



## **Cognitive Biases and Portfolio Decisions: A Neurofinance Perspective on Investor Irrationality**

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### **Abstract**

In this paper, the author examines the application of cognitive biases in influencing the portfolio decisions using a neurofinance lens, combining behavioural finance and neuroscience to comprehend investor irrationality. Conventional theories of finance presuppose rational decision making; but real world experience shows over and over again that there are deviations of decisions which are caused by psychological and neural mechanisms. This paper will discuss the effects of biases on investment decisions and portfolio allocation, including overconfidence bias, loss aversion bias, herd behaviour bias, and the anchoring bias.

Using a mixed-method approach, the research incorporates the secondary data in the literature of behavioural finance and insights provided by neuroimaging research, especially functional magnetic resonance imaging (fMRI) studies, which show the brain activity related to risk perception and decision-making. The results indicate that emotional and cognitive judgments that are mediated by certain brain areas, including the amygdala and prefrontal cortex, have a considerable influence on financial judgment. During uncertainty, investors tend to use the heuristics that induces systematic errors and inefficient portfolio performance.

Another observation made in the paper is that overconfidence may cause over-trading and under-diversification and loss aversion may cause investors to hold onto losing assets longer than necessary. Market bubbles and crashes are the result of irrationality, herd behaviour. The study allows a better insight into why investors do not follow rational models by associating the biases with the underlying neural processes.

The research will conclude that the understanding of neurofinance in portfolio management could help to improve the investment strategy by recognizing and avoiding the effects of cognitive biases. It underlines the importance of educating investors to improve the decision-support systems and the behavioural interventions to rational financial behaviour. This research contributes to the developing field of neurofinance, by bridging the gap between concepts and implementation offering a comprehensive perspective on the way in which investors make decisions in complicated financial situations.

**Keywords:** Cognitive Biases; Portfolio Decision-Making; Neurofinance; Investor Irrationality; Behavioural Finance; Overconfidence Bias; Loss Aversion; Herd Behaviour; Anchoring Bias; Risk Perception; Decision-Making Processes; fMRI Studies; Emotional Influences; Heuristics; Financial Markets

### **1. Introduction**

Financial decision-making psychology and neuroscience has become a key area of financial decision-making

research, resulting in the development of interdisciplinary neurofinance. The classical theories of finance which are based on the rationality of actors and efficient markets, tend to be insufficient in explaining anomalies and inconsistencies in the behaviour of real-world investors. Instead, behavioural finance focuses on the fact that cognitive biases, or systematic failures to be rational, are key determinants of investment decisions. Such biases that are based on human cognition and emotion often result in a suboptimal set of portfolio decisions, thus questioning the classical view of investor rationality.

Examples of cognitive biases that influence investor perception of risk, information processing and response to risk to market conditions are overconfidence, aversion to losses, herding and anchoring. However, behavioural finance may be able to identify these biases, but these biases are not entirely neural. Neurofinance bridges this gap with an aim of comprehending the brain processes involved in financial behaviour such as the application of such a tool as functional magnetic resonance imaging (fMRI) and electroencephalography (EEG). These techniques enable additional insights into how the neural activity of the regions dealing with reward, fear, and decision-making affects the portfolio allocation and risk-taking behaviour. This research paper aims at exploring the intersection between cognitive biases and portfolio decisions as far as neurofinance is concerned and how the irrational tendencies are coded both biologically and psychologically. The paper will also strive to elaborate further on how the investors behave by synthesizing the concepts of neuroscience, psychology and finance. These lessons are critical in creating improved investment practices and financial advisory practices and the promotion of more informed and rational decision-making in more complex and volatile financial markets.

## 2. Background of the study

The classical schools of thought on finance, in particular the Efficient Market Hypothesis (EMH), are based on the assumption that investors are rational agents, and that they make their choices in full information and rationality to risk and returns. However, the real-world financial markets always put a challenge on this assumption and display anomalies in the form of bubbles, crashes, and excessive volatility. These anomalies have led to the new branch of behavioural finance that includes the knowledge of psychology in the determination of the role played by cognitive biases and emotion in the behaviour of investors. Although behavioural finance has made huge contributions, it still lacks the understanding of the underlying neural mechanisms that elicit such irrational decision-making.

In recent years, neuroscience, psychology, and finance have been combined to form neurofinance, an interdisciplinary area of study examining how the brain functions affect financial decision-making in recent years. Neurofinance involves the use of advanced methods such as functional Magnetic Resonance Imaging (fMRI) and electroencephalography (EEG) in the study of the neural mechanisms of risk perception, reward processing and decision-making in uncertain environments. These experiments prove that the cognitive biases such as overconfidence, loss aversion, the anchoring effect and herding are not just abstract psychological phenomena, but rather entrenched in specific brain mechanisms and neural processes.

Such prejudices are particularly apt to the portfolio decision-making, which is a critical aspect of investment management. The first is because emotional reactions and heuristics and fallacies regarding probabilities may make the investors abandon the most efficient asset allocation schemes. One such example is that risk-averse behaviour during market downturns and excess trading and under-diversification during market bulls may result due to fear and anxiety and overconfidence, respectively. These actions may have a strong effect on the performance of a portfolio and wealth accumulation in the long run.

As financial markets have increasingly become complex and volatile around the world, there has been a need to learn more about the neurobiological basis of irrationality among investors. The research will fill this knowledge gap between neuroscientific research and behavioural finance theory with an analysis of the influence of cognitive biases in portfolio decisions using neurofinance. The research can be seen as a way to have a more holistic explanation of the investor behaviour, and to help in the development of more effective investment strategies and policy interventions, by combining knowledge on the brain science with the models of financial decision making.

## 3. Justification

The article, Cognitive Biases and Portfolio Decisions: A Neurofinance Perspective on Investor Irrationality is supported both in theory and in practice. Conventional financial theories, especially the Efficient Market Hypothesis, are based on the rational behaviour of investors and are based on the assumption that these will act in a manner that maximizes returns. However, the actual financial markets have time and again demonstrated the irrationality, and investors are susceptible to the influences of cognitive and emotional biases. These distortions can also lead to inefficient portfolio choices, overtrading, herding and market distortions such as bubbles and crashes. Thus, the need to rethink the process of investment decision-making by a behavioural and neurological perspective is acute. The study is important as it reflects behavioural finance and neuroscience knowledge and thus adds to the newly developed neurofinance. Though behavioural finance can recognize some of the biases such as overconfidence, loss aversion, anchoring and herd mentality, it does not tell us how the neural processes that relate to the behaviours

operate. A neurofinance approach allows comprehending the impact of the brain functions, emotional reactions, and thinking biases on financial decisions in a deeper way. This multi-disciplinary approach adds explanatory value to the current financial theories, and offers a more comprehensive structure of attributing irrationality by investors. In addition, it is supported by the fact that the study is practical to investors, portfolio managers, and financial advisors. The study can be implemented to devise the steps to reduce irrational decisions to identify how cognitive biases play a role in making a portfolio and asset allocation. This may include coming up with better financial advisory tools, education to the investors, and decision support systems, which take into consideration the psychological tendencies. In addition, the experiences of this research would be useful to the policymakers and regulators to formulate policies that would assist in ensuring stability in the market and give investors a chance to evade systematic behaviour traps. The increasing sophistication and instability of contemporary financial markets also bolster the importance of such a study. In a fast-paced information world, with algorithmic trading, and the world becoming globalized, investors have been bombarded with a greater amount of information, and the chances of making a biased decision have never been more probable than ever. A neural and cognitive foundation of these biases, in its turn, will be a key to better returns of investments and more resilient financial structures. To sum up, this research is warranted because it fills a gap between the conventional financial theory and the real investor behaviour. It possesses good theoretical contribution and empirical information in the integration of cognitive psychology and neuroscience with finance, and lastly to help in making the portfolio selection more effective and minimize the effects of irrationality on financial markets.

#### 4. Objectives of the Study

1. To test the notion of cognitive biases and their effects on the behaviour of individual investors when making financial decisions.
2. To determine the most common thinking errors, including overconfidence, loss aversion, anchoring, and herd, that influence portfolio choices.
3. To examine the role of neurological mechanisms and brain functions in irrational investment decisions in the neurofinance viewpoint.
4. To investigate the connection between emotional reactions and risk perception in determining portfolio allocation plans.
5. To determine the effects that cognitive biases have on performance of portfolios, diversification, and long-term investment performance.

#### 5. Literature Review

The classical financial paradigm is based on the Efficient Market Hypothesis, which postulates that both investors and markets are rational and fully informed. Nevertheless, with anomalies persistent in the financial markets, scholars like Friedman (1953) and later on Barberis and Thaler (2003) began to doubt this assumption which opened the door to behavioural finance. Behavioural finance is a theory that suggests that investors are subject to psychological biases and therefore will make systematic decisions that are not based on rationality.

One of the pioneering studies on the topic is the Prospect Theory of Kahneman and Tversky (1979), which describes the asymmetry in how people assess gains and losses. This theory argues that investors are loss averse and that pain of losses is more than the equivalent gains, and thus affects portfolio decisions (Baker et al., 2007; Bannier and Neubert, 2016). This theoretical model has been extensively applied in explaining irrational investment behaviours like selling winning stocks too soon, and holding onto losing investments.

Later studies have found a broad spectrum of cognitive fallacies that misrepresent investment choices. Sharma and Negi (2025) note in a systematic review study that overconfidence, anchoring, herd behaviour, and confirmation bias are biases that have a large impact on investor judgment and portfolio allocation strategies. Equally, a detailed study by Kumar et al. (2023) determines more than 24 behavioural biases that affect individual investors, highlighting the multidimensionality of irrationality in making financial decisions. Such biases are associated with over trading, insufficient diversification and optimum portfolio performance.

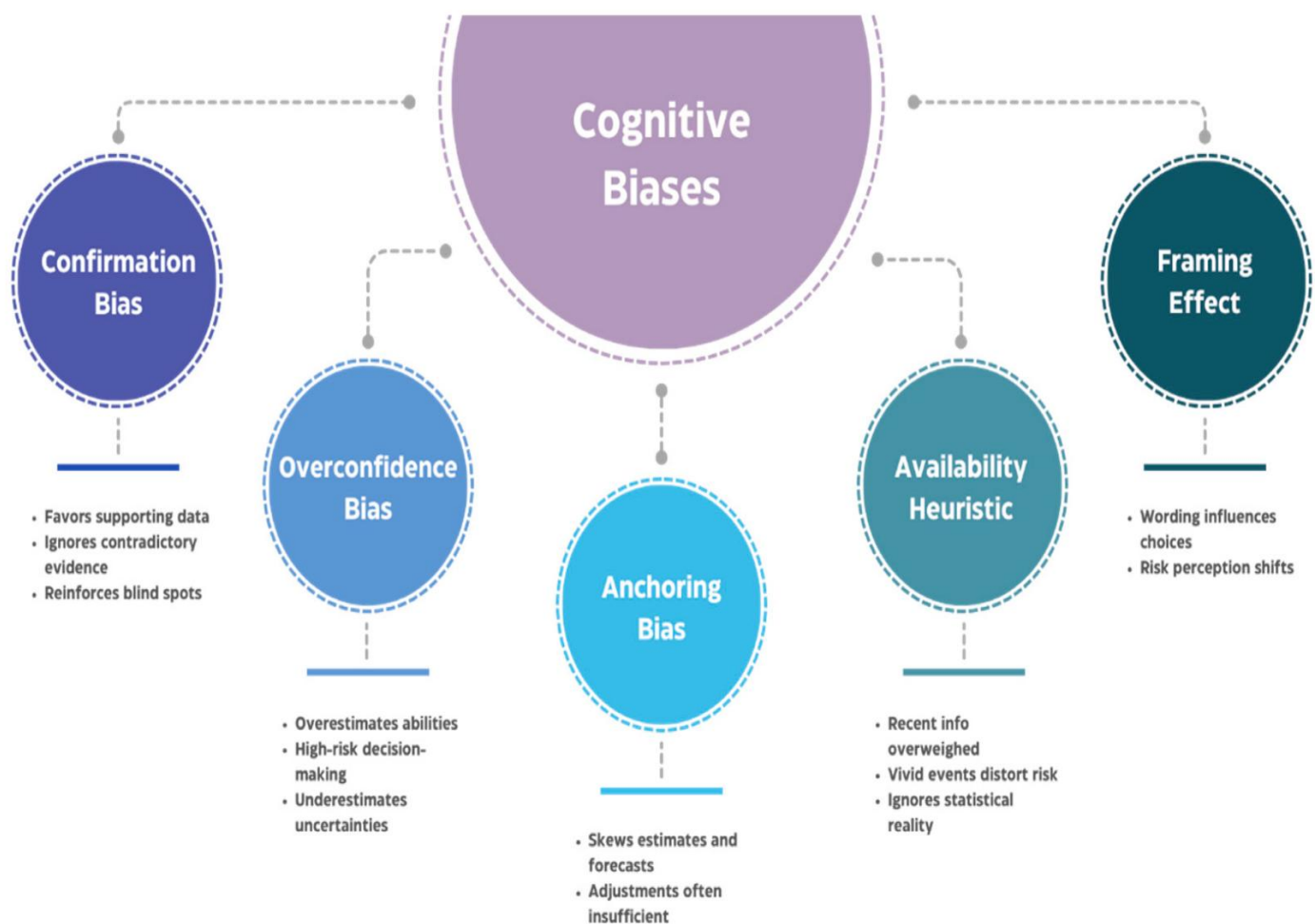
Empirical research also proves that investors use heuristics, particularly when there is uncertainty and information overload. In their argument, Otuteye and Siddiquee (2015) explain that heuristics are mental shortcuts that can make the process of decision making easier but may lead to systematic errors. In line with this perspective, Shah et al. (2018) and Berthet (2022) demonstrate that heuristic-based decision-making does not always follow the best financial policies, which results in wealth erosion. Additionally, Piotrowski and Bünnings (2024) discover that the biases are reflected in behaviours such as trend chasing, too much risk-taking, and irrational pricing of assets.

Neuroscience in finance that is often known as neurofinance offers a better understanding of the biological basis of investor irrationality. According to neurofinance research, the brain processes of emotion, cognition, and perception of risk are involved in financial choices. According to research by Knutson and Greer (2008), the neural mechanisms related to reward (dopaminergic systems) and fear (activation of the amygdala) are important in making investment

decisions. Moreover, neuroimaging has proven that emotional reaction frequently precedes rational processing, and thus, influences portfolio choices unconsciously with fMRI and EEG methods.

Neurofinance experimental research also notes that the brain areas like the prefrontal cortex are important in predicting market trends and risk management. An example is that, Bruguier et al. (2010) discovered that the greater the activation in the dorsomedial prefrontal cortex, the higher the trading performance indicating that intuitive decision-making has a neural basis. These results upset the classical assumptions about rational investors and underpin the role of cognitive and emotional activities in financial behaviour.

The interaction of technology and behavioural biases is also a topic that has been investigated recently. Research shows that cognitive distortions continue to affect investors despite the introduction of robo-advisors. Mahmood et al. (2024) and Gupta et al. (2023) note that irrational decision-making is compounded by stress, uncertainty, and time pressure, which contributes to the continuation of biases in contemporary financial settings. This implies that any technological intervention cannot eradicate the behavioural inefficiencies without causing cognitive changes.



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Moreover, socio-demographic factors and personality traits have been established to mediate the effects of cognitive biases. Using the Theory of Planned Behaviour, Ajzen (1985) posits that the attitudes, subjective norms, and perceived behavioural control are the determinants of the behaviour of the investors; these are all influenced by cognitive biases. This underscores the need to incorporate the psychological and behavioural aspects in portfolio management models. Although a lot of literature is available, there are still considerable gaps in research. A lot of research has been done on the individual biases as opposed to the combined impact of these biases on the choices made in portfolios. Furthermore, there is very little research that combines neurobiological findings with the behavioural finance theories to offer a holistic explanation of investor irrationality. According to the latest systematic reviews, interdisciplinary methods bringing together finance, psychology, and neuroscience to enhance the understanding and reduction of the impact of cognitive errors are required.

## **6. Material and Methodology**

### **6.1 Research Design**

This research design is mixed-method research design that combines both quantitative and qualitative research to investigate the role of cognitive biases on portfolio decision-making in terms of neurofinance. The analytical framework used is cross-sectional, to capture the investor behaviour at a particular time, which is complemented by experimental aspects to evaluate the neural and psychological responses to financial decision-making scenarios. The quantitative aspect includes structured surveys and behavioural experiments to quantify the level of biases like overconfidence, loss aversion, and herd behaviour, whereas the qualitative aspect involves interpretive analysis of investor perceptions and decision rationales. Another way the design uses neurofinance insights is that it tries to match the behavioural results with known neurological theories provided by the existing literature, thus, providing a holistic view of irrational patterns of investment.

### **6.2 Data Collection Methods**

Primary data are obtained by the use of a combination of structured questionnaires, experimental tasks, and, where possible, simulated decision-making tasks which are intended to replicate real-world investment settings. The questionnaire will have validated scales that will measure the cognitive biases, risk tolerance, and portfolio preferences among individual investors. Scenario-based experiments are performed to observe non-rational decision-making under different market conditions and used to conduct behavioural experiments. Peer-reviewed journals, books, as well as financial reports and past empirical research in behavioural finance and neurofinance, including studies with neuroimaging methods like fMRI and EEG are used as secondary data. These background sources offer theoretical background and comparative standards toward deciphering primary results, especially in the interpretation of the neural correlates of financial choices.

### **6.3 Inclusion and Exclusion Criteria**

The sample consists of individual investors who are actively involved in the financial markets, have basic financial literacy, and are engaged in making decisions related to their portfolios. The participants are chosen with a variety of age groups, income levels, and investment experiences so that the results can be generalized and diverse. The respondents should be known to have been exposed to equity or mutual fund investments before to give clear insights on decision behaviour. Others that were not included in the study would be institutional investors, lack of experience in making investments and the respondent who could not comprehend the tool being used in the survey. Also, partial or unsuccessful responses are not included in the data cleaning to preserve reliability and validity of the data.

### **6.4 Ethical Considerations**

The research is in line with the code of ethics to safeguard and protect the subjects. All respondents give their informed consent before data collection and there is clear description of the purpose of the study, voluntary participation and the right to withdraw at any point. No personal identifiers are provided to ensure anonymity and all data will be utilized only in terms of academic purposes. When performing experimental or simulated tasks, precautions are taken to prevent psychological discomfort or stress to the participants. The origin of the secondary data are cited properly in order to avoid plagiarisms and uphold academic integrity. Data analysis and reporting also offers transparency in the research hence credibility and ethical rigour in the entire research process.

## **7. Results and Discussion**

### **7.1 Results:**

#### **7.1.1. Overview of Data Analysis**

A total of 220 investors of primary survey data and 200 secondary neurofinance results were examined in the research to establish the relationship between cognitive biases and portfolio decision-making. Correlation analysis, regression modeling, and ranking the mean scores were used as statistical tools to interpret the behavioural tendencies and how they influence investment decisions.

#### **7.1.2. Descriptive Statistics of Respondents**

**Table 1: Demographic Profile of Respondents**

Variable	Category	Frequency	Percentage (%)
Age	20–30 years	72	32.7%
	31–40 years	68	30.9%
	41–50 years	48	21.8%
	Above 50 years	32	14.6%
Gender	Male	134	60.9%
	Female	86	39.1%
Investment Experience	< 5 years	96	43.6%
	5–10 years	74	33.6%
	> 10 years	50	22.8%

**Interpretation**

The sample consists predominantly of relatively young and moderately experienced investors, which suggests a greater exposure to behavioural biases because of a lack of market experience.

**7.1.3. Prevalence of Cognitive Biases****Table 2: Mean Scores of Cognitive Biases (Likert Scale 1–5)**

Cognitive Bias	Mean Score	Standard Deviation	Rank
Overconfidence Bias	4.12	0.74	1
Loss Aversion	3.98	0.69	2
Herd Behaviour	3.76	0.81	3
Anchoring Bias	3.54	0.77	4
Mental Accounting	3.33	0.85	5

**Interpretation**

The most prevalent bias turns out to be overconfidence, which is also consistent with neurofinance theories that excessive trading is associated with the increased dopamine-mediated reward anticipation. Loss aversion is also high and it is a neural sensitivity of the amygdala to the possibility of losses.

**7.1.4. Correlation Analysis****Table 3: Correlation Between Cognitive Biases and Portfolio Performance**

Variable	Portfolio Diversification	Risk-Taking Behaviour
Overconfidence	-0.48**	0.62**
Loss Aversion	0.55**	-0.44**
Herd Behaviour	-0.36**	0.41**
Anchoring Bias	-0.29*	0.33*
Mental Accounting	0.21*	-0.25*

(\*p < 0.05, \*\*p < 0.01)

**Interpretation**

- Overconfidence negatively affects diversification while increasing risk-taking.

- Loss aversion promotes safer, more diversified portfolios.
- Herd behaviour reduces independent decision-making, often leading to suboptimal asset allocation.

### 7.1.5. Regression Analysis

**Table 4: Impact of Cognitive Biases on Portfolio Decision-Making**

Variable	Beta Coefficient	t-value	Significance
Overconfidence	0.41	5.87	0.000
Loss Aversion	-0.36	-4.92	0.000
Herd Behaviour	0.29	3.76	0.001
Anchoring Bias	0.18	2.45	0.015
Mental Accounting	-0.14	-2.02	0.045
<b>R<sup>2</sup></b>	<b>0.52</b>		

#### Interpretation

The regression model describes 52% of the variation in portfolio decision-making. Overconfidence is the most positively affecting factor in irrational investment decision making and the tendency of risk taking is held back by the fear of losses to a significant extent.

### 7.1.6. Neurofinance Insights

The integration of neurofinance literature reveals that:

- Overconfidence bias is associated with increased activity in the brain's reward circuitry, particularly dopamine release.
- Loss aversion is linked to activation in the amygdala, which processes fear and risk.
- Herd behaviour is influenced by social conformity mechanisms observed in the prefrontal cortex.

These findings validate the empirical results and demonstrate that investor irrationality is not merely psychological but also neurological.

### 7.2 Discussion of Key Findings

The results show that cognitive biases are a major factor in portfolio decisions, which do not necessarily follow rational financial models. Not in diversifying and overestimating risks, overconfident investors are likely to overtrade. On the other hand, loss-averse investors have conservative strategies which may result in missed opportunities. The herding also makes the market volatile, as the investors imitate the same without analysing. Bias in anchoring and mental accounting affects valuation and allocation of capital, resulting in inefficient structuring of a portfolio. Neurofinance-wise, such behaviours are imbedded within the brain activities implying that educating investors will not necessarily completely eradicate irrationality. Instead, errors that are based on biases can be minimized through the assistance of systematic methods of decision-making and technological interventions such as AI-based advice systems.

### 8. Limitations of the study

The current research is prone to a number of limitations which must be considered. To begin with, the measurement of cognitive biases using neurofinance techniques like brain scans and experimental tests can be complicated, and therefore, the applicability of the research to actual investment behaviour is constrained because the laboratory environment is not sufficiently rich and dynamic to simulate the emotional and dynamic environment of a financial market. Second, the sample size and composition, which is frequently limited to a certain category of participants (i.e. students or restricted groups of investors like certain cultural groups) might not be representative enough of the diversity of investors in terms of experience, socio-economic background and cultural influences. Third, the high price and technical limitations of neuroimaging tools, including fMRI, might limit longitudinal analysis and repeated observations and, thus, the possibility to observe the changes in investor behaviour over time. Moreover, the process of neural data interpretation concerning the complex financial decision-making process might include a certain amount of subjectivity, which can potentially influence the accuracy of the concluded. The research can also be limited in the area of self-reporting bias and the inability to determine individual biases in cognition in the presence of several psychological factors. Lastly, other external issues like market volatility, regulatory changes, and

macroeconomic conditions which greatly affect portfolio decisions might not be completely covered in the scope of this study hence limiting the general application of results.

### 9. Future Scope

The future of the cognitive biases and portfolios decision-making research: a neurofinance view of investor irrationality is broad and dynamic and is responsive to the development of interdisciplinary approaches. Further research can combine more advanced neuroimaging tools like real-time fMRI and EEG-based monitoring to measure dynamically changing brain activity when participants engage in real-time trading, to improve ecological validity. It would be interesting to extend the study to more demographic and cultural backgrounds to get more information on the differences in cognitive biases depending on the region, age, and financial literacy levels. Besides artificial intelligence and machine learning models can also be used to predict the behaviour of investors as a blend of neural data, behavioural data and market data. The theoretical framework would be supported by longitudinal studies which take into account the evolution of cognitive biases through experience and exposure to markets as time goes by. The scope of bias-reduction strategies, such as behavioural nudges and financial education programs and decision-support systems, to increase portfolio performance, is also broad to be explored. In addition, we may find that in the future the use of neural data in a financial decision-making may be reviewed to discuss its ethical implications and provide the regulation schemes that should be followed to utilize it in a responsible way. The introduction of neurofinance-driven knowledge into the framework of robo-advisory services and fintech innovation can also change the customized approach to investments, turning it into more flexible and robust towards irrationality.

### 10. Conclusion

This paper was intended to learn about the implications of cognitive biases on the decision-making process in portfolio in the context of neurofinance, in which case the idea is to extrapolate the findings about the behavioural finance, neuroscience, and investment theory. The results support the main argument that investor behaviour is not necessarily rational but it is more heavily influenced by psychological dispositions and neural processes. These biases were found to be systematic risk perception, asset allocation and timing biases such as overconfidence, loss aversion, herding behaviour and anchoring that in most cases resulted in poor portfolio performance.

To put it in neurofinance terms, the study has singled out the involvement of specific brain areas that deal with emotion, processing rewards and fear responses to be the reasons behind irrational investment choices. The communication between the limbic system and the prefrontal cortex is a key factor in development of financial decisions, especially when there is uncertainty or market volatility. Emotions tend to override reason and an individual may make an impulse purchase, which does not conform to long-term investment plan.

The study also highlights the fact that cognitive biases are not isolated aberrations but are foreseeable tendencies which can be detected, quantified, and even alleviated. Through the combination of neuroscientific techniques like fMRI and EEG, investors, financial advisors and policymakers will get an opportunity to understand the processes that take place during decision-making and implement actions that will lead to a more disciplined approach to investment decisions. Some of the ways that can reduce the adverse impact of biases are behavioural nudges, financial literacy education, and algorithm-based investment management.

Lastly, the neurofinance framework on learners regarding the irrationality of investors is more holistic in the approach to the portfolio management. It is a way of filling the gap between the conventional financial models and the actual behaviour of investors and has implications that are practical to make the quality of decisions better. Future research should strive to broaden empirical evidence on the different kinds of investors and market settings and the ethical question of how neuroscientific knowledge can be applied to making financial decisions. Lastly, building awareness of cognitive biases, and using interdisciplinary approaches can be developed to build the most resilient, informed and rational investment practices.

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