancements. The resulting realistic models aim to comprehensively capture the drivers, modifiers, and mediators shaping retail investment decisions within the dynamic markets of India.

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