Convergence
A Journal for Young Researchers

Received: [for official use only] ; Accepted: [for official use only];
Managing Editor: [for official use only];
Action Editor: [for official use only]

Cognitive Biases in Financial Decision Making and the Design of Nudge-Based Corrective Mechanisms

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Abstract

While considerable progress has been made in the field of behavioral finance, relatively few bias-mitigation mechanisms have been incorporated into the decision-making platforms used by retail investors. Consequently, investors remain exposed to cognitive biases such as loss aversion, anchoring, and the availability heuristic, among others, which can contribute to asset mispricing and excessive trading. Drawing on empirical research, this paper analyzes the relationship among the three biases discussed above and examines how they interact and reinforce one another. The paper subsequently proposes an investment platform grounded in Richard Thaler and Cass Sunstein's nudge theory.

Keywords:
Behavioral Science, Economics, Cognitive Biases, Nudges, Investment Behavior, Portfolio Allocation, Financial Decision Making

1. Introduction

Financial markets are central institutions in modern economies, helping to allocate the flow of capital from those who supply funds to those who seek investment. These markets allow investors to generate wealth while facilitating economic growth by directing funds to companies, governments, and public projects. Nonetheless, markets do not always function smoothly. Major financial crises such as the Great Depression of 1929 and the global financial crisis of 2008 reveal how instability in financial markets can trigger widespread economic disruption, causing uncertainty and panic among investors and institutions alike (Bernanke, 2000; Krugman, 2009). In these situations, market volatility itself causes additional confusion among all players rather than promoting development.

Traditional financial theory assumes rationality for all investors, indicating that they make decisions based solely on logical calculations and publicly available information in order to maximize utility. According to the Efficient Market Hypothesis (EMH) formulated by Eugene Fama (1970), the efficiency of financial markets is exceptionally high in processing and incorporating information about investments, meaning that the price of stocks and other financial instruments adjusts almost instantly upon receiving new information. Under this framing, it would thus be impossible for investors to achieve higher returns than the general market just by examining public information or analyzing price histories. Furthermore, future price changes would be unpredictable since they depend only on new, unexpected information.

This paper makes two primary contributions. First, it synthesizes evidence on how loss aversion, anchoring, and the availability heuristic systematically distort investor judgment away from rationality. Second, it argues that these distortions cannot be fully addressed through education alone; the design of decision-making environments themselves must be reconsidered. To that end, this paper proposes a digital investment platform that incorporates behavioral nudges directly into the investment process. These nudges leverage the same heuristics and biases that distort decision making, using them to redirect investors toward more disciplined outcomes rather than attempting to eliminate them. Within the platform, loss aversion and anchoring are addressed through personalized targets and default rebalancing recommendations that shift investors' reference points toward their own long-term goals. This approach follows the nudge mechanisms in the *Save More Tomorrow* program tested by Benartzi and Thaler (2004), where loss aversion and anchoring were successfully used to encourage employees to save more for retirement. Finally, findings from Schwarz *et al.* (1991) and Salas-Velasco (2024) are utilized to argue that redirecting recall can reduce the impact of availability aimed to redirect investor attention to encourage rational analysis.

The paper proceeds as follows. The next section briefly discusses the shift from the Efficient Market Hypothesis to behavioral finance. The following three sections examine loss aversion, the availability heuristic, and anchoring, each considering empirical studies and real-world examples that illustrate their impact on financial

decision making. The fifth section proposes an integrated solution designed to help investors mitigate the influence of these biases and make more disciplined decisions. Section six concludes by considering implications, limitations, and potential areas for future research.

2. From Efficient Markets to Behavioral Economics: The Deviation from Rationality

As introduced in the previous section, the Efficient Market Hypothesis (EMH) holds that asset prices fully and immediately reflect all available information. Fama (1970) identifies three categories of market efficiency. Weak-form efficiency proposes that prices already incorporate all information from past trading activity, meaning that analyzing patterns in price movements or trading volumes cannot be used to earn higher returns. Semi-strong-form efficiency extends this idea to all publicly available information, such as news releases or financial statements. Under this form, prices reflect such data so quickly that analysis cannot be relied upon to outperform the market. Strong-form efficiency takes this even further by indicating that prices reflect all public and private information, meaning that even those with access to exclusive insider data cannot regularly generate higher profits than the ordinary investor.

Under this assumption, investor behavior should reflect all publicly available financial information. In practice, however, investor behavior frequently deviates from the assumptions of traditional finance theory. While the EMH posits that asset prices fully and immediately reflect all available information, behavioral evidence suggests that markets can remain mispriced for extended periods due to psychological biases. Individuals often hold losing positions longer than is rational, overreact to recent events at the expense of long-term trends, and overvalue familiar assets even when diversification would improve expected returns.

Behavioral economics provides a framework for understanding these deviations by integrating psychology into economic theory. Instead of assuming that individuals are perfectly rational, it explores the role of cognitive processes and social influences in economic decision-making. This theory, pioneered by Nobel Prize-winning scholars such as Daniel Kahneman and Amos Tversky (1981), is based on the concept that human beings are not always rational because of mental shortcuts made due to uncertainty, thus leading to behavioral biases.

Central to this framework is the idea that the human brain operates through two systems, which Daniel Kahneman (2011) refers to as System 1 and System 2. Actions controlled by System 1 are often done subconsciously; for example, comprehending simple sentences and locating the source of a loud sound. System 2, on the other hand, requires attention and mental effort to sustain its operations and is often used when assessing complex situations. Example actions may include generating a strong move in chess as an amateur or finding a familiar face in a crowded room. Because System 2 requires conscious effort, individuals tend to rely on the intuitive processes of System 1, particularly in uncertain or stressful situations. Behavioral biases appear when the automatic responses of System 1 dominate, forming decisions that depart from the fully rational thinking of System 2. Behavioral economics, therefore, provides a more realistic account of human behavior by

recognizing the role of psychological factors in real-world financial decisions. Drawing on experimental studies, market data, and real-world evidence, this paper examines why investors act irrationally and the impact of these behaviors on market outcomes.

Building on this behavioral framework, this paper examines the importance of three cognitive biases that are key influences on financial decision making: loss aversion, anchoring, and the availability heuristic. Each of these biases impacts how investors evaluate risk, interpret information, and allocate assets, causing departures from rational behavior. This paper explores how psychological tendencies can distort market outcomes by analyzing their effects on portfolio diversification, stock valuation, and trading decisions. Beginning with loss aversion, the first section explores how investors feel the pain of a loss more than an equivalent gain, and its impact on investor behavior in both laboratory and real-world settings. The primary consequence of loss aversion is that most investors are less willing to sell losing stocks than gaining ones, leading to inefficient portfolio management. Similarly, evidence from French and Poterba (1991) indicates that loss aversion also makes investors reluctant to diversify their portfolios, as fear of losses is bolstered by the unfamiliarity of foreign assets. Following the discussion of loss aversion, the second section examines the anchoring bias. Anchoring occurs when investors rely too heavily on the first pieces of information they receive when making decisions. In real-world settings, investors are excessively influenced by historical returns, causing their predictions to reflect these numbers instead of all historical data. The final bias considered is the availability heuristic, which influences how people judge frequency and probability. This heuristic occurs when investors overestimate the frequency of events that are vivid, or easier to recall, even when those examples may not be relevant. The effect persists in real-world settings where investor overoptimism caused by availability bias actually leads hot-topic firms to become overvalued, and ultimately underperform. Evidence also shows that awareness and targeted education can actually reduce the effect of this bias, leading to more informed decisions.

3. Loss Aversion and Decision Making

Tversky and Kahneman (1981) articulate this asymmetry in preferences, stating that "[...] the response to losses is more extreme than the response to gains. The displeasure associated with losing a sum of money is generally greater than the pleasure associated with winning the same amount" (Tversky & Kahneman, 1981, p. 454). This definition challenges the traditional economic model of the rational investor who weighs gains and losses equally in decision-making.

Imagine you are walking in the bustling city streets and find a $100 bill on the sidewalk: you'd likely feel pleasantly surprised, maybe even lucky, as you slip the unexpected cash into your pocket. Now imagine a contrasting scenario: you reach into your wallet and discover that $100 had been stolen. For most people, the sharp sting of the loss feels much more intense than the joy of the gain, even though the amounts are identical. In a lab experiment conducted with 160 Wharton MBA students, Schoemaker and Hershey (1992) explored how loss aversion affects individuals' ability to evaluate risky choices involving gains, losses, and mixed outcomes.

Using a within-subject design across three rounds, participants made judgements about certainty equivalents (CE): the amount they'd accept instead of a gamble, and probability equivalents (PE): the probabilities at which they would be indifferent between a gamble and a sure outcome.

To produce these judgments, carefully worded questions were used. For example, in the gain domain, subjects faced a choice: "Suppose you could choose between $100 for sure, and a 50-50 gamble offering either $0 or $200. Which would you prefer?" They then indicated whether they preferred the sure amount, the gamble, or were indifferent. If they chose the sure amount, they were asked for the minimum certain amount they would be willing to accept instead of the gamble. If they chose the gamble, they were asked how much more the sure amount would need to be for them to switch. Similarly structured questions were posed in the loss domain (e.g., choosing between a certain loss of $100 and a 50-50 chance of losing $200 or nothing) and in the mixed domain involving a potential gain or loss of $100. In the mixed and loss domains, participants also indicated either the sure amount or the probability that would make them indifferent. Subjects were clearly told that there were no right or wrong answers and that their responses would not affect their course grades. These findings have significant implications for investor decision-making, as individuals influenced by loss aversion may adopt inefficient investment strategies centered around the avoidance of short-term losses over long-term portfolio optimization.

Consistent with Tversky and Kahneman's definition, the Wharton MBA students' responses showed that losses were valued significantly more than gains. Participants showed risk aversion when dealing with gains, but their reactions to losses were significantly more pronounced. For instance, 56% of participants who were initially risk-seeking when evaluating sure gains became risk-averse when assessing gains under uncertainty. However, this pattern became even more pronounced in the loss and mixed domains. Participants showed a stronger shift toward avoiding outcomes that might solidify a larger loss, even if the expected value was the same. For example, a participant may be indifferent between gaining $100 or nothing, versus $45 for sure, but would reject a 50/50 chance to lose $100 or lose nothing in favor of a certain loss of $45. In mixed-outcome cases, where participants faced a 50% chance of gaining $100 or losing $100, responses were even more conservative: participants often demanded a gain significantly larger than the potential loss before they were willing to accept the gamble. Because of this, Schoemaker and Hershey (1992) determined that the asymmetric tradeoffs in individuals' choices were a direct result of loss aversion.

One of the most striking demonstrations of loss aversion in real-world financial behavior comes from Terrance Odean. Odean (1998) analyzes over 162,000 trading records from 10,000 retail investor accounts at a large U.S discount brokerage firm between 1987 and 1993, reconstructing each investor's stock portfolio from the raw trade data. For every stock sold, he compares the sale price with the average purchase price to determine whether it was a realized gain or a realized loss. Stocks still held in the portfolio on a given day are classified as

unrealized ("paper") gains or losses, determined by whether the market price lies above or below the purchase price. Using this data, Odean (1998) calculates two key metrics:

Proportion of Gains Realized (PGR): realized gains / (realized gains + paper gains)

Proportion of Losses Realized (PLR): realized losses / (realized losses + paper losses)

If investors weighed gains equal to losses, there would be no consistent difference between PGR and PLR. However, the data reveal a significant gap: across the full sample, the average PGR is 0.148, while the PLR is only 0.098. This 5 percent difference is significant and indicates that investors are substantially more likely to realize gains than losses.

Because the data is observational, it is challenging to attribute the high sell-to-hold ratio to loss aversion directly. However, Odean (1998) addresses this by ruling out several alternative rational explanations. Using publicly available stock prices, he reconstructs individual trading decisions and finds that loss aversion persists even after controlling for tax status, transaction costs, and portfolio rebalancing motives. For example, the effect still holds after partial sales and trades followed by immediate repurchases are excluded. Additionally, investors display the same pattern regardless of whether they are frequent or infrequent traders, and across stocks that vary in price. Further analysis shows that this reluctance to sell losing stocks is also financially costly. Odean (1998) finds that on average, the winning stocks that investors sell go on to outperform the stocks they chose to hold. Specifically, sold winners outperform held losers by approximately 3.4% over the following year. This underperformance suggests that the decision to hold onto losers is harming investors' long-run portfolio returns. If investors were truly rationally evaluating future performance, they would not consistently retain underperforming assets.

While Odean studies how loss aversion affects investor behavior after purchasing assets, particularly the reluctance to realize losses, French and Poterba (1991) examine how loss aversion may shape portfolio allocation before trades are even made. They focus on the phenomenon of home bias, where investors allocate a disproportionately large share of their equity portfolios to domestic stocks despite the recognized benefits of international diversification. Using data from the late 1980s, French and Poterba (1991) analyze portfolio holdings in the United States, Japan, and the United Kingdom. They find that investors in all three countries exhibit a strong preference for domestic equities. Specifically, over 98 percent of Japanese portfolios, 94 percent of U.S. portfolios, and 82 percent of U.K. portfolios are held in domestic stocks. These figures suggest that investors forgo potential diversification gains by holding a disproportionate amount of assets in their home markets.

It is very difficult to explain the presence of home bias within the traditional economic framework. Based on historical return correlations, French and Poterba (1991) calculate the expected returns on domestic equities that would be necessary to justify the observed home-biased allocations. The results indicate that investors must

believe domestic stocks will outperform foreign stocks by substantial margins. For instance, U.S. investors would need to expect U.S. equities to yield approximately 2.5 percentage points more per year than Japanese equities. Similar return premiums are implied for investors in the United Kingdom and Japan. These expectations are difficult to explain with historical data, which suggests the presence of cognitive biases. One explanation hypothesized by the authors is that investors perceive foreign markets as riskier due to unfamiliarity or a lack of control. This perceived risk, however, differs from objective risk measures used in standard economic models. Importantly, the concept of loss aversion is key to explaining why investors react more strongly to potential losses in foreign investments because the uncertain chance of a loss is more painful than any equivalent gain. This means investors demand higher returns to compensate for the perceived losses associated with foreign equities, even when objective measures of risk do not justify such premiums. It is loss aversion, rather than analytical risk perception, that motivates this avoidance behavior.

French and Poterba (1991) complement Odean (1998) by demonstrating that loss aversion influences not only trading behavior but also long-term investment decisions. While Odean (1998) focuses on how investors respond to gains and losses once they occur, French and Poterba (1991) highlight how the anticipation of potential losses can lead investors to avoid international diversification altogether. Ultimately, it is clear that individuals' innate fear of losses directly translates to a real impact on the financial market. Recognizing the influence of loss aversion helps explain anomalies in market responses and is crucial to addressing inefficient portfolio management.

4. Anchoring and Distorted Evaluation

Tversky and Kahneman (1974) define anchoring as a process in which "people make estimates by starting from an initial value [...] that is adjusted to yield the final answer," noting that "adjustments are typically insufficient" and that "different starting points yield different estimates, which are biased toward the initial values" (Tversky and Kahneman, 1974, p. 1128). In summary, anchoring refers to the human tendency to rely heavily on the first piece of information received, regardless of its actual relevance, and to adjust subsequent judgments insufficiently away from that initial anchor.

Consider a scenario in which you encounter a watch originally priced at $1,000 but now marked down to $700. In this case, the initial $1,000 price serves as a reference point, making the $700 price appear significantly more attractive, even if the actual value of the watch is uncertain or unrelated to either figure. You might even feel compelled to purchase the watch, persuaded by the perception of saving $300 on what seems like an exceptional deal. This phenomenon illustrates a cognitive bias known as anchoring.

A particularly influential demonstration of the anchoring effect is found in the same study mentioned above, in which Tversky and Kahneman (1974) demonstrate how clearly irrelevant numerical values can distort judgment. In this study, participants observed a roulette wheel numbered from 0 to 100, which was spun in their presence

to generate a random number. Immediately afterwards, they were asked to estimate several quantities stated in percentages. In one of such cases, subjects were asked whether the percentage of African countries in the United Nations was higher or lower than the number they had just seen. They were then instructed to provide their own best estimate of the actual percentage.

Importantly, the experiment employed a between-subjects design, separating participants into different anchor groups. Each group received a different number from the wheel, and was determined to be a high or low anchor group. For example, a high anchor group received the number 65, and a low anchor group received the number 10. This design eliminates the possibility that individuals adjusted their estimates based on seeing multiple anchor conditions, thereby strengthening the validity of the observed effect. Although the participants were consciously aware that the number generated by the roulette wheel had no logical connection to the question, it significantly influenced participants' responses. For example, those exposed to a low anchor value of 10 gave a median estimate of 25 percent, while those who received a high anchor of 65 estimated the figure at 45 percent. This experiment demonstrates the excessive weight put on initial reference points under uncertainty and the presence of insufficient adjustments.

Beyond experimental tasks, anchoring has been shown to influence professional judgments in real-life settings. In a study by Northcraft and Neale (1987), both seasoned real estate agents and amateur undergraduate business students were asked to appraise a house using identical property information, but different listing prices. Using a between-subjects design, participants were randomly assigned to different listing price anchor conditions for actual residential properties in Tucson, Arizona. Despite receiving identical, detailed market information and touring the properties, participants' valuation estimates were disproportionately influenced by the manipulated listing prices, illustrating the pervasive impact of anchoring even in information-rich contexts.

In this context, the appraisal value refers to an expert's unbiased estimate of the property's fair market value based on objective analysis, while the listing price is the seller's asking price, which may be strategically set and can serve as an anchor for buyers' judgments. In the first experiment, the actual appraisal value of the property was $74,900. Listing prices were set at four levels: including the low anchor of $65,900 (12 percent below appraisal), and the high anchor of $83,900 (12 percent above). Among the amateur undergraduate business students, appraisal value estimates ranged from $63,571 under the low anchor condition to $72,196 under the high anchor condition. Selling price estimates similarly varied from $69,414 in the low anchor scenario to $78,014 in the high anchor scenario as the anchor increased. These differences were statistically significant. Professional real estate agents, tested under the low and high anchor conditions, showed comparable effects; their appraisal value estimates increased from approximately $67,811 to $75,190 between the low and high anchor conditions, with statistically significant differences.[16] These results show that both professional real estate agents and amateur students are considerably influenced by listing price anchors when estimating property values.

Anchoring bias accounted for a substantial portion of the variation in their estimates and persisted even when anchors deviated notably from the true appraisal value.

Likewise, stock price levels can serve as anchoring points for investor expectations in financial markets. Kaustia *et al.* (2008) provide empirical evidence that both novice and professional investors are susceptible to anchoring when estimating long-term stock returns. Across three controlled experiments involving 300 Scandinavian financial professionals, the authors manipulated background information to examine how different anchors affected participants' return expectations. In the first experiment, professionals were divided into groups based on the information provided to them. One group was explicitly shown the historical average real stock market return of 4.5 percent per annum based on data from 1900 to 2000 in European countries (the disclosed group), while the other group was asked to estimate the historical return themselves before predicting future returns (the estimated group). Those who generated their own anchors predicted significantly higher future returns: on average, 8.05 percent, compared to 4.62 percent when the subjects were given the 4.5 percent return (the disclosed group). The overall findings demonstrate that anchoring, particularly on recent or salient returns, remains a powerful bias even in expert populations. Importantly, professionals with more experience showed reduced anchoring effects, but the bias was not eliminated. These results help explain persistent underreaction to new information and the reluctance of investors to revise beliefs or cut losses, particularly when recent highs serve as cognitive anchors for perceived fair value.

Building on the concept of anchoring in financial judgment, Loughran and Ritter (2002) examine how anchoring influences the perceptions of companies issuing initial public offerings, the first sale of a company's shares to the public. In IPOs, "leaving money on the table" refers to the difference between the offer price and the higher first-day closing price, multiplied by the shares sold, representing potential proceeds lost by issuers. This is calculated as $(P_m - P_f) \times$ quantity of shares sold, where P_f is the final offer price, and P_m is the market price at the close of the first trading day. The authors argue that issuers are influenced by anchoring when setting expectations. Specifically, they anchor on the midpoint of the initial price range disclosed in the preliminary prospectus, where P_r is the midpoint of that initial estimated price range. Even though this range is only a rough early estimate, companies often treat P_r as a reference point for judging the IPO's success. If the final offer price P_f is above the midpoint anchor ($P_f > P_r$), issuers perceive the IPO as favorable, even if the stock trades much higher on the first day (P_m is significantly greater than P_f). This means that their satisfaction is driven more by how P_f compares to P_r, rather than by how much higher P_m is compared to P_f.

Because of this anchoring effect, issuers may feel they performed well, despite having underpriced the offering and left significant money on the table. Their mental benchmark (P_r) distorts their perception of loss, leading them to overlook the actual value investors were willing to pay. In essence, anchoring on P_r causes them to focus on the relative gain over an arbitrary reference point rather than the absolute shortfall in proceeds. Loughran and Ritter (2002) find empirical evidence that supports this view. IPOs priced above the initial range leave the most money on the table, averaging $23 million, but also yield the largest wealth gains, over $113 million, resulting

in minimal dissatisfaction. This suggests that the anchoring effect can mask underpricing by making outcomes feel successful, even when more money could have been captured.

In sum, anchoring is a persistent bias that subconsciously shapes investor decision making. Across contexts ranging from professional appraisals and stock market predictions to IPO pricing, initial reference points exert strong influence over estimates and perceptions, even when those anchors are arbitrary or irrelevant to the matter at hand. However, studies find that experience and expertise can reduce the impact of anchoring. Because these distortions are predictable and persist even among experts in the field, they cannot be dismissed as random noise. In each case, final judgments reflected the anchor as much as the underlying evidence, which has direct implications for how researchers interpret the relationship between information and asset prices.

5. Availability and Investor Attention

This reaction is an example of a cognitive bias called the availability heuristic. As defined by Tversky and Kahneman (1973), the availability heuristic is the process by which individuals “estimate frequency of classes or the probability of events by the ease with which instances or associations could be brought to mind” (Tversky and Kahneman, 1973, p. 207). Rather than relying on statistical data or base rates, people often base judgments on how quickly and vividly they can recall examples. Events that are recent or heavily publicized are more mentally accessible and therefore perceived as more common or more probable than they truly are.

In 1975, the release of the film *Jaws* dramatically altered public perception of shark attacks. Despite the extremely low statistical probability of encountering a shark, fear spread rapidly. According to *Save Our Seas Foundation* (2019), while shark fishing tournaments already existed in the United States before the film's release, *Jaws* brought renewed publicity to these competitions and helped popularize the sport of hunting so-called “trophy sharks.” The public’s reaction was not driven by actual changes in shark behavior, but rather by how easily the terrifying imagery of a shark attack could be recalled.

In the same paper, Tversky and Kahneman (1973) also held an experiment in which 152 participants were asked questions regarding whether English contains more words that begin with a certain letter, or the letter in the third place. They tested this with five letters, one of which was ‘K’. Participants were also asked to estimate the ratio between the two categories. Results showed that 69% of participants believed words beginning with "K" were more frequent, while only 31% correctly identified that more words have "K" in the third position. In reality, English contains approximately twice as many words with "K" as the third letter as it does with the first. The error was attributed to the fact that words are more easily recalled by their initial letter, making those examples more mentally accessible. This experiment illustrates a core mechanism of the availability heuristic. When judging frequency or probability, individuals rely on the ease with which examples come to mind, rather than on objective data. As a result, events or categories that are easier to recall tend to be overestimated in frequency, leading to systematic biases in judgment.

This same cognitive shortcut can also influence complex decisions, such as those made in financial markets. A clear example comes from Gadarowski (2002), who examined whether recent press coverage of firms could predict future stock returns. Using data from about 1,500 U.S. nonfinancial firms between 1980 and 1994, the study found that firms with low book-to-market ratios (i.e., whose market values exceed their accounting, or book, values) and high recent press coverage earned about 10 percent lower annual returns over the following two years compared to similar firms with low news coverage. These firms are often considered "growth" firms because investors expect their future earnings and growth potential to be high, which typically leads to higher stock prices relative to their current net assets.

At first, these results might seem to fit rational explanations. For example, the investor recognition hypothesis suggests that firms with more visibility are better known and less risky, which should lead to lower expected returns. Other rational models argue that systematic risk (market-wide risk factors) or estimation risk (uncertainty about a firm's value) might justify lower returns for firms receiving more attention. However, Gadarowski (2002) does not support these views. The lower returns were concentrated *specifically* in low book-to-market firms, and traditional measures of risk or analyst coverage did not explain the pattern. If visibility alone explained the results, the effect would be seen across more firms.

The significance of the effect being limited to low book-to-market firms suggests that behavioral biases like the availability heuristic play a stronger role where investor expectations about growth are already optimistic. These firms are more likely to attract attention because their high market valuations attract speculation about future performance. Investors' tendency to overreact to news and recent information is amplified in this group, causing prices to rise beyond justified levels. Value firms, which already trade at lower prices relative to their book values, are less prone to this kind of over-optimism and intense media focus, which may explain why the effect is not observed among them.

Instead, the evidence supports a behavioral explanation based on the availability heuristic. Firms that get more press coverage become easier for investors to recall and more mentally available. When it has become common practice to focus on firms that are seen as "good stocks" simply because they come to mind more readily, investors develop a bias toward buying companies with greater media exposure. Gadarowski (2002) argues that these firms are then more likely to be actively traded, fueling bubbles around those with seemingly strong prospects. Moreover, the study also showed that the effect was stronger after periods of strong economic growth, suggesting that optimism increases the bias. Overall, these findings demonstrate that investor attention driven by easily recalled information can lead to predictable mispricing in the stock market.

Furthermore, a study by Kliger and Kudryavtsev (2010) goes on to specifically examine how the availability heuristic impacts investors' reactions to analyst recommendation revisions for individual stocks. Using a dataset

of 2,746 analyst recommendation changes from 1,373 NYSE-listed firms over 2001–2006, the authors focus on how stock prices behave on the days these recommendations are announced (day 0) and the day before (day –1).

The authors distinguish between two forms of availability: outcome availability and risk availability. Outcome availability captures the ease with which investors can envision positive or negative investment outcomes. This is measured by contemporaneous market returns, serving as a proxy: when the overall market rises, positive outcomes become more available, amplifying responses to positive news such as analyst upgrades. Conversely, when the market declines, negative outcomes become more salient, intensifying reactions to downgrades. Risk availability refers to the prominence of financial risk in investors' minds, especially on days of large market moves or high volatility.

The study finds that stock price reactions to upgrades are stronger on days with positive returns, and reactions to downgrades are stronger on days with negative returns. Abnormal returns (ARs), which represent deviations of actual stock returns from expected market-based returns, quantify the magnitude of these reactions. For instance, on the event day (day 0), upgrades yield an average AR of +2.45%, while downgrades produce -2.38%, both highly significant. More specifically, the study demonstrates that upgrades on days with positive market returns register ARs of +2.82%, compared to +1.89% on negative market days, a significant difference of 0.93%. Downgrades on negative market days show ARs of -3.04%, versus -1.82% on positive market days, a significant difference of 1.22%. These findings illustrate that investors weigh outcomes more heavily when they are psychologically more available: positive market days increase the salience of gains, and negative market days the salience of losses. These effects are more pronounced for small-cap stocks, stocks with higher beta, or greater volatility, consistent with the notion that such stocks have less available information and are more susceptible to behavioral biases.

Similarly, the authors find that trading volumes also increase on days when market moves and analyst recommendations align, further highlighting the presence of the availability bias. In this study, abnormal trading volume (ABVOL) is derived by taking the actual trading volume on day 0 and comparing it to that stock's own typical volume before the event. The experiment finds that on day 0 of upgrades, ABVOL equals 1.91 when MRs are positive, versus 1.55 when MRs are negative. For downgrades, the ABVOL is 2.13 when MRs are negative versus 1.50 when MRs are positive, with all differences statistically significant. Since ABVOL is the standardized difference between the event-day volume and this historical average, a higher ABVOL means trading is unusually heavy relative to that stock's normal level. In both cases, trading volume was abnormally large when market returns aligned with analyst recommendations. As the authors explain, because contemporaneous market returns make matching outcomes more salient and mentally accessible, it draws stronger investor reactions, demonstrating a response caused by the availability bias.

Even though the availability bias is a common influence in both financial and everyday decisions, it can actually be mitigated through awareness. A study by Salas-Velasco (2024) demonstrates this point through a randomized

controlled trial involving 538 senior business undergraduate students at a public university in southern Spain. Although Salas-Velasco examines student loan decisions rather than investment behavior directly, it remains relevant as it demonstrates that the availability heuristic can be reduced through targeted education. In the study, participants were randomly assigned to three groups: a control group with no intervention, a financial education group that completed an online course covering personal financial management principles, and a third group that received the same education along with an additional module that explained the impact of the availability heuristic on their thinking. Participants in this final group were instructed to counteract this bias by relying on official, verified sources and expert advice to make better-informed choices. Following the interventions, participants were presented with a hypothetical scenario in which they imagined pursuing a 12-month master's degree costing €30,000, with only 50 percent of the funds available and the remainder financed through a loan under realistic bank conditions. Objective labor market data on wages and employability were provided to counterbalance optimism bias, and participants assumed a full-time study with maintained academic performance. Through statistical analysis, Salas-Velasco (2024) found that only the combined financial education and debiasing group showed statistically significant improvements, with the author determining a p-value of less than .05, indicating a less than five percent probability that these effects were due to chance.

This result highlights that awareness of the availability heuristic through explicit education removes its influence by instead encouraging evidence-based decisions. The author found that the debiasing group even showed more positive attitudes toward student loan borrowing, enhanced perceptions of social approval, greater financial self-efficacy, and stronger borrowing intentions. Even in real-world scenarios, financial education needs to be accompanied by heuristic awareness to motivate the most rational decision-making. Overall, the availability bias leads people to overestimate the likelihood of events that are vivid and heavily publicized, leading to systematic distortions in both everyday life and financial contexts. Studies of this heuristic find that individual perception is often shaped more by mental accessibility than by objective data. Tversky and Kahneman (1973) establish the mechanism of availability, Gadarowski (2002) and Kliger and Kudryavtsev (2010) demonstrate its effects on stock returns and trading behavior, and Salas-Velasco (2024) shows that targeted education can meaningfully reduce its influence.

6. Compounding Effects: How the Three Biases Interact

The concepts of loss aversion, anchoring, and the availability heuristic do not work independently; rather, they combine to form the basis for a chain of cognitive errors whose combined power can only further influence investment decisions. In the majority of instances, the process of anchoring lays the groundwork for the subsequent loss aversion bias because once a certain price is used as a reference point for comparison, a fall from it will lead to a feeling of loss, and the investor will be reluctant to sell. The impact of availability heuristic bias in such situations is that all events in the recent past become easily recognizable and thus strengthen the anchored price, as negative information becomes especially noticeable during economic downturns. Therefore, it appears as if a combination of the three discussed biases makes the process of revision and improvement much more complicated than necessary. Table 1 summarizes the behavioral biases and their corresponding nudge solutions incorporated in the proposed solution design

7. Proposed Solution

Investor decisions are rarely made in a vacuum; they are shaped by the interaction of psychological tendencies that push people toward short-term, emotionally packed reactions rather than long-term strategy. The previous three sections of this paper have shown that loss aversion, anchoring, and availability often reinforce each other, creating a cycle where fear of loss, false reference points, and attention to flashing headlines drive poor trades. The purpose of this section is to formulate an effective solution that confronts these biases together through "nudges", structuring the investment process to redirect investors toward disciplined behavior.

Nudges are deliberate design choices that steer individuals toward better decisions while preserving freedom of choice. In their book *Nudge*, Thaler and Sunstein (2021) propose libertarian paternalism as an ideal approach, combining libertarianism, which preserves freedom of choice, with paternalism, the nudge that helps individuals act in ways that improve their own lives as defined by them. Nudges guide people toward the choices they would make if they had perfect information, attention, self-control, and no cognitive biases. Effective nudges use tools such as defaults and strategically placed options that exploit mental biases and, in turn, make desirable behaviors more salient. This section proposes a design of an app that mitigates the impact of common behavioral biases in investing, allowing consumers to make informed decisions and avoid heuristic-induced losses. This digital application embeds structured decision tools directly into an investor's digital workflow, allowing for efficient use while addressing loss aversion, anchoring, and availability in an accessible experience.

To address loss aversion and anchoring, the platform incorporates a rule-based portfolio management feature designed as a behavioral nudge consistent with Thaler and Sunstein's (2021) libertarian paternalism framework. Users would be invited to first create a personalized Investment Policy Statement, setting objectives, target asset allocations, and a preferred rebalancing strategy, either on a fixed schedule or when allocations drift beyond percentage thresholds. The feature monitors the portfolio and delivers timely alerts, such as: "*Your equity allocation has grown seven percent above your target. Your IPS recommends rebalancing. Would you like to review now?*" Importantly, this prompt presents rebalancing as a recommendation rather than a mandate, ensuring that investors ultimately retain full control over their decisions.

As previously mentioned, loss aversion causes investors to hold losing positions too long, leading to unnecessary losses.[5] This feature directly combats loss aversion by exploiting the anchoring heuristic, as investors will not feel compelled to sell a stock irrationally when the IPS feature allows them to anchor to their own preset threshold. This nudge approach not only encourages investors to align their investment strategy with their long-term target but also prevents them from succumbing to loss aversion during market volatility. To illustrate this feature, consider an investor who begins with a conservative Investment Policy Statement, setting a 40 percent equity and 60 percent bond allocation, with a rule to rebalance when any asset class shifts more than 4 percent from target. During a market downturn, the app alerts the investor that equities have fallen to 35 percent. Left unaided, they might hesitate to buy more stocks, anchored to recent losses and constrained by loss aversion. The platform reframes the decision by reminding them of their original plan: "Your IPS indicates a 40 percent equity target. Rebalancing is recommended." The deliberate wording labels rebalancing as the default option, making it more likely for investors to consider the option. Additional educational information on the impact of loss aversion on portfolio diversification would also be available upon clicking on this alert. This prompt shifts the anchor point from short-term price movements back to their pre-set long-term goals, helping the investor anchor to their own strategy rather than to market volatility.

Furthermore, to ensure the rationality of rebalancing decisions, the platform incorporates mechanisms that directly prevent mass selloffs triggered by loss aversion. These safeguards aim to prevent another sudden market failure like the 1987 "Black Monday" crash, when the Dow Jones fell about 22% due to automated trading and widespread investor panic. In events like those, widespread panic triggers investors' innate fear of loss, ultimately leading to wide-scale selloffs. These features include side-by-side comparisons that show the long-term impact of rebalancing versus doing nothing, further encouraging disciplined investing. Powered by historical market data and Monte Carlo simulations, these features are able to generate thousands of possible future scenarios based on real asset volatility, correlations, and historical return patterns. The platform then analyzes the entire range of these scenarios to see how rebalancing would perform under various market conditions, including measuring risk and portfolio value. The system then visualizes projected portfolio growth for each strategy, displaying metrics such as average annual return, drawdowns, and risk-adjusted performance, which shows how efficiently a portfolio earns returns relative to the risk taken. This broad set of outcomes would then be summarized by artificial intelligence platforms trained on leading financial models of risk, such as AlphaSense or Verity, in order to identify the ideal rebalancing strategy that aligns with the investor's IPS. Users can see, in a single view, how consistently rebalancing their investments could lead to steadier growth compared to leaving their portfolio unchanged. This visual, side-by-side approach makes the consequences of each decision tangible, helping investors understand the value of disciplined choices.

These approaches parallel the *Save More Tomorrow* (SMarT) program by Thaler & Benartzi (2004), a field-based behavioral intervention designed to increase employee retirement savings. In SMarT, employees pre-commit to gradually increase savings rates automatically with future pay raises, by exploiting loss aversion and anchoring.

Specifically, the program asks employees to commit in advance to increasing their savings rates only when they receive future pay raises, rather than immediately reducing their take-home pay. This design anchors savings increases to anticipated salary increments, making the higher contribution feel psychologically linked to a gain rather than a loss. By tying contributions to raises, the program leverages the "money illusion," where individuals perceive nominal increases positively and are less sensitive to corresponding increases in savings deductions. Thus, employees do not experience a perceived reduction in their disposable income, which significantly diminishes the painful impact of loss aversion. Empirical evidence from the first SMarT implementation reveals that 78% of eligible employees chose to join the program, with 80% of them remaining enrolled through four annual salary raises, and average savings rates increased from 3.5% to 13.6% over roughly 40 months.

Likewise, to mitigate availability bias, the platform changes how information is displayed. Instead of focusing solely on recent price changes or breaking news like popular financial trading platforms, the interface includes long-term return distributions, historical drawdowns, and volatility patterns alongside current data. A study by Schwarz *et al.* (1991) shows that availability plays a role in participants' self-evaluation of their assertiveness. However, researchers also found that the introduction of an external element like meditation music was an effective method to reduce participants' tendency to overly rely on ease of recall, reducing the impact of the availability bias. By attributing the difficulty of recall to the music rather than to themselves, participants no longer relied on their subjective feeling of ease when evaluating their own assertiveness. When the ease of recall was made "diagnostically irrelevant," participants were forced to base their judgments on the actual content of their examples. This experiment demonstrates how shifting attention away from the ease of recall directs individuals to make more rational decisions.

Moreover, to manipulate this bias in investors, the platform includes a media salience score, which flags when a stock is receiving unusually high or low coverage relative to its historical baseline. This feature contrasts the structure of today's most popular trading interfaces, where recent news headlines appear prominently on a firm's profile, making them especially salient in investors' minds. The presence of a media salience score allows investors to consider whether media coverage is driven by strong fundamentals or short-term hype, removing the tendency to make judgments solely based on salient information. For instance, a "high" score displayed next to the stock name would signal a sudden surge in media attention, while a "low" score would suggest a decline in coverage.

Next, a pop-up placed next to the stock would educate investors on the availability heuristic, drawing on studies such as Gadarowski (2002), which demonstrate how the heuristic can distort financial decision making. This feature follows the approach by Salas-Velasco (2024), which finds that increasing awareness and providing targeted education can significantly reduce the heuristic's impact and promote more efficient investment decisions. The proposed platform provides a practical framework for disciplined investing through the direct integration of behavioral nudges into the investing process. Anchored thresholds and pre-set rules address loss

aversion and anchoring, while contextual displays and salience indicators counter the effects of availability bias. The use of behavioral nudges allows investors to exploit their biases to support their individual long-term goals, helping investors act more rationally in complex, changing markets, where uncertainty is inevitable. However, this approach also raises important limitations, including the risk of overreliance on automated systems leading to the potential overautomation of investment decisions. Additionally, further research is needed to determine the extent of tasks that AI systems can reliably perform within this framework and to ensure that such systems do not inadvertently replicate or amplify the same cognitive biases they are designed to mitigate.

Cognitive Bias	**Proposed Nudge/Platform Feature**
Loss aversion	The inclusion of an Investment Policy Statement (IPS) with fixed thresholds and rules for rebalancing notifications, framing portfolio rebalancing as the execution of prior commitments rather than realizing losses, therefore promoting appropriate rebalancing behavior.
Anchoring	The inclusion of preset portfolio allocation targets and automatic thresholds in IPS can help move investors' reference point from price movement to the target portfolio strategy.
Availability	This design weakens the effect of extremely salient short-term stimuli through integration of long-term statistics powered by financial LLMs such as Verity or AlphaSense. (e.g. distribution of returns over many years, frequency of drawdowns, volatility ranges). The salience score in the media section clearly communicates that increased media attention may not reflect reality, which encourages people to consider whether saliency of information reflects true market performance.

Table 1: Cognitive biases in investor decision-making and the corresponding behavioral nudges embedded within the proposed investment platform design

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Acknowledgements

I would like to express my sincere gratitude to my research mentor, Dr. Edoardo Gallo, for his support and guidance throughout the research process. His insightful feedback and thoughtful encouragement greatly shaped the development of this paper.

Author Biography

Rachel Jiang is a student researcher with a strong passion for economics and finance. In college, she hopes to pursue finance and business-related majors to further explore how financial ideas are reflected in real-world markets and consumer decisions.

Mentor Contribution Statement

Dr. Edoardo Gallo was very supportive during the writing of this research paper. He helped me assess the validity and

reliability of the sources used, gave recommendations on readings that would further solidify the foundation of my research, and provided comments that guided my work towards a more focused direction. His mentoring enabled me to do independent research and analysis on this topic.

The paper needs to clarify its contribution. At present, it reads partly as a literature review and partly as a proposal for a behavioral investment platform. Both elements are interesting, but the link between them needs to be made much more explicit. The author should explain more systematically how each bias generates a specific investor error, and how each proposed nudge directly addresses that mechanism. For example, if anchoring causes investors to rely excessively on purchase prices or recent highs, the proposed corrective design should show exactly how it shifts the reference point toward long-term portfolio goals.

The proposed platform also needs more operational detail. The paper mentions a nudge-based investment platform, but it should specify what the user sees, when the nudge appears, what information is provided, and how success would be evaluated. Even if the paper does not include original empirical testing, it should still explain how the intervention could be tested in future work, for example through an experiment, A/B testing, or simulated portfolio decisions.

Finally, the paper requires careful proofreading. There are awkward phrases, merged words, inconsistent section ordering, and some factual imprecision. These issues are fixable, but they currently weaken the professionalism of the submission.

Convergence
A Journal for Young Researchers

Received: [for official use only] ; Accepted: [for official use only];
Managing Editor: [for official use only];
Action Editor: [for official use only]

Cognitive Biases in Financial Decision Making and the Design of Nudge-Based Corrective Mechanisms

[redacted]

Abstract

While considerable progress has been made in the field of behavioral finance, relatively few bias-mitigation mechanisms have been incorporated into the decision-making platforms used by retail investors. Consequently, investors remain exposed to cognitive biases such as loss aversion, anchoring, and the availability heuristic, among others, which can contribute to asset mispricing and excessive trading. Drawing on empirical research, this paper analyzes the relationship among the three biases discussed above and examines how they generate distinct investor errors. Loss aversion contributes to the reluctance to rebalance and diversify portfolios. Anchoring causes investors to misjudge stock performance by relying excessively on purchase prices and recent market highs. The availability heuristic encourages investors to overweight salient news and ignore long term data. Subsequently, the paper proposes a behavioral design framework for digital investing platforms by mapping the errors caused by each bias to a corresponding nudge intervention. Founded on Thaler and Sunstein (2021)'s nudge theory, the proposed platform manipulates these biases to direct investors towards decisions that are more aligned with their long term financial objectives.

Keywords: Behavioral Science, Economics, Cognitive Biases, Nudges, Investment Behavior, Portfolio Allocation, Financial Decision Making

1. Introduction

Financial markets are central institutions in modern economies, helping to allocate the flow of capital from those who supply funds to those who seek investment. These markets allow investors to generate wealth while facilitating economic growth by directing funds to companies, governments, and public projects. Nonetheless, markets do not always function smoothly. Major financial crises such as the Great Depression of 1929 and the global financial crisis of 2008 reveal how instability in financial markets can trigger widespread economic disruption, causing panic among investors and institutions alike (Bernanke, 2000; Krugman, 2009). In these situations, the complex and interconnected nature of financial markets causes additional confusion among all players rather than promoting development.

Traditional Financial Theory assumes rationality for all investors, indicating that they make decisions based solely on logical calculations and publicly available information in order to maximize utility. According to the Efficient Market Hypothesis (EMH) formulated by Eugene Fama (1970), the efficiency of financial markets is exceptionally high in incorporating information about investments, meaning that the price of stocks and other financial instruments should adjust almost instantly upon receiving new information. Under this framing, it would be impossible for investors to achieve higher returns than the general market just by examining public information or analyzing price histories. Furthermore, future price changes would be unpredictable since they could only depend only on new, unexpected information.

This paper makes two primary contributions. First, it identifies three recurring investor errors generated by the following behavioral biases: loss aversion, anchoring, and the availability heuristic. Second, it develops a behavioral design framework that links each error to a corresponding nudge intervention embedded within a digital investment platform. These nudges leverage the same biases that distort decision making and manipulate them to redirect investors toward more disciplined outcomes. Within the platform, loss aversion and anchoring are addressed through personalized targets and rebalancing recommendations that shift investors' reference points toward their own long-term goals. The mechanisms used to correct loss aversion and anchoring in the proposal reference the nudge methods tested in the *Save More Tomorrow* program by Benartzi and Thaler (2004), where these biases were successfully used to encourage employees to save more for retirement. Finally, findings from Schwarz *et al.* (1991) and Salas-Velasco (2024) are utilized to argue that redirecting recall can reduce the impact of availability, a mechanism that informs the platform's media salience indicators and contextual information displays.

The paper proceeds as follows. The next section briefly discusses the shift from the Efficient Market Hypothesis to behavioral finance. The following three sections examine loss aversion, the availability heuristic, and anchoring, each considering empirical studies and real-world examples that illustrate their impact on financial decision making. The fifth section proposes an integrated solution designed to help investors mitigate the

influence of these biases and make more disciplined decisions. Section six concludes by considering implications, limitations, and potential areas for future research.

2. From Efficient Markets to Behavioral Economics: The Deviation from Rationality

As introduced in the previous section, the Efficient Market Hypothesis (EMH) holds that asset prices fully and immediately reflect all available information. Fama (1970) identifies three categories of market efficiency. Weak-form efficiency proposes that prices already incorporate all information from past trading activity, meaning that analyzing patterns in price movements or trading volumes cannot be used to earn higher returns. Semi-strong-form efficiency extends this idea to all publicly available information, such as news releases or financial statements. Under this form, prices reflect such data so quickly that analysis cannot be relied upon to outperform the market. Strong-form efficiency takes this even further by indicating that prices reflect all public and private information, meaning that even those with access to exclusive insider data cannot regularly generate higher profits than the ordinary investor.

Under this assumption, investor behavior should reflect all publicly available financial information. In practice, however, investor behavior frequently deviates from the assumptions of traditional finance theory. While the EMH posits that asset prices fully and immediately reflect all available information, behavioral evidence suggests that markets can remain mispriced for extended periods due to psychological biases. Individuals often hold losing positions longer than is rational, overreact to recent events at the expense of long-term trends, and overvalue familiar assets even when diversification would improve expected returns.

Behavioral economics provides a framework for understanding these deviations by integrating psychology into economic theory. Instead of assuming that individuals are perfectly rational, it explores the role of cognitive processes and social influences in economic decision-making. This theory, pioneered by Nobel Prize-winning scholars such as Daniel Kahneman and Amos Tversky (1981), is based on the concept that human beings are not always rational because of mental shortcuts made due to uncertainty, thus leading to behavioral biases.

Central to this framework is the idea that the human brain operates through two systems, which Daniel Kahneman (2011) refers to as System 1 and System 2. Actions controlled by System 1 are often done subconsciously; for example, comprehending simple sentences and locating the source of a loud sound. System 2, on the other hand, requires attention and mental effort to sustain its operations and is often used when assessing complex situations. Example actions may include generating a strong move in chess as an amateur or finding a familiar face in a crowded room. Because System 2 requires conscious effort, individuals tend to rely on the intuitive processes of System 1, particularly in uncertain or stressful situations. Behavioral biases appear when the automatic responses of System 1 dominate, forming decisions that depart from the fully rational thinking of System 2. Behavioral economics, therefore, provides a more realistic account of human behavior by

recognizing the role of psychological factors in real-world financial decisions. Drawing on experimental studies, market data, and real-world evidence, this paper examines why investors act irrationally and the impact of these behaviors on market outcomes.

Building on this behavioral framework, this paper examines the importance of three cognitive biases that are key influences on financial decision making: loss aversion, anchoring, and the availability heuristic. Each of these biases impacts how investors evaluate risk, interpret information, and allocate assets, causing departures from rational behavior. This paper explores how psychological tendencies can distort market outcomes by analyzing their effects on portfolio diversification, stock valuation, and trading decisions.

Beginning with loss aversion, the first section explores how investors feel the pain of a loss more than an equivalent gain, and its impact on investor behavior in both laboratory and real-world settings. The primary consequence of loss aversion is that most investors are less willing to sell losing stocks than gaining ones, leading to inefficient portfolio management. Similarly, evidence from French and Poterba (1991) indicates that loss aversion also makes investors reluctant to diversify their portfolios, as fear of losses is bolstered by the unfamiliarity of foreign assets. Following the discussion of loss aversion, the second section examines the anchoring bias. Anchoring occurs when investors rely too heavily on the first pieces of information they receive when making decisions. In real-world settings, investors are excessively influenced by historical returns, causing their predictions to reflect these numbers instead of all historical data. The final bias considered is the availability heuristic, which influences how people judge frequency and probability. This heuristic occurs when investors overestimate the frequency of events that are vivid, or easier to recall, even when those examples may not be relevant. The effect persists in real-world settings where investor overoptimism caused by the availability heuristic actually leads hot-topic firms to become overvalued, and ultimately underperform. Evidence also shows that awareness and targeted education can actually reduce the effect of this bias, leading to more informed decisions.

Understanding how these biases arise is essential because effective interventions must target the underlying cognitive mechanism rather than merely provide additional information.

3. Loss Aversion and Decision Making

Tversky and Kahneman (1981) articulate this asymmetry in preferences, stating that "[...] the response to losses is more extreme than the response to gains. The displeasure associated with losing a sum of money is generally greater than the pleasure associated with winning the same amount" (Tversky & Kahneman, 1981, p. 454). This definition challenges the traditional economic model of the rational investor who weighs gains and losses equally in decision-making.

Imagine you are walking in the bustling city streets and find a $100 bill on the sidewalk: you'd likely feel pleasantly surprised, maybe even lucky, as you slip the unexpected cash into your pocket. Now imagine a contrasting scenario: you reach into your wallet and discover that $100 had been stolen. For most people, the sharp sting of the loss feels much more intense than the joy of the gain, even though the amounts are identical. In a lab experiment conducted with 160 Wharton MBA students, Schoemaker and Hershey (1992) explored how loss aversion affects individuals' ability to evaluate risky choices involving gains, losses, and mixed outcomes. Using a within-subject design across three rounds, participants made judgements about certainty equivalents (CE): the amount they'd accept instead of a gamble, and probability equivalents (PE): the probabilities at which they would be indifferent between a gamble and a sure outcome.

To produce these judgments, carefully worded questions were used. For example, in the gain domain, subjects faced a choice: "Suppose you could choose between $100 for sure, and a 50-50 gamble offering either $0 or $200. Which would you prefer?" They then indicated whether they preferred the sure amount, the gamble, or were indifferent. If they chose the sure amount, they were asked for the minimum certain amount they would be willing to accept instead of the gamble. If they chose the gamble, they were asked how much more the sure amount would need to be for them to switch. Similarly structured questions were posed in the loss domain (e.g., choosing between a certain loss of $100 and a 50-50 chance of losing $200 or nothing) and in the mixed domain involving a potential gain or loss of $100. In the mixed and loss domains, participants also indicated either the sure amount or the probability that would make them indifferent. Subjects were clearly told that there were no right or wrong answers and that their responses would not affect their course grades. These findings have significant implications for investor decision-making, as individuals influenced by loss aversion may adopt inefficient investment strategies centered around the avoidance of short-term losses over long-term portfolio optimization.

Consistent with Tversky and Kahneman's definition, the Wharton MBA students' responses showed that losses were valued significantly more than gains. Participants showed risk aversion when dealing with gains, but their reactions to losses were significantly more pronounced. For instance, 56% of participants who were initially risk-seeking when evaluating sure gains became risk-averse when assessing gains under uncertainty. However, this pattern became even more pronounced in the loss and mixed domains. Participants showed a stronger shift toward avoiding outcomes that might solidify a larger loss, even if the expected value was the same. For example, a participant may be indifferent between gaining $100 or nothing, versus $45 for sure, but would reject a 50/50 chance to lose $100 or lose nothing in favor of a certain loss of $45. In mixed-outcome cases, where participants faced a 50% chance of gaining $100 or losing $100, responses were even more conservative: participants often demanded a gain significantly larger than the potential loss before they were willing to accept the gamble. Because of this, Schoemaker and Hershey (1992) determined that the asymmetric tradeoffs in individuals' choices were a direct result of loss aversion.

One of the most striking demonstrations of loss aversion in real-world financial behavior comes from Terrance Odean. Odean (1998) analyzes over 162,000 trading records from 10,000 retail investor accounts at a large U.S discount brokerage firm between 1987 and 1993, reconstructing each investor's stock portfolio from the raw trade data. For every stock sold, he compares the sale price with the average purchase price to determine whether it was a realized gain or a realized loss. Stocks still held in the portfolio on a given day are classified as unrealized ("paper") gains or losses, determined by whether the market price lies above or below the purchase price. Using this data, Odean (1998) calculates two key metrics:

Proportion of Gains Realized (PGR): realized gains / (realized gains + paper gains)

Proportion of Losses Realized (PLR): realized losses / (realized losses + paper losses)

If investors weighed gains equal to losses, there would be no consistent difference between PGR and PLR. However, the data reveal a significant gap: across the full sample, the average PGR is 0.148, while the PLR is only 0.098. This 5 percent difference is significant and indicates that investors are substantially more likely to realize gains than losses.

Because the data is observational, it is challenging to attribute the high sell-to-hold ratio to loss aversion directly. However, Odean (1998) addresses this by ruling out several alternative rational explanations. Using publicly available stock prices, he reconstructs individual trading decisions and finds that loss aversion persists even after controlling for tax status, transaction costs, and portfolio rebalancing motives. For example, the effect still holds after partial sales and trades followed by immediate repurchases are excluded. Additionally, investors display the same pattern regardless of whether they are frequent or infrequent traders, and across stocks that vary in price. Further analysis shows that this reluctance to sell losing stocks is also financially costly. Odean (1998) finds that on average, the winning stocks that investors sell go on to outperform the stocks they chose to hold. Specifically, sold winners outperform held losers by approximately 3.4% over the following year. This underperformance suggests that the decision to hold onto losers is harming investors' long-run portfolio returns. If investors were truly rationally evaluating future performance, they would not consistently retain underperforming assets.

While Odean studies how loss aversion affects investor behavior after purchasing assets, particularly the reluctance to realize losses, French and Poterba (1991) examine how loss aversion may shape portfolio allocation before trades are even made. They focus on the phenomenon of home bias, where investors allocate a disproportionately large share of their equity portfolios to domestic stocks despite the recognized benefits of international diversification. Using data from the late 1980s, French and Poterba (1991) analyze portfolio holdings in the United States, Japan, and the United Kingdom. They find that investors in all three countries exhibit a strong preference for domestic equities. Specifically, over 98 percent of Japanese portfolios, 94 percent of U.S.

portfolios, and 82 percent of U.K. portfolios are held in domestic stocks. These figures suggest that investors forgo potential diversification gains by holding a disproportionate amount of assets in their home markets.

It is very difficult to explain the presence of home bias within the traditional economic framework. Based on historical return correlations, French and Poterba (1991) calculate the expected returns on domestic equities that would be necessary to justify the observed home-biased allocations. The results indicate that investors must believe domestic stocks will outperform foreign stocks by substantial margins. For instance, U.S. investors would need to expect U.S. equities to yield approximately 2.5 percentage points more per year than Japanese equities. Similar return premiums are implied for investors in the United Kingdom and Japan. These expectations are difficult to explain with historical data, which suggests the presence of cognitive biases. One explanation hypothesized by the authors is that investors perceive foreign markets as riskier due to unfamiliarity or a lack of control. This perceived risk, however, differs from objective risk measures used in standard economic models. Importantly, the concept of loss aversion is key to explaining why investors react more strongly to potential losses in foreign investments because the uncertain chance of a loss is more painful than any equivalent gain. This means investors demand higher returns to compensate for the perceived losses associated with foreign equities, even when objective measures of risk do not justify such premiums. It is loss aversion, rather than analytical risk perception, that motivates this avoidance behavior.

Odean (1998) focuses on how investors respond to gains and losses after they occur, whereas French and Poterba (1991) highlight how the anticipation of potential losses can discourage investors from engaging in international diversification in the first place. Collectively, these findings suggest two recurring investor errors. First, investors hold losing assets longer than rational portfolio optimization would recommend. Second, investors avoid diversification opportunities when unfamiliar investments are perceived as potential sources of loss. Both behaviors reduce portfolio efficiency and provide specific targets for corrective intervention. Accordingly, effective corrective mechanisms should reframe investment decisions around pre-committed long-term objectives and diversified portfolio targets, reducing the tendency for investors to evaluate choices primarily through the lens of potential short-term losses.

4. Anchoring and Distorted Evaluation

Tversky and Kahneman (1974) define anchoring as a process in which “people make estimates by starting from an initial value [...] that is adjusted to yield the final answer,” noting that “adjustments are typically insufficient” and that “different starting points yield different estimates, which are biased toward the initial values” (Tversky and Kahneman, 1974, p. 1128). In summary, anchoring refers to the human tendency to rely heavily on the first piece of information received, regardless of its actual relevance, and to adjust subsequent judgments insufficiently away from that initial anchor.

Consider a scenario in which you encounter a watch originally priced at $1,000 but now marked down to $700. In this case, the initial $1,000 price serves as a reference point, making the $700 price appear significantly more

attractive, even if the actual value of the watch is uncertain or unrelated to either figure. You might even feel compelled to purchase the watch, persuaded by the perception of saving $300 on what seems like an exceptional deal. This phenomenon illustrates a cognitive bias known as anchoring.

A particularly influential demonstration of the anchoring effect is found in the same study mentioned above, in which Tversky and Kahneman (1974) demonstrate how clearly irrelevant numerical values can distort judgment. In this study, participants observed a roulette wheel numbered from 0 to 100, which was spun in their presence to generate a random number. Immediately afterwards, they were asked to estimate several quantities stated in percentages. In one of such cases, subjects were asked whether the percentage of African countries in the United Nations was higher or lower than the number they had just seen. They were then instructed to provide their own best estimate of the actual percentage.

Importantly, the experiment employed a between-subjects design, separating participants into different anchor groups. Each group received a different number from the wheel, and was determined to be a high or low anchor group. For example, a high anchor group received the number 65, and a low anchor group received the number 10. This design eliminates the possibility that individuals adjusted their estimates based on seeing multiple anchor conditions, thereby strengthening the validity of the observed effect. Although the participants were consciously aware that the number generated by the roulette wheel had no logical connection to the question, it significantly influenced participants' responses. For example, those exposed to a low anchor value of 10 gave a median estimate of 25 percent, while those who received a high anchor of 65 estimated the figure at 45 percent. This experiment demonstrates the excessive weight put on initial reference points under uncertainty and the presence of insufficient adjustments.

Beyond experimental tasks, anchoring has been shown to influence professional judgments in real-life settings. In a study by Northcraft and Neale (1987), both seasoned real estate agents and amateur undergraduate business students were asked to appraise a house using identical property information, but different listing prices. Using a between-subjects design, participants were randomly assigned to different listing price anchor conditions for actual residential properties in Tucson, Arizona. Despite receiving identical, detailed market information and touring the properties, participants' valuation estimates were disproportionately influenced by the manipulated listing prices, illustrating the pervasive impact of anchoring even in information-rich contexts.

In this context, the appraisal value refers to an expert's unbiased estimate of the property's fair market value based on objective analysis, while the listing price is the seller's asking price, which may be strategically set and can serve as an anchor for buyers' judgments. In the first experiment, the actual appraisal value of the property was $74,900. Listing prices were set at four levels: including the low anchor of $65,900 (12 percent below appraisal), and the high anchor of $83,900 (12 percent above). Among the amateur undergraduate business students, appraisal value estimates ranged from $63,571 under the low anchor condition to $72,196 under the

high anchor condition. Selling price estimates similarly varied from $69,414 in the low anchor scenario to $78,014 in the high anchor scenario as the anchor increased. These differences were statistically significant. Professional real estate agents, tested under the low and high anchor conditions, showed comparable effects; their appraisal value estimates increased from approximately $67,811 to $75,190 between the low and high anchor conditions, with statistically significant differences.[16] These results show that both professional real estate agents and amateur students are considerably influenced by listing price anchors when estimating property values. Anchoring bias accounted for a substantial portion of the variation in their estimates and persisted even when anchors deviated notably from the true appraisal value.

Likewise, stock price levels can serve as anchoring points for investor expectations in financial markets. Kaustia *et al.* (2008) provide empirical evidence that both novice and professional investors are susceptible to anchoring when estimating long-term stock returns. Across three controlled experiments involving 300 Scandinavian financial professionals, the authors manipulated background information to examine how different anchors affected participants' return expectations. In the first experiment, professionals were divided into groups based on the information provided to them. One group was explicitly shown the historical average real stock market return of 4.5 percent per annum based on data from 1900 to 2000 in European countries (the disclosed group), while the other group was asked to estimate the historical return themselves before predicting future returns (the estimated group). Those who generated their own anchors predicted significantly higher future returns: on average, 8.05 percent, compared to 4.62 percent when the subjects were given the 4.5 percent return (the disclosed group). The overall findings demonstrate that anchoring, particularly on recent or salient returns, remains a powerful bias even in expert populations. Importantly, professionals with more experience showed reduced anchoring effects, but the bias was not eliminated. These results help explain persistent underreaction to new information and the reluctance of investors to revise beliefs or cut losses, particularly when recent highs serve as cognitive anchors for perceived fair value.

Building on the concept of anchoring in financial judgment, Loughran and Ritter (2002) examine how anchoring influences the perceptions of companies issuing initial public offerings, the first sale of a company's shares to the public. In IPOs, "leaving money on the table" refers to the difference between the offer price and the higher first-day closing price, multiplied by the shares sold, representing potential proceeds lost by issuers. This is calculated as $(P_m - P_f) \times$ quantity of shares sold, where P_f is the final offer price, and P_m is the market price at the close of the first trading day. The authors argue that issuers are influenced by anchoring when setting expectations. Specifically, they anchor on the midpoint of the initial price range disclosed in the preliminary prospectus, where P_r is the midpoint of that initial estimated price range. Even though this range is only a rough early estimate, companies often treat P_r as a reference point for judging the IPO's success. If the final offer price P_f is above the midpoint anchor ($P_f > P_r$), issuers perceive the IPO as favorable, even if the stock trades much higher on the first day (P_m is significantly greater than P_f). This means that their satisfaction is driven more by how P_f compares to P_r, rather than by how much higher P_m is compared to P_f.

Because of this anchoring effect, issuers may feel they performed well, despite having underpriced the offering and left significant money on the table. Their mental benchmark (P_r) distorts their perception of loss, leading them to overlook the actual value investors were willing to pay. In essence, anchoring on P_r causes them to focus on the relative gain over an arbitrary reference point rather than the absolute shortfall in proceeds. Loughran and Ritter (2002) find empirical evidence that supports this view. IPOs priced above the initial range leave the most money on the table, averaging $23 million, but also yield the largest wealth gains, over $113 million, resulting in minimal dissatisfaction. This suggests that the anchoring effect can mask underpricing by making outcomes feel successful, even when more money could have been captured.

Across contexts ranging from professional appraisals and stock market predictions to IPO pricing, initial reference points exert strong influence over investor perceptions , even when those anchors are irrelevant to asset's fundamental characteristics. As a result, investors may resist selling underperforming assets, underestimate changing market conditions, or evaluate outcomes relative to outdated benchmarks. Effective interventions must therefore replace unstable anchors with reference points that are aligned with long-term investment objectives.

Availability and Investor Attention

This reaction is an example of a cognitive bias called the availability heuristic. As defined by Tversky and Kahneman (1973), the availability heuristic is the process by which individuals "estimate frequency of classes or the probability of events by the ease with which instances or associations could be brought to mind" (Tversky and Kahneman, 1973, p. 207). Rather than relying on statistical data or base rates, people often base judgments on how quickly and vividly they can recall examples. Events that are recent or heavily publicized are more mentally accessible and therefore perceived as more common or more probable than they truly are.

In 1975, the release of the film *Jaws* dramatically altered public perception of shark attacks. Despite the extremely low statistical probability of encountering a shark, fear spread rapidly. According to *Save Our Seas Foundation* (2019), while shark fishing tournaments already existed in the United States before the film's release, *Jaws* brought renewed publicity to these competitions and helped popularize the sport of hunting so-called "trophy sharks." The public's reaction was not driven by actual changes in shark behavior, but rather by how easily the terrifying imagery of a shark attack could be recalled.

In the same paper, Tversky and Kahneman (1973) also held an experiment in which 152 participants were asked questions regarding whether English contains more words that begin with a certain letter, or the letter in the third place. They tested this with five letters, one of which was 'K'. Participants were also asked to estimate the ratio between the two categories. Results showed that 69% of participants believed words beginning with "K" were more frequent, while only 31% correctly identified that more words have "K" in the third position. In reality,

English contains approximately twice as many words with "K" as the third letter as it does with the first. The error was attributed to the fact that words are more easily recalled by their initial letter, making those examples more mentally accessible. This experiment illustrates a core mechanism of the availability heuristic. When judging frequency or probability, individuals rely on the ease with which examples come to mind, rather than on objective data. As a result, events or categories that are easier to recall tend to be overestimated in frequency, leading to systematic biases in judgment.

This same cognitive shortcut can also influence complex decisions, such as those made in financial markets. A clear example comes from Gadarowski (2002), who examined whether recent press coverage of firms could predict future stock returns. Using data from about 1,500 U.S. nonfinancial firms between 1980 and 1994, the study found that firms with low book-to-market ratios (i.e., whose market values exceed their accounting, or book, values) and high recent press coverage earned about 10 percent lower annual returns over the following two years compared to similar firms with low news coverage. These firms are often considered "growth" firms because investors expect their future earnings and growth potential to be high, which typically leads to higher stock prices relative to their current net assets.

At first, these results might seem to fit rational explanations. For example, the investor recognition hypothesis suggests that firms with more visibility are better known and less risky, which should lead to lower expected returns. Other rational models argue that systematic risk (market-wide risk factors) or estimation risk (uncertainty about a firm's value) might justify lower returns for firms receiving more attention. However, Gadarowski (2002) does not support these views. The lower returns were concentrated *specifically* in low book-to-market firms, and traditional measures of risk or analyst coverage did not explain the pattern. If visibility alone explained the results, the effect would be seen across more firms.

The significance of the effect being limited to low book-to-market firms suggests that behavioral biases like the availability heuristic play a stronger role where investor expectations about growth are already optimistic. These firms are more likely to attract attention because their high market valuations attract speculation about future performance. Investors' tendency to overreact to news and recent information is amplified in this group, causing prices to rise beyond justified levels. Value firms, which already trade at lower prices relative to their book values, are less prone to this kind of over-optimism and intense media focus, which may explain why the effect is not observed among them.

Instead, the evidence supports a behavioral explanation based on the availability heuristic. Firms that get more press coverage become easier for investors to recall and more mentally available. When it has become common practice to focus on firms that are seen as "good stocks" simply because they come to mind more readily, investors develop a bias toward buying companies with greater media exposure. Gadarowski (2002) argues that these firms are then more likely to be actively traded, fueling bubbles around those with seemingly strong

prospects. Moreover, the study also showed that the effect was stronger after periods of strong economic growth, suggesting that optimism increases the bias. Overall, these findings demonstrate that investor attention driven by easily recalled information can lead to predictable mispricing in the stock market.

Furthermore, a study by Kliger and Kudryavtsev (2010) goes on to specifically examine how the availability heuristic impacts investors' reactions to analyst recommendation revisions for individual stocks. Using a dataset of 2,746 analyst recommendation changes from 1,373 NYSE-listed firms over 2001–2006, the authors focus on how stock prices behave on the days these recommendations are announced (day 0) and the day before (day –1).

The authors distinguish between two forms of availability: outcome availability and risk availability. Outcome availability captures the ease with which investors can envision positive or negative investment outcomes. This is measured by contemporaneous market returns, serving as a proxy: when the overall market rises, positive outcomes become more available, amplifying responses to positive news such as analyst upgrades. Conversely, when the market declines, negative outcomes become more salient, intensifying reactions to downgrades. Risk availability refers to the prominence of financial risk in investors' minds, especially on days of large market moves or high volatility.

The study finds that stock price reactions to upgrades are stronger on days with positive returns, and reactions to downgrades are stronger on days with negative returns. Abnormal returns (ARs), which represent deviations of actual stock returns from expected market-based returns, quantify the magnitude of these reactions. For instance, on the event day (day 0), upgrades yield an average AR of +2.45%, while downgrades produce -2.38%, both highly significant. More specifically, the study demonstrates that upgrades on days with positive market returns register ARs of +2.82%, compared to +1.89% on negative market days, a significant difference of 0.93%. Downgrades on negative market days show ARs of -3.04%, versus -1.82% on positive market days, a significant difference of 1.22%. These findings illustrate that investors weigh outcomes more heavily when they are psychologically more available: positive market days increase the salience of gains, and negative market days the salience of losses. These effects are more pronounced for small-cap stocks, stocks with higher beta, or greater volatility, consistent with the notion that such stocks have less available information and are more susceptible to behavioral biases.

Similarly, the authors find that trading volumes also increase on days when market moves and analyst recommendations align, further highlighting the presence of the availability bias. In this study, abnormal trading volume (ABVOL) is derived by taking the actual trading volume on day 0 and comparing it to that stock's own typical volume before the event. The experiment finds that on day 0 of upgrades, ABVOL equals 1.91 when MRs are positive, versus 1.55 when MRs are negative. For downgrades, the ABVOL is 2.13 when MRs are negative versus 1.50 when MRs are positive, with all differences statistically significant. Since ABVOL is the standardized difference between the event-day volume and this historical average, a higher ABVOL means trading is unusually heavy relative to that stock's normal level. In both cases, trading volume was abnormally large when market

returns aligned with analyst recommendations. As the authors explain, because contemporaneous market returns make matching outcomes more salient and mentally accessible, it draws stronger investor reactions, demonstrating a response caused by the availability bias.

Even though the availability heuristic is a common influence in both financial and everyday decisions, it can actually be mitigated through awareness. A study by Salas-Velasco (2024) demonstrates this point through a randomized controlled trial involving 538 senior business undergraduate students at a public university in southern Spain. Although Salas-Velasco examines student loan decisions rather than investment behavior directly, it remains relevant as it demonstrates that the availability heuristic can be reduced through targeted education. In the study, participants were randomly assigned to three groups: a control group with no intervention, a financial education group that completed an online course covering personal financial management principles, and a third group that received the same education along with an additional module that explained the impact of the availability heuristic on their thinking. Participants in this final group were instructed to counteract this bias by relying on official, verified sources and expert advice to make better-informed choices. Following the interventions, participants were presented with a hypothetical scenario in which they imagined pursuing a 12-month master's degree costing €30,000, with only 50 percent of the funds available and the remainder financed through a loan under realistic bank conditions. Objective labor market data on wages and employability were provided to counterbalance optimism bias, and participants assumed a full-time study with maintained academic performance. Through statistical analysis, Salas-Velasco (2024) found that only the combined financial education and debiasing group showed statistically significant improvements, with the author determining a p-value of less than .05, indicating a less than five percent probability that these effects were due to chance.

This result highlights that awareness of the availability heuristic through explicit education removes its influence by instead encouraging evidence-based decisions. The author found that the debiasing group even showed more positive attitudes toward student loan borrowing, enhanced perceptions of social approval, greater financial self-efficacy, and stronger borrowing intentions. Even in real-world scenarios, financial education needs to be accompanied by heuristic awareness to motivate the most rational decision-making.

In sum, studies of availability find that individual perception is often shaped more by mental accessibility than by objective data. Tversky and Kahneman (1973) establish the mechanism of availability, Gadarowski (2002) and Kliger and Kudryavtsev (2010) demonstrate its effects on stock returns and trading behavior. However, Salas-Velasco (2024) demonstrates that targeted education can meaningfully reduce its influence. The studies reviewed suggest that availability primarily distorts investor attention, causing them to overweight information that is recent and heavily publicized while underweighting less salient but equally relevant empirical data. This can result in excessive trading, overvaluation of highly publicized firms, and investment decisions driven by attention rather than fundamentals. Accordingly, corrective interventions should not only provide investors with

broader contextual information, but also incorporate educational prompts that increase awareness of the availability heuristic itself, as evidence suggests that such awareness can reduce the bias's impact on decision-making (Salas-Velasco, 2024).

5. Compounding Effects: How the Three Biases Interact

The concepts of loss aversion, anchoring, and the availability heuristic do not work independently; rather, they combine to form the basis for a chain of cognitive errors which can further influence investment decisions. Anchoring frequently serves as the starting point of this process. Investors often become attached to a numerical anchor, for example, a purchase price or a recent market high using it as a reference point for evaluating future outcomes. When the value of an asset falls below that reference point, the decline is perceived as a loss, triggering loss aversion and increasing the investor's reluctance to sell the asset despite evidence that doing so may be beneficial.

The availability heuristic can further intensify this effect. During periods of market volatility, highly publicized news stories and recent price movements become especially salient and easy to recall. As a result, investors may place excessive weight on these readily available pieces of information, reinforcing their existing anchors and amplifying the emotional impact of perceived losses. For example, an investor anchored to a stock's previous high price may become even more reluctant to sell after repeated exposure to news emphasizing recent market declines or uncertainty.

These interactions suggest that effective interventions should not target biases individually. A decline in stock price may first establish an anchor, then trigger loss aversion, while heightened media attention increases the availability of negative information. Consequently, corrective mechanisms should be designed as an integrated system that addresses multiple cognitive processes simultaneously. Therefore, it appears as if a combination of the three discussed biases makes the process of revision and improvement much more complicated than necessary. Table 1 summarizes the behavioral biases and their corresponding nudge solutions incorporated in the proposed solution design

6. Proposed Solution

Investor decisions are rarely made in a vacuum; they are shaped by the interaction of psychological tendencies that push people toward short-term, emotionally packed reactions rather than long-term strategy. The previous three sections of this paper have shown that loss aversion, anchoring, and availability often reinforce each other, creating a cycle where fear of loss, false reference points, and attention to flashing headlines drive poor trades. The purpose of this section is to formulate an effective solution that confronts these biases together through "nudges", structuring the investment process to redirect investors toward disciplined behavior.

Nudges are deliberate design choices that steer individuals toward better decisions while preserving freedom of choice. In their book *Nudge*, Thaler and Sunstein (2021) propose libertarian paternalism as an ideal approach, combining libertarianism, which preserves freedom of choice, with paternalism, the nudge that helps individuals

act in ways that improve their own lives as defined by them. Nudges guide people toward the choices they would make if they had perfect information, attention, self-control, and no cognitive biases. Effective nudges use tools such as defaults and strategically placed options that exploit mental biases and, in turn, make desirable behaviors more salient. This section proposes a design of an app that mitigates the impact of common behavioral biases in investing, allowing consumers to make informed decisions and avoid heuristic-induced losses. This digital application embeds structured decision tools directly into an investor's digital workflow, allowing for efficient use while addressing loss aversion, anchoring, and availability in an accessible experience.

To address loss aversion and anchoring, the platform incorporates a rule-based portfolio management feature designed as a behavioral nudge consistent with Thaler and Sunstein's (2021) libertarian paternalism framework. Users would be invited to first create a personalized Investment Policy Statement, setting objectives, target asset allocations, and a preferred rebalancing strategy, either on a fixed schedule or when allocations drift beyond percentage thresholds. The feature monitors the portfolio and delivers timely alerts, such as: "*Your equity allocation has grown seven percent above your target. Your IPS recommends rebalancing. Would you like to review now*?" Importantly, this prompt presents rebalancing as a recommendation rather than a mandate, ensuring that investors ultimately retain full control over their decisions.

As previously mentioned, loss aversion causes investors to hold losing positions too long, leading to unnecessary losses.[5] This feature directly combats loss aversion by exploiting the anchoring heuristic, as investors will not feel compelled to sell a stock irrationally when the IPS feature allows them to anchor to their own preset threshold. This nudge approach not only encourages investors to align their investment strategy with their long-term target but also prevents them from succumbing to loss aversion during market volatility. To illustrate this feature, consider an investor who begins with a conservative Investment Policy Statement, setting a 40 percent equity and 60 percent bond allocation, with a rule to rebalance when any asset class shifts more than 4 percent from target. During a market downturn, the app alerts the investor that equities have fallen to 35 percent. Left unaided, they might hesitate to buy more stocks, anchored to recent losses and constrained by loss aversion. The platform reframes the decision by reminding them of their original plan: "Your IPS indicates a 40 percent equity target. Rebalancing is recommended." The deliberate wording labels rebalancing as the default option, making it more likely for investors to consider the option. Additional educational information on the impact of loss aversion on portfolio diversification would also be available upon clicking on this alert. This prompt shifts the anchor point from short-term price movements back to their pre-set long-term goals, helping the investor anchor to their own strategy rather than to market volatility.

Furthermore, to address investor's unwillingness to diversify, the platform could present globally diversified model portfolios during onboarding and explain the historical benefits of diversification. Once the investor selects a target allocation, rebalancing notifications help maintain that diversified portfolio despite future discomfort with foreign assets. This feature is designed to intervene at the point when investors establish their

initial portfolio strategy, before loss aversion can discourage exposure to unfamiliar foreign assets. By providing diversification as a structured default option rather than requiring investors to independently seek out international investments, the platform reduces the influence of perceived loss risk associated with unfamiliar markets. Once an investor selects a target allocation, the Investment Policy Statement records this commitment and rebalancing notifications help maintain the chosen level of diversification over time. As market conditions change, investors may become reluctant to add to foreign holdings after periods of underperformance or heightened uncertainty. By framing portfolio adjustments as adherence to a previously selected strategy rather than a new investment decision, the platform reduces the tendency to avoid foreign assets due to anticipated losses. For example, an investor creating an account may initially prefer a portfolio consisting entirely of U.S. stocks because foreign markets feel less familiar and therefore more risky. The platform could instead present a model portfolio containing 70 percent U.S. equities and 30 percent international equities, accompanied by visualizations showing how diversification has historically reduced the impact of downturns in any single country. After selecting this allocation, the investor's Investment Policy Statement records it as a long-term objective. Suppose that several months later international stocks experience a period of underperformance and the allocation falls from 30 percent to 25 percent. Without intervention, the investor may hesitate to purchase additional foreign equities because recent losses make further investment feel risky. Rather than asking the investor whether they would like to buy more international stocks, the platform would issue a notification stating that the portfolio has drifted from its target allocation and that rebalancing is recommended. By framing the action as restoring a previously chosen strategy rather than making a new speculative investment, the platform reduces the influence of loss aversion and helps preserve diversification over time. In this way, the investor's attention is directed toward achieving a long-term portfolio objective rather than reacting to short-term fluctuations in unfamiliar markets.

These approaches parallel the *Save More Tomorrow* (SMarT) program by Thaler & Benartzi (2004), a field-based behavioral intervention designed to increase employee retirement savings. In SMarT, employees pre-commit to gradually increase savings rates automatically with future pay raises, by exploiting loss aversion and anchoring. Specifically, the program asks employees to commit in advance to increasing their savings rates only when they receive future pay raises, rather than immediately reducing their take-home pay. This design anchors savings increases to anticipated salary increments, making the higher contribution feel psychologically linked to a gain rather than a loss. By tying contributions to raises, the program leverages the "money illusion," where individuals perceive nominal increases positively and are less sensitive to corresponding increases in savings deductions. Thus, employees do not experience a perceived reduction in their disposable income, which significantly diminishes the painful impact of loss aversion. Empirical evidence from the first SMarT implementation reveals that 78% of eligible employees chose to join the program, with 80% of them remaining enrolled through four annual salary raises, and average savings rates increased from 3.5% to 13.6% over roughly 40 months.

Likewise, to mitigate availability bias, the platform changes how information is displayed. Instead of focusing solely on recent price changes or breaking news like popular financial trading platforms, the interface includes long-term return distributions, historical drawdowns, and volatility patterns alongside current data. A study by Schwarz *et al.* (1991) shows that availability plays a role in participants' self-evaluation of their assertiveness. However, researchers also found that the introduction of an external element like meditation music was an effective method to reduce participants' tendency to overly rely on ease of recall, reducing the impact of the availability bias. By attributing the difficulty of recall to the music rather than to themselves, participants no longer relied on their subjective feeling of ease when evaluating their own assertiveness. When the ease of recall was made "diagnostically irrelevant," participants were forced to base their judgments on the actual content of their examples. This experiment demonstrates how shifting attention away from the ease of recall directs individuals to make more rational decisions.

Moreover, the platform includes a media salience score, which flags when a stock is receiving unusually high or low coverage relative to its historical baseline. This feature contrasts the structure of today's most popular trading interfaces, where recent news headlines appear prominently on a firm's profile, making them especially salient in investors' minds. The presence of a media salience score allows investors to consider whether media coverage is driven by strong fundamentals or short-term hype, removing the tendency to make judgments solely based on salient information. For instance, a "high" score displayed next to the stock name would signal a sudden surge in media attention, while a "low" score would suggest a decline in coverage.

Next, a pop-up placed next to the stock would educate investors on the availability heuristic, drawing on studies such as Gadarowski (2002), which demonstrate how the heuristic can distort financial decision making. This feature follows the approach by Salas-Velasco (2024), which finds that increasing awareness and providing targeted education can significantly reduce the heuristic's impact and promote more efficient investment decisions. The proposed platform provides a practical framework for disciplined investing through the direct integration of behavioral nudges into the investing process. Anchored thresholds and pre-set rules address loss aversion and anchoring, while contextual displays and salience indicators counter the effects of availability bias. The use of behavioral nudges allows investors to exploit their biases to support their individual long-term goals, helping investors act more rationally in complex, changing markets, where uncertainty is inevitable.

However, this approach also raises important limitations, including the risk of overreliance on automated systems leading to the potential overautomation of investment decisions. Additionally, further research is needed to determine the extent of tasks that AI systems can reliably perform within this framework and to ensure that such systems do not inadvertently replicate or amplify the same cognitive biases they are designed to mitigate.

Future research could evaluate the platform through a randomized controlled experiment involving approximately 200 retail investors between the ages of 18 and 30 with more than six months of prior investing experience. Participants would be randomly assigned to either a standard brokerage interface or the proposed nudge-based platform. After completing a brief onboarding exercise, participants would engage in a series of simulated investment decisions involving portfolio rebalancing, international diversification, and responses to highly publicized stocks. The simulation would be structured around three controlled scenarios, each corresponding to one of the behavioral biases identified in this paper: a market downturn intended to activate loss aversion, a price-history condition designed to induce anchoring, and a high-visibility stock scenario aimed at triggering availability bias.

The effectiveness of the platform could then be evaluated by comparing investment behavior between participants using the intervention and those using a standard brokerage interface. In particular, researchers could assess whether users of the platform demonstrate more disciplined decision-making, including greater portfolio diversification, stronger adherence to pre-set asset allocation targets, and reduced reliance on salient news events or recent price fluctuations when making investment choices. Beyond behavioral data, post-experiment surveys could be administered to capture participants' self-assessments of their investment decisions, perceived risk, confidence in their choices, and the extent to which different factors influenced their behavior. These responses would offer additional insight into whether the platform affects not only observable decisions but also the cognitive processes underlying those decisions, particularly those associated with each bias. Finally, regression analysis could be employed to control for variation in financial literacy, prior investing experience, and individual risk tolerance. Such a design would allow researchers to determine whether the proposed nudges meaningfully improve investment decision-making relative to a standard investing interface.

Cognitive Bias	**Investor Error Caused By Bias**	**Nudge Mechanism Within Proposed Platform**
Loss aversion	Reluctance to realize losses and avoidance of portfolio diversification due to uncertainty	During onboarding, investors are presented with globally diversified model portfolios and visualizations demonstrating the benefits of diversification. Once a target allocation is selected, it is recorded in an Investment Policy Statement (IPS). When allocations drift from

		their targets, the platform issues rebalancing notifications that frame adjustments as adherence to a previously chosen strategy rather than a new investment decision, reframing what would be otherwise perceived by investors as a painful loss into an opportunity for redirection.
Anchoring	Reliance on purchase prices or recent market values as reference points, leading to distorted evaluation of performance	The IPS prominently displays target asset allocations and predefined rebalancing thresholds on the fintech interface. Portfolio alerts reference these targets rather than recent price movements, encouraging investors to evaluate performance relative to long-term objectives instead of short-term market fluctuations.
Availability	Overweighting of recent, vivid, or highly publicized information in investment decisions, leading to overreaction to short-term news	Alongside current market information, the interface displays long-term return distributions, historical drawdowns, and volatility ranges generated from historical market data. A media salience score appearing beside a stock's profile flags red when it is receiving unusually high attention relative to its historical baseline, while educational pop-ups explain how excessive media coverage can distort investment judgment. These nudges encourage investors to consider fundamentals over salient headlines when making decisions.

603 Table 1: Cognitive biases in investor decision-making and the corresponding behavioral nudges embedded within
604 the proposed investment platform design

7. Conclusion

The paper has argued that loss aversion, anchoring, and the availability heuristic collectively contribute to distortions in investor judgment. It has further demonstrated that these cognitive biases are systemic in nature, consistently influencing how investors perceive information, assess risk, and make portfolio decisions. At the same time, the findings suggest that the effects of these biases can be mitigated through targeted behavioral education and structured decision-making frameworks.

These results therefore indicate that behavioral considerations are a crucial component in the design of financial technologies. As the evidence presented suggests, investor behavior is predictably shaped by cognitive biases; accordingly, fintech tools that assume fully rational decision-making are unlikely to operate optimally in real-world contexts. This implies that nudges and other behavioral design mechanisms should be incorporated into financial applications to support more disciplined decision-making while preserving user autonomy.

One of the main limitations of this study is that the proposed platform has not been empirically validated. Although its design is grounded in established behavioral finance literature, it remains conceptual and therefore requires further evaluation regarding its effectiveness in influencing decision-making and its broader implications in real-world financial environments. To address this limitation, the paper proposes a randomized experimental design that could be used to evaluate whether the platform's nudges improve investment decisions relative to a standard brokerage interface. Future research should implement and test this framework to determine the extent to which behavioral interventions can reduce the influence of cognitive biases in practice.

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Acknowledgements

I would like to express my sincere gratitude to my research mentor, [redacted] for his support and guidance throughout the research process. His insightful feedback and thoughtful encouragement greatly shaped the development of this paper.

Author Biography

[redacted] is a student researcher with a strong passion for economics and finance. In college, she hopes to pursue finance and business-related majors to further explore how financial ideas are reflected in real-world markets and consumer decisions.

Mentor Contribution Statement

[redacted] was very supportive during the writing of this research paper. He helped me assess the validity and reliability of the sources used, gave recommendations on readings that would further solidify the foundation of my research, and provided comments that guided my work towards a more focused direction. His mentoring enabled me to do independent research and analysis on this topic.

Response to Editorial Feedback

Thank you for your thoughtful comments on my manuscript, *Cognitive Biases in Financial Decision Making and the Design of Nudge-Based Corrective Mechanisms*. I have carefully revised the paper in response to each point raised. Below is a summary of the changes made.

1. Clarifying the Paper's Contribution and Strengthening the Link Between the Literature Review and the Proposed Platform

Editor Comment:
The paper's contribution was unclear and the connection between the behavioral finance literature and the proposed investment platform needed to be made more explicit. The editor suggested systematically linking each cognitive bias to a specific investor error and then demonstrating how the corresponding nudge addresses that mechanism.

Response:
This concern was addressed throughout the Introduction, the individual bias sections, the Proposed Solution section, and Table 1.

Specific revisions include:

• Revised the Introduction to explicitly state the paper's two primary contributions:
(1) identifying investor errors caused by loss aversion, anchoring, and the availability heuristic, and
(2) developing a behavioral design framework that links each error to a corresponding nudge intervention.

• Added stronger causal framing throughout each behavioral bias section to identify the specific investor error produced by the bias and to establish a direct connection to the later platform design.

• Strengthened the concluding paragraphs of the Loss Aversion and Availability sections to explicitly identify recurring investor errors and explain how these errors create targets for corrective intervention.

• Revised the transition into the Proposed Solution section so that the platform is presented as a direct extension of the behavioral mechanisms discussed earlier rather than as a separate idea.

• Expanded Table 1 to include an "Investor Error Caused by Bias" column that explicitly maps:

- Loss aversion: reluctance to realize losses and avoidance of diversification
- Anchoring: reliance on purchase prices and recent market values

- Availability heuristic: overweighting recent, vivid, or highly publicized information

• Table 1 now also directly connects each investor error to a corresponding nudge mechanism within the platform.

These revisions make the paper's central contribution substantially clearer and create a more systematic connection between the behavioral finance literature and the proposed intervention.

2. Providing Greater Operational Detail About the Proposed Platform

Editor Comment:
The platform required more operational detail regarding what users see, when nudges appear, what information is presented, and how the intervention could be evaluated.

Response:
The Proposed Solution section was substantially expanded to provide concrete implementation details.

Specific revisions include:

• Added detailed descriptions of the Investment Policy Statement (IPS) onboarding process.

• Specified that users select target asset allocations and preferred rebalancing thresholds during onboarding.

• Added examples of platform notifications, including rebalancing alerts that appear when portfolio allocations drift from predefined targets.

• Clarified that alerts are framed as recommendations rather than mandates, preserving investor autonomy while encouraging disciplined decision-making.

• Added descriptions of interface components designed to address availability bias, including:

- media salience indicators,
- long-term return distributions,
- historical drawdown information,
- volatility displays, and
- educational pop-up explanations.

• Expanded the diversification intervention by explaining how globally diversified model portfolios are presented during onboarding and how subsequent notifications help maintain diversification over time.

• Added a dedicated future research and evaluation section proposing a randomized controlled experiment involving approximately 200 retail investors aged 18-35.

The proposed evaluation framework now specifies:

- treatment and control groups,
- three simulation scenarios corresponding to the three biases,
- behavioral outcome measures,
- post-experiment survey measures,
- and regression controls for financial literacy, risk tolerance, and prior investment experience.

These additions provide substantially greater detail regarding both implementation and future testing of the proposed intervention.

3. Improving Clarity, Organization, and Proofreading

Editor Comment:
The manuscript contained awkward phrasing, structural inconsistencies, and proofreading issues that weakened its professionalism.

Response:
The manuscript was revised extensively for clarity, organization, and academic tone.

Specific revisions include:

• Improved transitions between sections, particularly the progression from the Efficient Market Hypothesis to Behavioral Economics.

• Standardized the structure of each behavioral bias section so that each now follows a consistent sequence:

1. definition,
2. experimental evidence,
3. market evidence,
4. financial implications and suggested solution

Throughout the entire manuscript:

• Revised numerous sentences to improve clarity and reduce repetition.

• Removed informal and conversational language in favor of a more academic tone.

• Strengthened analytical transitions connecting empirical findings to the broader argument.

• Corrected grammatical inconsistencies, formatting issues, and typographical errors

These revisions improve readability, strengthen the logical flow of the argument, and enhance the overall professionalism of the paper.

Thank you again for your feedback and consideration. I believe these revisions have substantially strengthened the manuscript and clarified both its contribution and practical implications. I look forward to any further feedback from the editorial board.

I have read the revised manuscript, Cognitive Biases in Financial Decision Making and the Design of Nudge-Based Corrective Mechanisms, with interest. In my view, the paper is suitable for publication in Convergence after minor revisions. It is an ambitious and quite mature paper for a student researcher, and it shows a real effort to move beyond a simple literature review. The author does not merely summarize behavioral finance concepts, but tries to connect them to a practical design problem: how a digital investment platform might help retail investors make more disciplined decisions.

The strongest aspect of the paper is its organization around three well-chosen biases: loss aversion, anchoring, and the availability heuristic. These are central concepts in behavioral economics, and they are also understandable enough to be developed clearly for the journal's readership. The manuscript does a good job explaining how these biases can produce concrete investor errors, such as reluctance to realize losses, excessive dependence on purchase prices or recent market values, and overreaction to salient news. I also found the proposed platform section useful. The discussion of an Investment Policy Statement, rebalancing reminders, media salience indicators, and educational prompts gives the paper a more original and applied dimension than many student papers in this area.

The author's use of the literature is generally strong. The paper appropriately draws on classic work by Kahneman, Tversky, Thaler, Sunstein, and Odean, while also incorporating more recent empirical and educational material. I especially appreciated that the revised manuscript now tries to explain why each study matters for the proposed intervention. This makes the paper feel less like a list of separate studies and more like a connected argument. The table linking each cognitive bias to an investor error and then to a proposed nudge is also helpful and should be retained.

Before acceptance, however, I recommend a few minor revisions. First, the author should moderate some of the causal language. At times, the paper suggests that the proposed platform would directly correct or remove investor biases. Since the platform is still conceptual and has not yet been tested, the language should be slightly more cautious. Phrases such as "may reduce," "could help mitigate," or "is designed to address" would be more scientifically accurate than stronger claims about what the platform will accomplish.

Second, the transition between the literature review and the proposed solution could be tightened further. The reader understands the individual biases by the time they reach the platform section, but the author could make the logic even clearer by briefly stating why these three biases should be addressed together rather than through three separate interventions. The section on compounding effects moves in this direction, but it could be made a little more precise.

Third, the evaluation proposal is promising but should be described with slightly more care. The manuscript proposes a randomized experiment, which is a sensible next step, but the author should clarify what the primary outcome variables would be. For example, would the main outcomes be rebalancing behavior, diversification choices, trading frequency, or attention to recent news? A sentence identifying two or three main measurable outcomes would make this part of the paper stronger without requiring major new work.

Finally, I recommend a final proofreading pass. There are a few places where the phrasing is somewhat informal or imprecise, especially in the proposed solution section. These are not serious problems, but correcting them would improve the polish of the manuscript.

Overall, this is a thoughtful and well-developed paper. It engages with important behavioral finance literature and makes a credible attempt to translate that literature into a practical design framework. I recommend acceptance after minor revisions.

I am pleased to recommend this manuscript for acceptance subject to minor revisions. The paper addresses an important topic in behavioral finance: why investors deviate from rational decision-making, and how investment platforms might be designed to reduce the consequences of those deviations. For a high-school research journal, the manuscript is impressively developed. It shows familiarity with major concepts in behavioral economics and makes a serious attempt to connect academic theory with a real-world financial technology application.

The paper's main contribution is its effort to connect specific cognitive biases to specific investor mistakes and then to specific corrective mechanisms. This is a useful structure. Loss aversion is connected to the tendency to hold losing investments too long and to avoid diversification. Anchoring is connected to excessive reliance on purchase prices, recent market highs, or other reference points. The availability heuristic is connected to overreaction to recent news, vivid examples, and media attention. The proposed platform design then tries to respond to these problems through rebalancing prompts, pre-set portfolio targets, contextual historical information, media salience indicators, and educational pop-ups. This is a clear and sensible framework.

I also found the paper's applied orientation to be one of its strengths. Many student papers on behavioral economics remain at the level of explaining famous experiments. This manuscript goes further by asking what those findings imply for the design of financial decision environments. The discussion of Investment Policy Statements and portfolio rebalancing notifications is especially effective because it shows how a theoretical bias can be translated into a concrete user-interface feature. The comparison with the Save More Tomorrow program is also appropriate, since it helps the reader see how behavioral tendencies can be redirected rather than simply condemned.

My requested revisions are minor. First, the author should distinguish a little more carefully between nudging, debiasing, and education. The paper sometimes treats these as almost the same thing, but they are not identical. A nudge changes the decision environment, debiasing tries to reduce the bias itself, and education gives users information that may improve judgment. The proposed platform appears to use all three. Making this distinction explicit would improve the conceptual clarity of the manuscript.

Second, the author should be cautious when applying findings from non-investment settings to investment behavior. For example, some of the evidence discussed in the paper comes from general judgment experiments, real estate valuation, retirement savings, or student loan decisions. These examples are relevant, but the author should add one or two sentences acknowledging that the transfer to retail investing is plausible rather than fully proven. This would make the argument more balanced and scientifically careful.

Third, the limitations section could be strengthened slightly. The paper already notes that the platform has not yet been empirically validated, which is important. I would suggest adding a little more discussion of possible risks, such as overreliance on automated prompts, data privacy concerns, or the possibility that poorly designed alerts could create too much friction for users. These points do not weaken the paper. On the contrary, they would show that the author understands the practical complications of applying behavioral design in financial markets.

Fourth, the manuscript would benefit from a careful editing pass for style and consistency. Some wording should be softened or clarified. For instance, language suggesting that the platform "manipulates" biases may sound unnecessarily strong; "redirects," "uses," or "channels" would be more appropriate. Section numbering and headings should also be checked so that the structure is completely consistent.

Convergence
A Journal for Young Researchers

Received: [for official use only] ; Accepted: [for official use only];
Managing Editor: [for official use only];
Action Editor: [for official use only]

Cognitive Biases in Financial Decision Making and the Design of Nudge-Based Corrective Mechanisms

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Abstract

While considerable progress has been made in the field of behavioral finance, relatively few bias-mitigation mechanisms have been incorporated into the decision-making platforms used by retail investors. Consequently, investors remain exposed to cognitive biases such as loss aversion, anchoring, and the availability heuristic, among others, which can contribute to asset mispricing and excessive trading. Drawing on empirical research, this paper analyzes the relationship among the three biases discussed above and examines how they generate distinct investor errors. Loss aversion contributes to the reluctance to rebalance and diversify portfolios. Anchoring causes investors to misjudge stock performance by relying excessively on purchase prices and recent market highs. The availability heuristic encourages investors to overweight salient news and ignore long term data. Subsequently, the paper proposes a behavioral design framework for digital investing platforms by mapping the errors caused by each bias to a corresponding nudge intervention. Founded on Thaler and Sunstein (2021)'s nudge theory, the proposed platform manipulates these biases to direct investors towards decisions that are more aligned with their long term financial objectives.

Keywords: Behavioral Science, Economics, Cognitive Biases, Nudges, Investment Behavior, Portfolio Allocation, Financial Decision Making

1. Introduction

Financial markets play a vital role in economic development by channeling capital from those who supply funds to those who seek investment. These markets allow investors to generate wealth while facilitating economic growth by directing funds to private companies and governments, spurring innovation and funding essential public projects. However, history has demonstrated that financial markets are also vulnerable to periods of extreme instability. Events such as the Great Depression of 1929 and the Global Financial Crisis of 2008 illustrate how investor panic and deteriorating market confidence can amplify economic shocks, leading to widespread financial and social consequences (Bernanke, 2000; Krugman, 2009). These episodes raise an important question: why do markets that are designed to allocate capital efficiently sometimes produce outcomes that appear highly irrational?

Traditional Financial Theory assumes rationality for all investors, indicating that they make decisions based solely on logical calculations and publicly available information in order to maximize utility. Additionally, according to the Efficient Market Hypothesis (EMH) formulated by Eugene Fama (1970), the efficiency of financial markets is exceptionally high in incorporating information about investments, meaning that the price of stocks and other financial instruments should adjust almost instantly upon receiving new information. Under these frameworks, it would be theoretically impossible for investors to achieve higher returns than the general market just by examining public information or analyzing price histories. Furthermore, future price changes would be unpredictable since they could only depend only on new, unexpected information.

This paper makes two primary contributions. First, it identifies three recurring investor errors generated by the following behavioral biases: loss aversion, anchoring, and the availability heuristic. Second, it develops a behavioral design framework that links each error to a corresponding nudge intervention embedded within a digital investment platform. These nudges leverage the same biases that distort decision making and channel them to redirect investors toward more disciplined outcomes. Within the platform, loss aversion and anchoring are addressed through personalized targets and rebalancing recommendations that shift investors' reference points toward their own long term goals. The proposed mechanisms that aim to correct loss aversion and anchoring reference nudge methods tested in the *Save More Tomorrow* program by Benartzi and Thaler (2004), where these biases were successfully redirected to encourage employees to save more for retirement. Finally, findings from Schwarz *et al.* (1991) and Salas-Velasco (2024) are utilized to argue that redirecting recall can reduce the impact of availability, insights that inform the proposed platform's media salience indicators and contextual information displays.

The paper proceeds as follows. The next section briefly discusses the shift from the Efficient Market Hypothesis to behavioral finance. The following three sections examine loss aversion, the availability heuristic, and anchoring, each considering empirical studies and real world examples that illustrate their impact on financial

decision making. The sixth section explores how these three biases interact and reinforce one another throughout the investment process, demonstrating why they are best addressed through a unified intervention. The seventh section proposes an integrated solution designed to help investors mitigate the influence of these biases and make more disciplined decisions. Section eight concludes by considering implications, limitations, and potential areas for future research.

2. From Efficient Markets to Behavioral Economics: The Deviation from Rationality

As introduced in the previous section, the Efficient Market Hypothesis (EMH) holds that asset prices fully and immediately reflect all available information. Fama (1970) identifies three categories of market efficiency. Weak form efficiency proposes that prices already incorporate all information from past trading activity, meaning that analyzing patterns in price movements or trading volumes cannot be used to earn higher returns. Semi-strong form efficiency extends this idea to all publicly available information, such as news releases or financial statements. Under this form, prices reflect such data so quickly that analysis cannot be relied upon to outperform the market. Strong form efficiency takes this even further by indicating that prices reflect all public and private information, meaning that even those with access to exclusive insider data cannot regularly generate higher profits than the ordinary investor.

Under this assumption, investor behavior should reflect all publicly available financial information. In practice, however, investor behavior frequently deviates from the assumptions of traditional finance theory. While the EMH posits that asset prices fully and immediately reflect all available information, behavioral evidence suggests that markets can remain mispriced for extended periods because investors do not always process information objectively.

Behavioral economics provides a framework for understanding these deviations by incorporating insights from psychology in economic decision making. This theory, pioneered by Nobel Prize winning scholars such as Daniel Kahneman and Amos Tversky (1981), attributes the irrationality of decision making to mental shortcuts activated under uncertainty.

Central to this framework is the idea that the human brain operates through two systems, which Daniel Kahneman (2011) refers to as System 1 and System 2. Actions controlled by System 1 are often done subconsciously; for example, comprehending simple sentences and locating the source of a loud sound. System 2, on the other hand, requires attention and mental effort to sustain its operations and is often used when assessing complex situations. Examples of such complex situations may include generating a strong move in chess as an amateur or finding a familiar face in a crowded room. Because System 2 requires conscious effort, individuals tend to rely on the intuitive processes of System 1, particularly in uncertain or stressful situations. Behavioral biases appear when the automatic responses of System 1 dominate, forming decisions that depart

from the fully rational thinking of System 2. Behavioral economics, therefore, provides a more realistic account of human behavior by recognizing the role of psychological factors in real world financial decisions. Drawing on experimental studies, market data, and real world evidence, this paper examines why investors act irrationally and the impact of these behaviors on market outcomes.

Building on this behavioral framework, this paper examines the importance of three cognitive biases that are key influences on financial decision making: loss aversion, anchoring, and the availability heuristic. Each of these biases impacts how investors evaluate risk, interpret information, and allocate assets, causing departures from rational behavior. This paper explores how psychological tendencies can distort market outcomes by analyzing their effects on portfolio diversification, stock valuation, and trading decisions.

Beginning with loss aversion, the first section explores how investors feel the pain of a loss more than an equivalent gain, and its impact on investor behavior in both laboratory and real world settings. The primary consequence of loss aversion is that most investors are less willing to sell losing stocks than gaining ones, leading to inefficient portfolio management. Similarly, evidence from French and Poterba (1991) indicates that loss aversion also makes investors reluctant to diversify their portfolios, as fear of losses is bolstered by the unfamiliarity of foreign assets. Following the discussion of loss aversion, the second section examines the anchoring bias. Anchoring occurs when investors rely too heavily on the primary pieces of information they receive during the decision making process. In real world settings, for instance, investors have shown to be excessively influenced by historical returns, causing their predictions to reflect these numbers instead of all historical data (Kaustia *et al.* 2008). The final bias considered is the availability heuristic, which influences how people judge frequency and probability. This heuristic occurs when investors overestimate the frequency of events that are easier to recall, even when those examples may not be relevant. The effect persists in real world settings where investor overoptimism caused by the availability heuristic actually leads hot topic firms to become overvalued, and ultimately underperform. However, evidence also shows that awareness and targeted education can actually reduce the effect of this bias, leading to more informed decisions.

Understanding how these biases arise is essential because effective interventions must target the underlying cognitive mechanism to mitigate irrational market behaviors.

3. Loss Aversion and Decision Making

Tversky and Kahneman (1981) define loss aversion as the phenomenon where "[...] the response to losses is more extreme than the response to gains." (Tversky & Kahneman, 1981, p. 454). This definition challenges the traditional economic assumption that investors evaluate gains and losses symmetrically when making decisions. It instead suggests that losses carry greater psychological weight than equivalent gains, leading individuals to make choices that deviate from the rational utility maximizing model.

Imagine you are walking in the bustling city streets and find a $100 bill on the sidewalk: you'd likely feel pleasantly surprised, maybe even lucky, as you slip the unexpected cash into your pocket. Now imagine a contrasting scenario: you reach into your wallet and discover that $100 had been stolen. For most people, the sharp sting of the loss feels much more intense than the joy of the gain, even though the amounts are identical. In a lab experiment conducted with 160 Wharton MBA students, Schoemaker and Hershey (1992) explored how loss aversion affects individuals' ability to evaluate risky choices involving gains, losses, and mixed outcomes. Using a within-subject design across three rounds, participants made judgements about certainty equivalents (CE): the amount they'd accept instead of a gamble, and probability equivalents (PE): the probabilities at which they would be indifferent between a gamble and a sure outcome.

To produce these judgments, carefully worded questions were used. For example, in the gain domain, subjects faced a choice: "Suppose you could choose between $100 for sure, and a 50-50 gamble offering either $0 or $200. Which would you prefer?" They then indicated whether they preferred the sure amount, the gamble, or were indifferent. If they chose the sure amount, they were asked for the minimum certain amount they would be willing to accept instead of the gamble. If they chose the gamble, they were asked how much more the sure amount would need to be for them to switch. Similarly structured questions were posed in the loss domain (e.g., choosing between a certain loss of $100 and a 50-50 chance of losing $200 or nothing) and in the mixed domain involving a potential gain or loss of $100. In the mixed and loss domains, participants also indicated either the sure amount or the probability that would make them indifferent. Subjects were clearly told that there were no right or wrong answers and that their responses would not affect their course grades.

Consistent with Tversky and Kahneman's definition, the Wharton MBA students' responses showed that losses were valued significantly more than gains. Participants showed risk aversion when dealing with gains, but their reactions to losses were significantly more pronounced. For instance, 56% of participants who were initially risk-seeking when evaluating sure gains became risk-averse when assessing gains under uncertainty. However, this pattern became even more pronounced in the loss and mixed domains. Participants showed a stronger shift toward avoiding outcomes that might solidify a larger loss, even if the expected value was the same. For example, a participant may be indifferent between gaining $100 or nothing, versus $45 for sure, but would reject a 50/50 chance to lose $100 or lose nothing in favor of a certain loss of $45. In mixed-outcome cases, where participants faced a 50% chance of gaining $100 or losing $100, responses were even more conservative: participants often demanded a gain significantly larger than the potential loss before they were willing to accept the gamble. Because of this, Schoemaker and Hershey (1992) determined that the asymmetric tradeoffs in individuals' choices were a direct result of loss aversion.

One of the most striking demonstrations of loss aversion in real world financial behavior comes from Terrance Odean's 1998 study. Odean (1998) analyzes over 162,000 trading records from 10,000 retail investor accounts at a large U.S discount brokerage firm between 1987 and 1993, reconstructing each investor's stock portfolio from the

raw trade data. For every stock sold, he compares the sale price with the average purchase price to determine whether it was a realized gain or a realized loss. Stocks still held in the portfolio on a given day are classified as unrealized ("paper") gains or losses, determined by whether the market price lies above or below the purchase price. Using this data, Odean (1998) calculates two key metrics:

Proportion of Gains Realized (PGR): realized gains / (realized gains + paper gains)

Proportion of Losses Realized (PLR): realized losses / (realized losses + paper losses)

If gains and losses were weighted equally in investment decisions, realized gains and realized losses would occur at comparable rates. Instead, the data highlights an asymmetry: the average PGR across the full sample is 0.148, whereas the average PLR is 0.098. This 5 percentage point difference indicates that investors are significantly more likely to realize gains than losses, supporting the hypothesis that losses carry greater psychological weight than equivalent gains.

Because the data is observational, it is challenging to attribute the high sell-to-hold ratio to loss aversion directly. However, Odean (1998) addresses this by ruling out several alternative rational explanations. Using publicly available stock prices, he reconstructs individual trading decisions and finds that loss aversion persists even after controlling for tax status, transaction costs, and portfolio rebalancing motives. For example, the effect still holds after partial sales and trades followed by immediate repurchases are excluded. Additionally, investors display the same pattern regardless of whether they are frequent or infrequent traders, and across stocks that vary in price. Further analysis shows that this reluctance to sell losing stocks is also financially costly. Odean (1998) finds that on average, the winning stocks that investors sell go on to outperform the stocks they chose to hold. Specifically, sold winners outperform held losers by approximately 3.4% over the following year. This underperformance suggests that the decision to hold onto losers is harming investors' long-run portfolio returns. If investors were truly rationally evaluating future performance, they would not consistently retain underperforming assets.

While Odean studies how loss aversion affects investor behavior after purchasing assets, particularly the reluctance to realize losses, French and Poterba (1991) examine how loss aversion may shape portfolio allocation before trades are even made. They focus on the loss aversion influenced phenomenon of home bias, where investors allocate a disproportionately large share of their equity portfolios to domestic stocks despite the recognized benefits of international diversification. Using data from the late 1980s, French and Poterba (1991) analyze portfolio holdings in the United States, Japan, and the United Kingdom. They find that investors in all three countries exhibit a strong preference for domestic equities. Specifically, over 98 percent of Japanese portfolios, 94 percent of U.S. portfolios, and 82 percent of U.K. portfolios are held in domestic stocks. These

figures suggest that investors forgo potential diversification gains by holding a disproportionate amount of assets in their home markets.

It is very difficult to explain the presence of home bias within the traditional economic framework. Based on historical return correlations, French and Poterba (1991) calculate the expected returns on domestic equities that would be necessary to justify the observed home-biased allocations. The results indicate that investors must believe domestic stocks will outperform foreign stocks by substantial margins. For instance, U.S. investors would need to expect U.S. equities to yield approximately 2.5 percentage points more per year than Japanese equities. Similar return premiums are implied for investors in the United Kingdom and Japan. These expectations are difficult to explain with historical data, which suggests the presence of cognitive biases. One explanation hypothesized by the authors is that investors perceive foreign markets as riskier due to unfamiliarity or a lack of control. This perceived risk, however, differs from objective risk measures used in standard economic models. Importantly, the concept of loss aversion is key to explaining why investors react more strongly to potential losses in foreign investments because the uncertain chance of a loss is more painful than any equivalent gain. This indicates that investors demand higher returns to compensate for the perceived losses associated with foreign equities, even when objective measures of risk do not justify such premiums. It is loss aversion, rather than solely analytical risk perception, that motivates this avoidance behavior.

Odean (1998) focuses on how investors respond to gains and losses after they occur, whereas French and Poterba (1991) highlight how the anticipation of potential losses can discourage investors from engaging in international diversification in the first place. Collectively, these findings suggest two recurring investor errors. First, investors hold losing assets longer than rational portfolio optimization would recommend. Second, investors avoid diversification opportunities when unfamiliar investments are perceived as potential sources of loss. Both behaviors reduce portfolio efficiency and provide specific targets for corrective intervention. Accordingly, effective corrective mechanisms should reframe investment decisions around precommitted long term objectives and diversified portfolio targets, reducing the tendency for investors to evaluate choices primarily through the lens of potential short-term losses.

4. Anchoring and Distorted Evaluation

Tversky and Kahneman (1974) define anchoring as a process in which “people make estimates by starting from an initial value [...] that is adjusted to yield the final answer,” noting that “adjustments are typically insufficient” and that “different starting points yield different estimates, which are biased toward the initial values” (Tversky and Kahneman, 1974, p. 1128). In summary, anchoring refers to the human tendency to rely heavily on the first piece of information received, regardless of its actual relevance, and to adjust subsequent judgments insufficiently away from that initial anchor.

Consider a scenario in which you encounter a watch originally priced at $1,000 but now marked down to $700. In this case, the initial $1,000 price serves as a reference point, making the $700 price appear significantly more

attractive, even if the actual value of the watch is uncertain or unrelated to either figure. You might even feel compelled to purchase the watch, persuaded by the perception of saving $300 on what seems like an exceptional deal. This phenomenon illustrates a cognitive bias known as anchoring.

A particularly influential demonstration of the anchoring effect is found in the same study mentioned above, in which Tversky and Kahneman (1974) demonstrate how clearly irrelevant numerical values can distort judgment. In this study, participants observed a roulette wheel numbered from 0 to 100, which was spun in their presence to generate a random number. Immediately afterwards, they were asked to estimate several quantities stated in percentages. In one of such cases, subjects were asked whether the percentage of African countries in the United Nations was higher or lower than the number they had just seen. They were then instructed to provide their own best estimate of the actual percentage.

Importantly, the experiment employed a between-subjects design, separating participants into different anchor groups. Each group received a different number from the wheel, and was determined to be a high or low anchor group. For example, a high anchor group received the number 65, and a low anchor group received the number 10. This design eliminates the possibility that individuals adjusted their estimates based on seeing multiple anchor conditions, thereby strengthening the validity of the observed effect. Although the participants were consciously aware that the number generated by the roulette wheel had no logical connection to the question, it significantly influenced participants' responses. For example, those exposed to a low anchor value of 10 gave a median estimate of 25 percent, while those who received a high anchor of 65 estimated the figure at 45 percent. This experiment demonstrates the excessive weight put on initial reference points under uncertainty and the presence of insufficient adjustments.

Beyond experimental tasks, anchoring has been shown to influence professional judgments in real-life settings. In a study by Northcraft and Neale (1987), both seasoned real estate agents and amateur undergraduate business students were asked to appraise a house using identical property information, but different listing prices. Using a between-subjects design, participants were randomly assigned to different listing price anchor conditions for actual residential properties in Tucson, Arizona. Despite receiving identical, detailed market information and touring the properties, participants' valuation estimates were disproportionately influenced by the manipulated listing prices, illustrating the pervasive impact of anchoring even in information rich contexts.

In this context, the appraisal value refers to an expert's unbiased estimate of the property's fair market value based on objective analysis, while the listing price is the seller's asking price, which may be strategically set and can serve as an anchor for buyers' judgments. In the first experiment, the actual appraisal value of the property was $74,900. Listing prices were set at four levels: including the low anchor of $65,900 (12 percent below appraisal), and the high anchor of $83,900 (12 percent above). Among the amateur undergraduate business students, appraisal value estimates ranged from $63,571 under the low anchor condition to $72,196 under the

high anchor condition. Selling price estimates similarly varied from $69,414 in the low anchor scenario to $78,014 in the high anchor scenario as the anchor increased. These differences were statistically significant. Professional real estate agents, tested under the low and high anchor conditions, showed comparable effects; their appraisal value estimates increased from approximately $67,811 to $75,190 between the low and high anchor conditions, with statistically significant differences.[16] These results show that both professional real estate agents and amateur students are considerably influenced by listing price anchors when estimating property values. Anchoring bias accounted for a substantial portion of the variation in their estimates and persisted even when anchors deviated notably from the true appraisal value.

Likewise, stock price levels can serve as anchoring points for investor expectations in financial markets. Kaustia *et al.* (2008) provides empirical evidence that both novice and professional investors are susceptible to anchoring when estimating long-term stock returns. Across three controlled experiments involving 300 Scandinavian financial professionals, the authors manipulated background information to examine how different anchors affected participants' return expectations. In the first experiment, professionals were divided into groups based on the information provided to them. One group was explicitly shown the historical average real stock market return of 4.5 percent per annum based on data from 1900 to 2000 in European countries (the disclosed group), while the other group was asked to estimate the historical return themselves before predicting future returns (the estimated group). Those who generated their own anchors predicted significantly higher future returns: on average, 8.05 percent, compared to 4.62 percent when the subjects were given the 4.5 percent return (the disclosed group). The overall findings demonstrate that anchoring, particularly on recent or salient returns, remains a powerful bias even in expert populations. Importantly, professionals with more experience showed reduced anchoring effects, but the bias was not eliminated. These results help explain persistent underreaction to new information and the reluctance of investors to revise beliefs or cut losses, particularly when recent highs serve as cognitive anchors for perceived fair value.

Building on the concept of anchoring in financial judgment, Loughran and Ritter (2002) examine how anchoring influences the perceptions of companies issuing initial public offerings, the first sale of a company's shares to the public. In IPOs, "leaving money on the table" refers to the difference between the offer price and the higher first-day closing price, multiplied by the shares sold, representing potential proceeds lost by issuers. This is calculated as $(P_m - P_f) \times$ quantity of shares sold, where P_f is the final offer price, and P_m is the market price at the close of the first trading day. The authors argue that issuers are influenced by anchoring when setting expectations. Specifically, they anchor on the midpoint of the initial price range disclosed in the preliminary prospectus, where P_r is the midpoint of that initial estimated price range. Even though this range is only a rough early estimate, companies often treat P_r as a reference point for judging the IPO's success. If the final offer price P_f is above the midpoint anchor ($P_f > P_r$), issuers perceive the IPO as favorable, even if the stock trades much higher on the first day (P_m is significantly greater than P_f). This means that their satisfaction is driven more by how P_f compares to P_r, rather than by how much higher P_m is compared to P_f.

Because of this anchoring effect, issuers may feel they performed well, despite having underpriced the offering and left significant money on the table. Their mental benchmark (P_r) distorts their perception of loss, leading them to overlook the actual value investors were willing to pay. In essence, anchoring on P_r causes them to focus on the relative gain over an arbitrary reference point rather than the absolute shortfall in proceeds. Loughran and Ritter (2002) find empirical evidence that supports this view. IPOs priced above the initial range leave the most money on the table, averaging $23 million, but also yield the largest wealth gains, over $113 million, resulting in minimal dissatisfaction. This suggests that the anchoring effect can mask underpricing by making outcomes feel successful, even when more money could have been captured.

Across contexts ranging from professional appraisals and stock market predictions to IPO pricing, initial reference points exert strong influence over investor perceptions , even when those anchors are irrelevant to an asset's fundamental characteristics. As a result, investors may resist selling underperforming assets, underestimate changing market conditions, or evaluate outcomes relative to outdated benchmarks. Effective interventions must therefore replace unstable anchors with reference points that are aligned with investors' long term objectives.

5. Availability and Investor Attention

As defined by Tversky and Kahneman (1973), the availability heuristic is the process by which individuals "estimate frequency of classes or the probability of events by the ease with which instances or associations could be brought to mind" (Tversky and Kahneman, 1973, p. 207). Rather than relying on statistical data or base rates, people often base judgments on how quickly and vividly they can recall examples. Events that are recent or heavily publicized are more mentally accessible and therefore perceived as more common or more probable than they truly are.

An example of this heuristic manifested in 1975, when the release of the film *Jaws* dramatically altered public perception of shark attacks. Despite the extremely low statistical probability of encountering a shark, the sensational movie caused fear to spread rapidly. According to *Save Our Seas Foundation* (2019), while shark fishing tournaments already existed in the United States before the film's release, *Jaws* brought renewed publicity to these competitions and even helped popularize the sport of hunting so-called "trophy sharks." The public's reaction, however, was not driven by actual changes in shark behavior, but rather by how easily the terrifying imagery of a shark attack could be recalled.

To test the effects of availability in a lab experiment, Tversky and Kahneman (1973) held an experiment in which 152 participants were asked questions regarding whether English contains more words that begin with a certain letter, or the letter in the third place. They tested this with five letters, one of which was 'K'. Results showed that 69% of participants believed words beginning with "K" were more frequent, while only 31% correctly identified

that more words have "K" in the third position. In reality, English contains approximately twice as many words with "K" as the third letter as it does with the first. The error was attributed to the fact that words are more easily recalled by their initial letter, making those examples more mentally accessible. This experiment illustrates a core mechanism of the availability heuristic. When judging frequency or probability, individuals rely on the ease with which examples come to mind, allowing for subjects easier to recall to be overestimated in frequency, leading to systematic biases in judgment.

This same cognitive shortcut can also influence complex decisions, such as those made in financial markets. A clear example comes from Gadarowski (2002), who examined whether recent press coverage of firms could predict future stock returns. Using data from about 1,500 U.S. nonfinancial firms between 1980 and 1994, the study found that firms with low book-to-market ratios (i.e., whose market values exceed their accounting, or book, values) and high recent press coverage earned about 10 percent lower annual returns over the following two years compared to similar firms with low news coverage. These firms are often considered "growth" firms because investors expect their future earnings and growth potential to be high, which typically leads to higher stock prices relative to their current net assets.

At first, these results might seem to fit rational explanations. For example, the investor recognition hypothesis suggests that firms with more visibility are better known and less risky, which should lead to lower expected returns. Other rational models argue that systematic risk (market-wide risk factors) or estimation risk (uncertainty about a firm's value) might justify lower returns for firms receiving more attention. In contrast to these theories, Gadarowski (2002) finds that lower returns were concentrated *specifically* in low book-to-market firms, and traditional measures of risk or analyst coverage did not explain the pattern. If visibility alone explained the results, the effect would be seen across more firms.

The significance of the effect being limited to low book-to-market firms suggests that behavioral biases like the availability heuristic play a stronger role where investor expectations about growth are already optimistic. These firms are more likely to attract attention because their high market valuations attract speculation about future performance. Investors' tendency to overreact to news and recent information is amplified in this group, causing prices to rise beyond justified levels. Value firms, which already trade at lower prices relative to their book values, are less prone to this kind of over-optimism and intense media focus, which may explain why the effect is not observed among them.

Gadarowski's evidence supports a behavioral explanation based on the availability heuristic. Firms that get more press coverage become easier for investors to recall and more mentally available. When it has become common practice to focus on firms that are seen as "good stocks" simply because they come to mind more readily, investors develop a bias toward buying companies with greater media exposure. Gadarowski (2002) argues that these firms are then more likely to be actively traded, fueling bubbles around those with seemingly strong

prospects. Moreover, the study also showed that the effect was stronger after periods of strong economic growth, suggesting that optimism increases the bias.

Furthermore, a study by Kliger and Kudryavtsev (2010) goes on to specifically examine how the availability heuristic impacts investors' reactions to analyst recommendation revisions for individual stocks. Using a dataset of 2,746 analyst recommendation changes from 1,373 NYSE-listed firms over 2001–2006, the authors focus on how stock prices behave on the days these recommendations are announced (day 0) and the day before (day –1).

The authors distinguish between two forms of availability: outcome availability and risk availability. Outcome availability captures the ease with which investors can envision positive or negative investment outcomes. This is measured by contemporaneous market returns, serving as a proxy: when the overall market rises, positive outcomes become more available, amplifying responses to positive news such as analyst upgrades. Conversely, when the market declines, negative outcomes become more salient, intensifying reactions to downgrades. Risk availability refers to the prominence of financial risk in investors' minds, especially on days of large market moves or high volatility.

The study finds that stock price reactions to upgrades are stronger on days with positive returns, and reactions to downgrades are stronger on days with negative returns. Abnormal returns (ARs), which represent deviations of actual stock returns from expected market-based returns, quantify the magnitude of these reactions. For instance, on the event day (day 0), upgrades yield an average AR of +2.45%, while downgrades produce -2.38%, both highly significant. More specifically, the study demonstrates that upgrades on days with positive market returns register ARs of +2.82%, compared to +1.89% on negative market days, a significant difference of 0.93%. Downgrades on negative market days show ARs of -3.04%, versus -1.82% on positive market days, a significant difference of 1.22%. These findings illustrate that investors weigh outcomes more heavily when they are psychologically more available: positive market days increase the salience of gains, and negative market days the salience of losses. These effects are more pronounced for small-cap stocks, stocks with higher beta, or greater volatility, consistent with the notion that such stocks have less available information and are more susceptible to behavioral biases.

Similarly, the authors find that trading volumes also increase on days when market moves and analyst recommendations align, further highlighting the presence of the availability bias. In this study, abnormal trading volume (ABVOL) is derived by taking the actual trading volume on day 0 and comparing it to that stock's own typical volume before the event. The experiment finds that on day 0 of upgrades, ABVOL equals 1.91 when MRs are positive, versus 1.55 when MRs are negative. For downgrades, the ABVOL is 2.13 when MRs are negative versus 1.50 when MRs are positive, with all differences statistically significant. Since ABVOL is the standardized difference between the event-day volume and this historical average, a higher ABVOL means trading is unusually heavy relative to that stock's normal level. In both cases, trading volume was abnormally large when market returns aligned with analyst recommendations. As the authors explain, contemporaneous market returns make

matching outcomes more salient and mentally accessible, drawing stronger investor reactions, exemplifying a response caused by the availability bias.

Even though the availability heuristic is a common influence in both financial and everyday decisions, research suggests that its effects can be mitigated through increased awareness. A study by Salas-Velasco (2024) demonstrates this point through a randomized controlled trial involving 538 senior business undergraduate students at a public university in southern Spain. Although Salas-Velasco examines student loan decisions rather than investment behavior directly, it remains relevant as it demonstrates how the effects of availability can be reduced through targeted education. In the study, students were randomly assigned to three groups: a control group with no intervention, a financial education group that completed an online course covering personal financial management principles, and a third group that received the same education along with an additional module that explained the impact of the availability heuristic on their thinking. Participants in this final group were instructed to counteract this bias by relying on official, verified sources and expert advice to make better informed choices. Following the interventions, participants were presented with a hypothetical scenario in which they imagined pursuing a 12-month master's degree costing €30,000, with only 50 percent of the funds available and the remainder financed through a loan under realistic bank conditions. Objective labor market data on wages and employability were provided to counterbalance optimism bias, and participants assumed a full time study with maintained academic performance. Through statistical analysis, Salas-Velasco (2024) found that only the combined financial education and debiasing group showed statistically significant improvements, with the author determining a p-value of less than .05, indicating a less than five percent probability that these effects were due to chance.

This result highlights that awareness of the availability heuristic through explicit education removes its influence by instead encouraging evidence-based decisions. The author found that the debiasing group even showed more positive attitudes toward student loan borrowing, enhanced perceptions of social approval, greater financial self efficacy, and stronger borrowing intentions. Even in real world scenarios, financial education needs to be accompanied by heuristic awareness to motivate the most rational decision making.

In sum, studies of availability find that individual perception is often shaped more by mental accessibility than by objective data. Tversky and Kahneman (1973) establish the mechanism of availability, Gadarowski (2002) and Kliger and Kudryavtsev (2010) demonstrate its effects on stock returns and trading behavior. However, Salas-Velasco (2024) demonstrates that targeted education can meaningfully reduce its influence. The studies reviewed suggest that availability primarily distorts investor attention, causing them to overweight information that is recent and heavily publicized while underweighting less salient but relevant empirical data. Accordingly, corrective interventions should not only provide investors with broader contextual information, but also incorporate educational prompts that increase awareness of the availability heuristic itself (Salas-Velasco, 2024).

6. Compounding Effects: How the Three Biases Interact

The concepts of loss aversion, anchoring, and the availability heuristic do not work independently; rather, they combine to form the basis for a chain of cognitive errors which can further influence investment decisions. Anchoring frequently serves as the starting point of this process. Investors often become attached to a numerical anchor, for example, a purchase price or a recent market high using it as a reference point for evaluating future outcomes. When the value of an asset falls below that reference point, the decline is perceived as a loss, triggering loss aversion and increasing the investor's reluctance to sell the asset despite evidence that doing so may be beneficial. The availability heuristic can further intensify this effect. During periods of market volatility, highly publicized news stories and recent price movements become especially salient and easy to recall. As a result, investors may place excessive weight on these readily available pieces of information, reinforcing their existing anchors and amplifying the emotional impact of perceived losses. For example, an investor anchored to a stock's previous high price may become even more reluctant to sell after repeated exposure to news emphasizing recent market declines or uncertainty.

These three biases are uniquely suited for a unified intervention because they map directly onto the distinct stages of financial decision making: valuation, information processing, and emotional execution. Anchoring establishes the flawed baseline value an investor fixates on, the availability heuristic serves as the environmental catalyst by using salient media headlines to reinforce that anchor, and loss aversion dictates the irrational behavioral response when an asset drops below the established baseline. Because these biases operate as an intertwined psychological loop, attempting to address them through separate interventions would create a fragmented user experience that fails to disrupt their compounding effects. Addressing all three biases within a single platform ensures that the corrective mechanisms actively reinforce one another, covering the entire lifecycle of an investment decision without cluttering the digital interface.

7. Proposed Solution

Investor decisions are rarely made in a vacuum; they are shaped by the interaction of psychological tendencies that push people toward short term, emotionally packed reactions rather than long term strategy. The previous three sections of this paper have shown that loss aversion, anchoring, and availability often reinforce each other, creating a cycle where fear of loss, false reference points, and attention to headlines drive poor trades. The purpose of this section is to formulate an effective solution that could confront these biases together through "nudges", structuring the investment process to redirect investors toward disciplined behavior.

Nudges are deliberate design choices that steer individuals toward better decisions while preserving freedom of choice. In their book *Nudge*, Thaler and Sunstein (2021) propose libertarian paternalism as an ideal approach, combining libertarianism, which preserves freedom of choice, with paternalism, the nudge that helps individuals act in ways that improve their own lives, as defined by them. Nudges guide people toward the choices they would make if they had perfect information, attention, and no influence from cognitive biases. Effective nudges use tools such as defaults and strategically placed options that redirect biases and, in turn, make desirable behaviors more salient. This section proposes a design of an app that could help mitigate the impact of common behavioral

biases in investing, allowing consumers to make informed decisions and avoid heuristic-induced losses. This digital application embeds structured decision tools directly into an investor's digital workflow, allowing for efficient use while addressing loss aversion, anchoring, and availability in an accessible experience.

To maximize its impact, the platform operates at the intersection of three distinct behavioral interventions: nudging, debiasing, and education. Though often conflated, these concepts tackle behavioral modification through different mechanisms.A nudge involves the manipulation of choice architecture in decision making without limiting choices or changing economic incentives. Debiasing is concerned with the cognitive process as the aim is to minimize the bias so that the investor analyzes the facts objectively. On the other hand, education seeks to help in judgment in the long term by giving the information needed for making independent decisions. The platform utilizes a combination of these three mechanisms to tackle investor biases .

To address loss aversion and anchoring, the platform would incorporate a rule based portfolio management feature designed as a behavioral nudge consistent with Thaler and Sunstein's (2021) libertarian paternalism framework. Users would be invited to first create a personalized Investment Policy Statement, setting objectives, target asset allocations, and a preferred rebalancing strategy, either on a fixed schedule or when allocations drift beyond percentage thresholds. The feature monitors the portfolio and delivers timely alerts, such as: "*Your equity allocation has grown seven percent above your target. Your IPS recommends rebalancing. Would you like to review now*?" Importantly, this prompt would present rebalancing as a recommendation rather than a mandate, aiming to ensure that investors retain full control over their decisions.

As previously mentioned, loss aversion causes investors to hold losing positions too long, leading to unnecessary losses.[5] This feature directly aims to combat loss aversion by channeling the anchoring heuristic; when the IPS feature allows them to anchor to their own preset threshold, investors will not feel compelled to sell a stock irrationally. This nudge approach not only aims to encourage investors to align their investment strategy with their long-term target but also could prevent them from succumbing to loss aversion during market volatility. To illustrate this feature, consider an investor who begins with a conservative Investment Policy Statement, setting a 40 percent equity and 60 percent bond allocation, with a rule to rebalance when any asset class shifts more than 4 percent from target. During a market downturn, the app alerts the investor that equities have fallen to 35 percent. Left unaided, they might hesitate to buy more stocks, anchored to recent losses and constrained by loss aversion. The platform reframes the decision by reminding them of their original plan: "Your IPS indicates a 40 percent equity target. Rebalancing is recommended." Establishing rebalancing as the default option through careful wording aims to make investors more likely to adopt it. Additional educational information on the impact of loss aversion on portfolio diversification would also be available upon clicking on this alert. This prompt is designed to shift the anchor point from short term price movements back to their pre-set long term goals, helping the investor anchor to their own strategy rather than to market volatility.

Furthermore, to address investor's unwillingness to diversify, the platform could present globally diversified model portfolios during onboarding and explain the historical benefits of diversification. Once the investor selects a target allocation, rebalancing notifications help maintain that diversified portfolio despite future discomfort with foreign assets. This feature is designed to intervene at the point when investors establish their initial portfolio strategy, before loss aversion can discourage exposure to unfamiliar foreign assets. By providing diversification as a structured default option rather than requiring investors to independently seek out international investments, the platform is designed to reduce the influence of perceived loss risk associated with unfamiliar markets. Once an investor selects a target allocation, the Investment Policy Statement records this commitment and rebalancing notifications help maintain the chosen level of diversification over time. As market conditions change, investors may become reluctant to add to foreign holdings after periods of underperformance or heightened uncertainty. By framing portfolio adjustments as adherence to a previously selected strategy rather than a new investment decision, the platform could reduce the tendency to avoid foreign assets due to anticipated losses. For example, an investor creating an account may initially prefer a portfolio consisting entirely of U.S. stocks because foreign markets feel less familiar and therefore more risky. The platform could instead present a model portfolio containing 70 percent U.S. equities and 30 percent international equities, accompanied by visualizations showing how diversification has historically reduced the impact of downturns in any single country. After selecting this allocation, the investor's Investment Policy Statement records it as a long term objective. Suppose that several months later international stocks experience a period of underperformance and the allocation falls from 30 percent to 25 percent. Without intervention, the investor may hesitate to purchase additional foreign equities because recent losses make further investment feel risky. Rather than asking the investor whether they would like to buy more international stocks, the platform would issue a notification stating that the portfolio has drifted from its target allocation and that rebalancing is recommended. By framing the action as restoring a previously chosen strategy, the platform could reduce the influence of loss aversion and help preserve diversification over time.

These approaches parallel the *Save More Tomorrow* (SMarT) program by Thaler & Benartzi (2004), a field-based behavioral intervention designed to increase employee retirement savings. In SMarT, employees pre-commit to gradually increase savings rates automatically with future pay raises, by using loss aversion and anchoring. Specifically, the program asks employees to commit in advance to increasing their savings rates only when they receive future pay raises, rather than immediately reducing their take-home pay. This design anchors savings increases to anticipated salary increments, making the higher contribution feel psychologically linked to a gain rather than a loss. By tying contributions to raises, the program leverages the "money illusion," where individuals perceive nominal increases positively and are less sensitive to corresponding increases in savings deductions. Thus, employees do not experience a perceived reduction in their disposable income, which significantly diminishes the painful impact of loss aversion. Empirical evidence from the first SMarT implementation reveals that 78% of eligible employees chose to join the program, with 80% of them remaining enrolled through four annual salary raises, and average savings rates increased from 3.5% to 13.6% over roughly 40 months.

Likewise, to mitigate availability bias, the platform changes how information is displayed. Instead of focusing solely on recent price changes or breaking news like popular financial trading platforms, the interface includes long-term return distributions, historical drawdowns, and volatility patterns alongside current data. A study by Schwarz *et al.* (1991) shows that availability plays a role in participants' self-evaluation of their assertiveness. However, researchers also found that the introduction of an external element, like meditation music, was an effective method to reduce participants' tendency to overly rely on ease of recall, reducing the impact of the availability bias. By attributing the difficulty of recall to the music rather than to themselves, participants no longer relied on their subjective feeling of ease when evaluating their own assertiveness. When the ease of recall was made "diagnostically irrelevant," participants were forced to base their judgments on the actual content of their examples.

Similarly, the platform includes a media salience score, which flags when a stock is receiving unusually high or low coverage relative to its historical baseline. This feature contrasts the structure of today's most popular trading interfaces, where recent news headlines appear prominently on a firm's profile, making them especially salient in investors' minds. The presence of a media salience score could allow investors to consider whether media coverage is driven by strong fundamentals or short-term hype, removing the tendency to make judgments solely based on salient information. For instance, a "high" score displayed next to the stock name would signal a sudden surge in media attention, while a "low" score would suggest a decline in coverage. Next, a pop up placed next to the stock would educate investors on the availability heuristic. This feature follows the approach by Salas-Velasco (2024), which finds that increasing awareness and providing targeted education can significantly reduce the heuristic's impact and promote more efficient investment decisions.

In this proposed platform, anchored thresholds and pre-set rules aim to address loss aversion and anchoring, while contextual displays and salience indicators are designed to counter the effects of availability bias. The use of behavioral nudges allows investors to redirect their biases to support their individual long term goals, helping investors act more rationally in complex, changing markets, where uncertainty is inevitable. However, this approach also raises important limitations, including the risk of overreliance on automated systems leading to the potential overautomation of investment decisions. Additionally, further research is needed to determine the extent of tasks that AI systems can reliably perform within this framework and to ensure that such systems do not inadvertently replicate or amplify the same cognitive biases they are designed to mitigate.

Future research could evaluate the platform through a randomized controlled experiment involving approximately 200 retail investors between the ages of 18 and 30 with more than six months of prior investing experience. Participants would be randomly assigned to either a standard brokerage interface or the proposed nudge-based platform. After completing a brief onboarding exercise, participants would engage in a series of simulated investment decisions involving portfolio rebalancing, international diversification, and responses to highly publicized stocks. The simulation would be structured around three controlled scenarios, each

corresponding to one of the behavioral biases identified in this paper: a market downturn intended to activate loss aversion, a price history condition designed to induce anchoring, and a high visibility stock scenario aimed at triggering availability bias.

The effectiveness of the platform could then be evaluated by comparing investment behavior between participants using the intervention and those using a standard brokerage interface. This evaluation would focus on three primary measurable outcome variables: trading frequency, portfolio diversification, and rebalancing behavior. Specifically, trading frequency would be measured by counting the total number of buy and sell orders placed by each participant during the simulation. Portfolio diversification would be tracked by measuring the percentage of the portfolio invested in a single stock compared to the amount spread across global assets. Finally, rebalancing behavior would be measured by calculating the difference between the investor's actual asset mix and their original target goals.

Beyond these behavioral metrics, post experiment surveys could capture participants' self assessments of their investment decisions and perceived risk. Regression analysis could also be employed to control for variation in financial literacy, prior investing experience, and individual risk tolerance. Such a design would allow researchers to determine whether the proposed nudges meaningfully improve investment decision making relative to a standard investing interface.

Cognitive Bias	**Investor Error Caused By Bias**	**Nudge Mechanism Within Proposed Platform**
Loss aversion	Reluctance to realize losses and avoidance of portfolio diversification due to uncertainty	During onboarding, investors are presented with globally diversified model portfolios and visualizations demonstrating the benefits of diversification. Once a target allocation is selected, it is recorded in an Investment Policy Statement (IPS). When allocations drift from their targets, the platform issues rebalancing notifications that frame adjustments as adherence to a previously chosen strategy rather than a new investment decision, reframing what would be otherwise perceived by investors

		as a painful loss into an opportunity for redirection.
Anchoring	Reliance on purchase prices or recent market values as reference points, leading to distorted evaluation of performance	The IPS prominently displays target asset allocations and predefined rebalancing thresholds on the fintech interface. Portfolio alerts reference these targets rather than recent price movements, encouraging investors to evaluate performance relative to long-term objectives instead of short-term market fluctuations.
Availability	Overweighting of recent, vivid, or highly publicized information in investment decisions, leading to overreaction to short-term news	Alongside current market information, the interface displays long-term return distributions, historical drawdowns, and volatility ranges generated from historical market data. A media salience score appearing beside a stock's profile flags red when it is receiving unusually high attention relative to its historical baseline, while educational pop-ups explain how excessive media coverage can distort investment judgment. These nudges encourage investors to consider fundamentals over salient headlines when making decisions.

Table 1: Cognitive biases in investor decision making and the corresponding behavioral nudges embedded within the proposed investment platform design

7. Conclusion

The paper has argued that loss aversion, anchoring, and the availability heuristic collectively contribute to distortions in investor judgment. It has further demonstrated that these cognitive biases are systemic in nature, consistently influencing how investors perceive information, assess risk, and make portfolio decisions. At the

same time, the findings suggest that the effects of these biases can be mitigated through targeted behavioral education and structured decision making frameworks.

These results therefore indicate that behavioral considerations are a crucial component in the design of financial technologies. As the evidence presented suggests, investor behavior is predictably shaped by cognitive biases; accordingly, fintech tools that assume fully rational decision making are unlikely to operate optimally in real world contexts. This implies that nudges and other behavioral design mechanisms should be incorporated into financial applications to support more disciplined decision making while preserving user autonomy.

One of the main limitations of this study is that the proposed platform has not been empirically validated and therefore requires further evaluation regarding its effectiveness in influencing decision making and its broader implications in real world financial environments. To address this limitation, the paper proposes a randomized experimental design that could be used to evaluate whether the platform's nudges improve investment decisions relative to a standard brokerage interface. Future research should implement and test this framework to determine the extent to which behavioral interventions can reduce the influence of cognitive biases in practice.

Moreover, the development of the above mentioned model into an actual platform involves risks which require careful design. The use of constant, automated prompts can actually contribute to the formation of user dependency, making users rely solely on the system's suggestions without developing any financial literacy. In addition to this, due to the fact that the platform will have to observe the portfolio information and users' behavior in order to apply the intervention techniques, a lot of issues related to data security emerge. Moreover, there is a possibility of placing too much friction on the user since, in case the nudges or behavioral prompts are not well designed, they can trigger alert fatigue, leading the users to simply ignore the notifications or to leave the platform and switch to another one with a more user friendly interface.

Furthermore, several of the behavioral interventions informing the platform are supported by evidence from related decision making contexts, including real estate valuation, retirement savings, and student loan decisions, rather than retail investing directly. Although the underlying cognitive mechanisms are well established and their application to retail investing is theoretically plausible, the effectiveness of transferring these interventions to investment platforms has not yet been fully established through direct empirical testing.

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Acknowledgements

I would like to express my sincere gratitude to my research mentor, Dr. Edoardo Gallo, for his support and guidance throughout the research process. His insightful feedback and thoughtful encouragement greatly shaped the development of this paper.

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Mentor Contribution Statement

Dr. Edoardo Gallo was very supportive during the writing of this research paper. He helped me assess the validity and reliability of the sources used, gave recommendations on readings that would further solidify the foundation of my research, and provided comments that guided my work towards a more focused direction. His mentoring enabled me to do independent research and analysis on this topic.

Cognitive Biases in Financial Decision Making and the Design of Nudge-Based Corrective Mechanisms

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Abstract

While considerable progress has been made in the field of behavioral finance, relatively few bias-mitigation mechanisms have been incorporated into the decision-making platforms used by retail investors. Consequently, investors remain exposed to cognitive biases such as loss aversion, anchoring, and the availability heuristic, among others, which can contribute to asset mispricing and excessive trading. Drawing on empirical research, this paper analyzes the relationship among the three biases discussed above and examines how they generate distinct investor errors. Loss aversion contributes to the reluctance to rebalance and diversify portfolios. Anchoring causes investors to misjudge stock performance by relying excessively on purchase prices and recent market highs. The availability heuristic encourages investors to overweight salient news and ignore long term data. Subsequently, the paper proposes a behavioral design framework for digital investing platforms by mapping the errors caused by each bias to a corresponding nudge intervention. Founded on Thaler and Sunstein (2021)'s nudge theory, the proposed platform manipulates these biases to direct investors towards decisions that are more aligned with their long term

Keywords: Behavioral Science, Economics, Cognitive Biases, Nudges, Investment Behavior, Portfolio Allocation, Financial Decision Making

1. Introduction

Financial markets play a vital role in economic development by channeling capital from those who supply funds to those who seek investment. These markets allow investors to generate wealth while facilitating economic growth by directing funds to private companies and governments, spurring innovation and funding essential public projects. However, history has demonstrated that financial markets are also vulnerable to periods of extreme instability. Events such as the Great Depression of

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confidence can amplify economic shocks, leading to widespread financial and social consequences (Bernanke, 2000; Krugman, 2009). These episodes raise an important question: why do markets that are designed to allocate capital efficiently sometimes produce outcomes that appear highly irrational?

Traditional Financial Theory assumes rationality for all investors, indicating that they make decisions based solely on logical calculations and publicly available information in order to maximize utility. Additionally, according to the Efficient Market Hypothesis (EMH) formulated by Eugene Fama (1970), the efficiency of financial markets is exceptionally high in incorporating information about investments, meaning that the price of stocks and other financial instruments should adjust almost instantly upon receiving new information. Under these frameworks, it would be theoretically impossible for investors to achieve higher returns than the general market just by examining public information or analyzing price histories. Furthermore, future price changes would be unpredictable since they could only depend only on new, unexpected information.

This paper makes two primary contributions. First, it identifies three recurring investor errors generated by the following behavioral biases: loss aversion, anchoring, and the availability heuristic. Second, it develops a behavioral design framework that links each error to a corresponding nudge intervention embedded within a digital investment platform. These nudges leverage the same biases that distort decision making and channel them to redirect investors toward more disciplined outcomes. Within the platform, loss aversion and anchoring are addressed through personalized targets and rebalancing recommendations that shift investors' reference points toward their own long term goals. The proposed mechanisms that aim to correct loss aversion and anchoring reference nudge methods tested in the *Save More Tomorrow* program by Benartzi and Thaler (2004), where these biases were successfully redirected to encourage employees to save more for retirement. Finally, findings from Schwarz *et al.* (1991) and Salas-Velasco (2024) are utilized to argue that redirecting recall can reduce the impact of availability, insights that inform the proposed platform's media salience indicators and contextual information displays.

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The paper proceeds as follows. The next section briefly discusses the shift from the Efficient Market Hypothesis to behavioral finance. The following three sections examine loss aversion, the availability heuristic, and anchoring, each considering empirical studies and real world examples that illustrate their impact on financial decision making. The sixth section explores how these three biases interact and reinforce one another throughout the investment process, demonstrating why they are best addressed through a unified intervention. The seventh section proposes an integrated solution designed to help investors mitigate the influence of these biases and make more disciplined decisions. Section eight concludes by considering implications, limitations, and potential areas for future research.

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2. From Efficient Markets to Behavioral Economics: The Deviation from Rationality

As introduced in the previous section, the Efficient Market Hypothesis (EMH) holds that asset prices fully and immediately reflect all available information. Fama (1970) identifies three categories of

market efficiency. Weak form efficiency proposes that prices already incorporate all information from past trading activity, meaning that analyzing patterns in price movements or trading volumes cannot be used to earn higher returns. Semi-strong form efficiency extends this idea to all publicly available information, such as news releases or financial statements. Under this form, prices reflect such data so quickly that analysis cannot be relied upon to outperform the market. Strong form efficiency takes this even further by indicating that prices reflect all public and private information, meaning that even those with access to exclusive insider data cannot regularly generate higher profits than the ordinary investor.

Under this assumption, investor behavior should reflect all publicly available financial information. In practice, however, investor behavior frequently deviates from the assumptions of traditional finance theory. While the EMH posits that asset prices fully and immediately reflect all available information, behavioral evidence suggests that markets can remain mispriced for extended periods because investors do not always process information objectively.

Behavioral economics provides a framework for understanding these deviations by incorporating insights from psychology in economic decision making. This theory, pioneered by Nobel Prize winning scholars such as Daniel Kahneman and Amos Tversky (1981), attributes the irrationality of decision making to mental shortcuts activated under uncertainty.

Central to this framework is the idea that the human brain operates through two systems, which Daniel Kahneman (2011) refers to as System 1 and System 2. Actions controlled by System 1 are often done subconsciously; for example, comprehending simple sentences and locating the source of a loud sound. System 2, on the other hand, requires attention and mental effort to sustain its operations and is often used when assessing complex situations. Examples of such complex situations may include generating a strong move in chess as an amateur or finding a familiar face in a crowded room. Because System 2 requires conscious effort, individuals tend to rely on the intuitive processes of System 1, particularly in uncertain or stressful situations. Behavioral biases appear when the automatic responses of System 1 dominate, forming decisions that depart from the fully rational thinking of System 2. Behavioral economics, therefore, provides a more realistic account of human behavior by recognizing the role of psychological factors in real world financial decisions. Drawing on experimental studies, market data, and real world evidence, this paper examines why investors act irrationally and the impact of these behaviors on market outcomes.

Building on this behavioral framework, this paper examines the importance of three cognitive biases that are key influences on financial decision making: loss aversion, anchoring, and the availability heuristic. Each of these biases impacts how investors evaluate risk, interpret information, and allocate assets, causing departures from rational behavior. This paper explores how psychological tendencies can distort market outcomes by analyzing their effects on portfolio diversification, stock valuation, and trading decisions.

Beginning with loss aversion, the first section explores how investors feel the pain of a loss more than an equivalent gain, and its impact on investor behavior in both laboratory and real world settings. The primary consequence of loss aversion is that most investors are less willing to sell losing stocks than gaining ones, leading to inefficient portfolio management. Similarly, evidence from French and

Poterba (1991) indicates that loss aversion also makes investors reluctant to diversify their portfolios, as fear of losses is bolstered by the unfamiliarity of foreign assets. Following the discussion of loss aversion, the second section examines the anchoring bias. Anchoring occurs when investors rely too heavily on the primary pieces of information they receive during the decision making process. In real world settings, for instance, investors have shown to be excessively influenced by historical returns, causing their predictions to reflect these numbers instead of all historical data (Kaustia *et al.* 2008). The final bias considered is the availability heuristic, which influences how people judge frequency and probability. This heuristic occurs when investors overestimate the frequency of events that are easier to recall, even when those examples may not be relevant. The effect persists in real world settings where investor overoptimism caused by the availability heuristic actually leads hot topic firms to become overvalued, and ultimately underperform. However, evidence also shows that awareness and targeted education can actually reduce the effect of this bias, leading to more informed decisions.

Understanding how these biases arise is essential because effective interventions must target the underlying cognitive mechanism to mitigate irrational market behaviors.

3. Loss Aversion and Decision Making

Tversky and Kahneman (1981) define loss aversion as the phenomenon where "[...] the response to losses is more extreme than the response to gains." (Tversky & Kahneman, 1981, p. 454). This definition challenges the traditional economic assumption that investors evaluate gains and losses symmetrically when making decisions. It instead suggests that losses carry greater psychological weight than equivalent gains, leading individuals to make choices that deviate from the rational utility maximizing model.

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Imagine you are walking in the bustling city streets and find a $100 bill on the sidewalk: you'd likely feel pleasantly surprised, maybe even lucky, as you slip the unexpected cash into your pocket. Now imagine a contrasting scenario: you reach into your wallet and discover that $100 had been stolen. For most people, the sharp sting of the loss feels much more intense than the joy of the gain, even though the amounts are identical. In a lab experiment conducted with 160 Wharton MBA students, Schoemaker and Hershey (1992) explored how loss aversion affects individuals' ability to evaluate risky choices involving gains, losses, and mixed outcomes. Using a within-subject design across three rounds, participants made judgements about certainty equivalents (CE): the amount they'd accept instead of a gamble, and probability equivalents (PE): the probabilities at which they would be indifferent between a gamble and a sure outcome.

To produce these judgments, carefully worded questions were used. For example, in the gain domain, subjects faced a choice: "Suppose you could choose between $100 for sure, and a 50-50 gamble offering either $0 or $200. Which would you prefer?" They then indicated whether they preferred the sure amount, the gamble, or were indifferent. If they chose the sure amount, they were asked for the minimum certain amount they would be willing to accept instead of the gamble. If they chose the gamble, they were asked how much more the sure amount would need to be for them to switch. Similarly structured questions were posed in the loss domain (e.g., choosing between a certain loss of $100 and a 50-50 chance of losing $200 or nothing) and in the mixed domain involving a potential gain

or loss of $100. In the mixed and loss domains, participants also indicated either the sure amount or the probability that would make them indifferent. Subjects were clearly told that there were no right or wrong answers and that their responses would not affect their course grades.

Consistent with Tversky and Kahneman's definition, the Wharton MBA students' responses showed that losses were valued significantly more than gains. Participants showed risk aversion when dealing with gains, but their reactions to losses were significantly more pronounced. For instance, 56% of participants who were initially risk-seeking when evaluating sure gains became risk-averse when assessing gains under uncertainty. However, this pattern became even more pronounced in the loss and mixed domains. Participants showed a stronger shift toward avoiding outcomes that might solidify a larger loss, even if the expected value was the same. For example, a participant may be indifferent between gaining $100 or nothing, versus $45 for sure, but would reject a 50/50 chance to lose $100 or lose nothing in favor of a certain loss of $45. In mixed-outcome cases, where participants faced a 50% chance of gaining $100 or losing $100, responses were even more conservative: participants often demanded a gain significantly larger than the potential loss before they were willing to accept the gamble. Because of this, Schoemaker and Hershey (1992) determined that the asymmetric tradeoffs in individuals' choices were a direct result of loss aversion.

One of the most striking demonstrations of loss aversion in real world financial behavior comes from Terrance Odean's 1998 study. Odean (1998) analyzes over 162,000 trading records from 10,000 retail investor accounts at a large U.S discount brokerage firm between 1987 and 1993, reconstructing each investor's stock portfolio from the raw trade data. For every stock sold, he compares the sale price with the average purchase price to determine whether it was a realized gain or a realized loss. Stocks still held in the portfolio on a given day are classified as unrealized ("paper") gains or losses, determined by whether the market price lies above or below the purchase price. Using this data, Odean (1998) calculates two key metrics:

Proportion of Gains Realized (PGR): realized gains / (realized gains + paper gains)

Proportion of Losses Realized (PLR): realized losses / (realized losses + paper losses)

If gains and losses were weighted equally in investment decisions, realized gains and realized losses would occur at comparable rates. Instead, the data highlights an asymmetry: the average PGR across the full sample is 0.148, whereas the average PLR is 0.098. This 5 percentage point difference indicates that investors are significantly more likely to realize gains than losses, supporting the hypothesis that losses carry greater psychological weight than equivalent gains.

Because the data is observational, it is challenging to attribute the high sell-to-hold ratio to loss aversion directly. However, Odean (1998) addresses this by ruling out several alternative rational explanations. Using publicly available stock prices, he reconstructs individual trading decisions and finds that loss aversion persists even after controlling for tax status, transaction costs, and portfolio rebalancing motives. For example, the effect still holds after partial sales and trades followed by immediate repurchases are excluded. Additionally, investors display the same pattern regardless of whether they are frequent or infrequent traders, and across stocks that vary in price. Further analysis

shows that this reluctance to sell losing stocks is also financially costly. Odean (1998) finds that on average, the winning stocks that investors sell go on to outperform the stocks they chose to hold. Specifically, sold winners outperform held losers by approximately 3.4% over the following year. This underperformance suggests that the decision to hold onto losers is harming investors' long-run portfolio returns. If investors were truly rationally evaluating future performance, they would not consistently retain underperforming assets.

While Odean studies how loss aversion affects investor behavior after purchasing assets, particularly the reluctance to realize losses, French and Poterba (1991) examine how loss aversion may shape portfolio allocation before trades are even made. They focus on the loss aversion influenced phenomenon of home bias, where investors allocate a disproportionately large share of their equity portfolios to domestic stocks despite the recognized benefits of international diversification. Using data from the late 1980s, French and Poterba (1991) analyze portfolio holdings in the United States, Japan, and the United Kingdom. They find that investors in all three countries exhibit a strong preference for domestic equities. Specifically, over 98 percent of Japanese portfolios, 94 percent of U.S. portfolios, and 82 percent of U.K. portfolios are held in domestic stocks. These figures suggest that investors forgo potential diversification gains by holding a disproportionate amount of assets in their home markets.

It is very difficult to explain the presence of home bias within the traditional economic framework. Based on historical return correlations, French and Poterba (1991) calculate the expected returns on domestic equities that would be necessary to justify the observed home-biased allocations. The results indicate that investors must believe domestic stocks will outperform foreign stocks by substantial margins. For instance, U.S. investors would need to expect U.S. equities to yield approximately 2.5 percentage points more per year than Japanese equities. Similar return premiums are implied for investors in the United Kingdom and Japan. These expectations are difficult to explain with historical data, which suggests the presence of cognitive biases. One explanation hypothesized by the authors is that investors perceive foreign markets as riskier due to unfamiliarity or a lack of control. This perceived risk, however, differs from objective risk measures used in standard economic models. Importantly, the concept of loss aversion is key to explaining why investors react more strongly to potential losses in foreign investments because the uncertain chance of a loss is more painful than any equivalent gain. This indicates that investors demand higher returns to compensate for the perceived losses associated with foreign equities, even when objective measures of risk do not justify such premiums. It is loss aversion, rather than solely analytical risk perception, that motivates this avoidance behavior.

Odean (1998) focuses on how investors respond to gains and losses after they occur, whereas French and Poterba (1991) highlight how the anticipation of potential losses can discourage investors from engaging in international diversification in the first place. Collectively, these findings suggest two recurring investor errors. First, investors hold losing assets longer than rational portfolio optimization would recommend. Second, investors avoid diversification opportunities when unfamiliar investments are perceived as potential sources of loss. Both behaviors reduce portfolio efficiency and provide specific targets for corrective intervention. Accordingly, effective corrective mechanisms should reframe investment decisions around precommitted long term objectives and diversified

portfolio targets, reducing the tendency for investors to evaluate choices primarily through the lens of potential short-term losses.

4. Anchoring and Distorted Evaluation

Tversky and Kahneman (1974) define anchoring as a process in which "people make estimates by starting from an initial value [...] that is adjusted to yield the final answer," noting that "adjustments are typically insufficient" and that "different starting points yield different estimates, which are biased toward the initial values" (Tversky and Kahneman, 1974, p. 1128). In summary, anchoring refers to the human tendency to rely heavily on the first piece of information received, regardless of its actual relevance, and to adjust subsequent judgments insufficiently away from that initial anchor.

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Consider a scenario in which you encounter a watch originally priced at $1,000 but now marked down to $700. In this case, the initial $1,000 price serves as a reference point, making the $700 price appear significantly more attractive, even if the actual value of the watch is uncertain or unrelated to either figure. You might even feel compelled to purchase the watch, persuaded by the perception of saving $300 on what seems like an exceptional deal. This phenomenon illustrates a cognitive bias known as anchoring.

A particularly influential demonstration of the anchoring effect is found in the same study mentioned above, in which Tversky and Kahneman (1974) demonstrate how clearly irrelevant numerical values can distort judgment. In this study, participants observed a roulette wheel numbered from 0 to 100, which was spun in their presence to generate a random number. Immediately afterwards, they were asked to estimate several quantities stated in percentages. In one of such cases, subjects were asked whether the percentage of African countries in the United Nations was higher or lower than the number they had just seen. They were then instructed to provide their own best estimate of the actual percentage.

Importantly, the experiment employed a between-subjects design, separating participants into different anchor groups. Each group received a different number from the wheel, and was determined to be a high or low anchor group. For example, a high anchor group received the number 65, and a low anchor group received the number 10. This design eliminates the possibility that individuals adjusted their estimates based on seeing multiple anchor conditions, thereby strengthening the validity of the observed effect. Although the participants were consciously aware that the number generated by the roulette wheel had no logical connection to the question, it significantly influenced participants' responses. For example, those exposed to a low anchor value of 10 gave a median estimate of 25 percent, while those who received a high anchor of 65 estimated the figure at 45 percent. This experiment demonstrates the excessive weight put on initial reference points under uncertainty and the presence of insufficient adjustments.

Beyond experimental tasks, anchoring has been shown to influence professional judgments in real-life settings. In a study by Northcraft and Neale (1987), both seasoned real estate agents and amateur undergraduate business students were asked to appraise a house using identical property information, but different listing prices. Using a between-subjects design, participants were randomly assigned to different listing price anchor conditions for actual residential properties in Tucson,

A [redacted] participants' valuation estimates were disproportionately influenced by the manipulated listing prices, illustrating the pervasive impact of anchoring even in information rich contexts.

In this context, the appraisal value refers to an expert's unbiased estimate of the property's fair market value based on objective analysis, while the listing price is the seller's asking price, which may be strategically set and can serve as an anchor for buyers' judgments. In the first experiment, the actual appraisal value of the property was $74,900. Listing prices were set at four levels: including the low anchor of $65,900 (12 percent below appraisal), and the high anchor of $83,900 (12 percent above). Among the amateur undergraduate business students, appraisal value estimates ranged from $63,571 under the low anchor condition to $72,196 under the high anchor condition. Selling price estimates similarly varied from $69,414 in the low anchor scenario to $78,014 in the high anchor scenario as the anchor increased. These differences were statistically significant. Professional real estate agents, tested under the low and high anchor conditions, showed comparable effects; their appraisal value estimates increased from approximately $67,811 to $75,190 between the low and high anchor conditions, with statistically significant differences.[16] These results show that both professional real estate agents and amateur students are considerably influenced by listing price anchors when estimating property values. Anchoring bias accounted for a substantial portion of the variation in their estimates and persisted even when anchors deviated notably from the true appraisal value.

Likewise, stock price levels can serve as anchoring points for investor expectations in financial markets. Kaustia *et al.* (2008) provides empirical evidence that both novice and professional investors are susceptible to anchoring when estimating long-term stock returns. Across three controlled experiments involving 300 Scandinavian financial professionals, the authors manipulated background information to examine how different anchors affected participants' return expectations. In the first experiment, professionals were divided into groups based on the information provided to them. One group was explicitly shown the historical average real stock market return of 4.5 percent per annum based on data from 1900 to 2000 in European countries (the disclosed group), while the other group was asked to estimate the historical return themselves before predicting future returns (the estimated group). Those who generated their own anchors predicted significantly higher future returns: on average, 8.05 percent, compared to 4.62 percent when the subjects were given the 4.5 percent return (the disclosed group). The overall findings demonstrate that anchoring, particularly on recent or salient returns, remains a powerful bias even in expert populations. Importantly, professionals with more experience showed reduced anchoring effects, but the bias was not eliminated. These results help explain persistent underreaction to new information and the reluctance of investors to revise beliefs or cut losses, particularly when recent highs serve as cognitive anchors for perceived fair value.

Building on the concept of anchoring in financial judgment, Loughran and Ritter (2002) examine how anchoring influences the perceptions of companies issuing initial public offerings, the first sale of a company's shares to the public. In IPOs, "leaving money on the table" refers to the difference between the offer price and the higher first-day closing price, multiplied by the shares sold, representing potential proceeds lost by issuers. This is calculated as $(P_m - P_f) \times$ quantity of shares sold, where P_f is the final offer price, and P_m is the market price at the close of the first trading day. The authors argue that issuers are influenced by anchoring when setting expectations. Specifically, they anchor on the

midpoint of the initial price range disclosed in the preliminary prospectus, where P_r is the midpoint of that initial estimated price range. Even though this range is only a rough early estimate, companies often treat P_r as a reference point for judging the IPO's success. If the final offer price P_f is above the midpoint anchor ($P_f > P_r$), issuers perceive the IPO as favorable, even if the stock trades much higher on the first day (P_m is significantly greater than P_f). This means that their satisfaction is driven more by how P_f compares to P_r, rather than by how much higher P_m is compared to P_f.

Because of this anchoring effect, issuers may feel they performed well, despite having underpriced the offering and left significant money on the table. Their mental benchmark (P_r) distorts their perception of loss, leading them to overlook the actual value investors were willing to pay. In essence, anchoring on P_r causes them to focus on the relative gain over an arbitrary reference point rather than the absolute shortfall in proceeds. Loughran and Ritter (2002) find empirical evidence that supports this view. IPOs priced above the initial range leave the most money on the table, averaging $23 million, but also yield the largest wealth gains, over $113 million, resulting in minimal dissatisfaction. This suggests that the anchoring effect can mask underpricing by making outcomes feel successful, even when more money could have been captured.

Across contexts ranging from professional appraisals and stock market predictions to IPO pricing, initial reference points exert strong influence over investor perceptions , even when those anchors are irrelevant to an asset's fundamental characteristics. As a result, investors may resist selling underperforming assets, underestimate changing market conditions, or evaluate outcomes relative to outdated benchmarks. Effective interventions must therefore replace unstable anchors with reference points that are aligned with investors' long term objectives.

5. Availability and Investor Attention

As defined by Tversky and Kahneman (1973), the availability heuristic is the process by which individuals "estimate frequency of classes or the probability of events by the ease with which instances or associations could be brought to mind" (Tversky and Kahneman, 1973, p. 207). Rather than relying on statistical data or base rates, people often base judgments on how quickly and vividly they can recall examples. Events that are recent or heavily publicized are more mentally accessible and therefore perceived as more common or more probable than they truly are.

An example of this heuristic manifested in 1975, when the release of the film *Jaws* dramatically altered public perception of shark attacks. Despite the extremely low statistical probability of encountering a shark, the sensational movie caused fear to spread rapidly. According to *Save Our Seas Foundation* (2019), while shark fishing tournaments already existed in the United States before the film's release, *Jaws* brought renewed publicity to these competitions and even helped popularize the sport of hunting so-called "trophy sharks." The public's reaction, however, was not driven by actual changes in shark behavior, but rather by how easily the terrifying imagery of a shark attack could be recalled.

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To test the effects of availability in a lab experiment, Tversky and Kahneman (1973) held an experiment in which 152 participants were asked questions regarding whether English contains more words that begin with a certain letter, or the letter in the third place. They tested this with five letters, one of which was 'K'. Results showed that 69% of participants believed words beginning with "K" were more

frequent, while only 31% correctly identified that more words have "K" in the third position. In reality, English contains approximately twice as many words with "K" as the third letter as it does with the first. The error was attributed to the fact that words are more easily recalled by their initial letter, making those examples more mentally accessible. This experiment illustrates a core mechanism of the availability heuristic. When judging frequency or probability, individuals rely on the ease with which examples come to mind, allowing for subjects easier to recall to be overestimated in frequency, leading to systematic biases in judgment.

This same cognitive shortcut can also influence complex decisions, such as those made in financial markets. A clear example comes from Gadarowski (2002), who examined whether recent press coverage of firms could predict future stock returns. Using data from about 1,500 U.S. nonfinancial firms between 1980 and 1994, the study found that firms with low book-to-market ratios (i.e., whose market values exceed their accounting, or book, values) and high recent press coverage earned about 10 percent lower annual returns over the following two years compared to similar firms with low news coverage. These firms are often considered "growth" firms because investors expect their future earnings and growth potential to be high, which typically leads to higher stock prices relative to their current net assets.

At first, these results might seem to fit rational explanations. For example, the investor recognition hypothesis suggests that firms with more visibility are better known and less risky, which should lead to lower expected returns. Other rational models argue that systematic risk (market-wide risk factors) or estimation risk (uncertainty about a firm's value) might justify lower returns for firms receiving more attention. In contrast to these theories, Gadarowski (2002) finds that lower returns were concentrated *specifically* in low book-to-market firms, and traditional measures of risk or analyst coverage did not explain the pattern. If visibility alone explained the results, the effect would be seen across more firms.

The significance of the effect being limited to low book-to-market firms suggests that behavioral biases like the availability heuristic play a stronger role where investor expectations about growth are already optimistic. These firms are more likely to attract attention because their high market valuations attract speculation about future performance. Investors' tendency to overreact to news and recent information is amplified in this group, causing prices to rise beyond justified levels. Value firms, which already trade at lower prices relative to their book values, are less prone to this kind of over-optimism and intense media focus, which may explain why the effect is not observed among them.

Gadarowski's evidence supports a behavioral explanation based on the availability heuristic. Firms that get more press coverage become easier for investors to recall and more mentally available. When it has become common practice to focus on firms that are seen as "good stocks" simply because they come to mind more readily, investors develop a bias toward buying companies with greater media exposure. Gadarowski (2002) argues that these firms are then more likely to be actively traded, fueling bubbles around those with seemingly strong prospects. Moreover, the study also showed that the effect was stronger after periods of strong economic growth, suggesting that optimism increases the bias.

Furthermore, a study by Kliger and Kudryavtsev (2010) goes on to specifically examine how the availability heuristic impacts investors' reactions to analyst recommendation revisions for individual stocks. Using a dataset of 2,746 analyst recommendation changes from 1,373 NYSE-listed firms over 2001–2006, the authors focus on how stock prices behave on the days these recommendations are announced (day 0) and the day before (day –1).

The authors distinguish between two forms of availability: outcome availability and risk availability. Outcome availability captures the ease with which investors can envision positive or negative investment outcomes. This is measured by contemporaneous market returns, serving as a proxy: when the overall market rises, positive outcomes become more available, amplifying responses to positive news such as analyst upgrades. Conversely, when the market declines, negative outcomes become more salient, intensifying reactions to downgrades. Risk availability refers to the prominence of financial risk in investors' minds, especially on days of large market moves or high volatility.

The study finds that stock price reactions to upgrades are stronger on days with positive returns, and reactions to downgrades are stronger on days with negative returns. Abnormal returns (ARs), which represent deviations of actual stock returns from expected market-based returns, quantify the magnitude of these reactions. For instance, on the event day (day 0), upgrades yield an average AR of +2.45%, while downgrades produce -2.38%, both highly significant. More specifically, the study demonstrates that upgrades on days with positive market returns register ARs of +2.82%, compared to +1.89% on negative market days, a significant difference of 0.93%. Downgrades on negative market days show ARs of -3.04%, versus -1.82% on positive market days, a significant difference of 1.22%. These findings illustrate that investors weigh outcomes more heavily when they are psychologically more available: positive market days increase the salience of gains, and negative market days the salience of losses. These effects are more pronounced for small-cap stocks, stocks with higher beta, or greater volatility, consistent with the notion that such stocks have less available information and are more susceptible to behavioral biases.

Similarly, the authors find that trading volumes also increase on days when market moves and analyst recommendations align, further highlighting the presence of the availability bias. In this study, abnormal trading volume (ABVOL) is derived by taking the actual trading volume on day 0 and comparing it to that stock's own typical volume before the event. The experiment finds that on day 0 of upgrades, ABVOL equals 1.91 when MRs are positive, versus 1.55 when MRs are negative. For downgrades, the ABVOL is 2.13 when MRs are negative versus 1.50 when MRs are positive, with all differences statistically significant. Since ABVOL is the standardized difference between the event-day volume and this historical average, a higher ABVOL means trading is unusually heavy relative to that stock's normal level. In both cases, trading volume was abnormally large when market returns aligned with analyst recommendations. As the authors explain, contemporaneous market returns make matching outcomes more salient and mentally accessible, drawing stronger investor reactions, exemplifying a response caused by the availability bias.

Even though the availability heuristic is a common influence in both financial and everyday decisions, research suggests that its effects can be mitigated through increased awareness. A study by Salas-Velasco (2024) demonstrates this point through a randomized controlled trial involving 538 senior business undergraduate students at a public university in southern Spain. Although Salas-Velasco

examines student loan decisions rather than investment behavior directly, it remains relevant as it demonstrates how the effects of availability can be reduced through targeted education. In the study, students were randomly assigned to three groups: a control group with no intervention, a financial education group that completed an online course covering personal financial management principles, and a third group that received the same education along with an additional module that explained the impact of the availability heuristic on their thinking. Participants in this final group were instructed to counteract this bias by relying on official, verified sources and expert advice to make better informed choices. Following the interventions, participants were presented with a hypothetical scenario in which they imagined pursuing a 12-month master's degree costing €30,000, with only 50 percent of the funds available and the remainder financed through a loan under realistic bank conditions. Objective labor market data on wages and employability were provided to counterbalance optimism bias, and participants assumed a full time study with maintained academic performance. Through statistical analysis, Salas-Velasco (2024) found that only the combined financial education and debiasing group showed statistically significant improvements, with the author determining a p-value of less than .05, indicating a less than five percent probability that these effects were due to chance.

This result highlights that awareness of the availability heuristic through explicit education removes its influence by instead encouraging evidence-based decisions. The author found that the debiasing group even showed more positive attitudes toward student loan borrowing, enhanced perceptions of social approval, greater financial self efficacy, and stronger borrowing intentions. Even in real world scenarios, financial education needs to be accompanied by heuristic awareness to motivate the most rational decision making.

In sum, studies of availability find that individual perception is often shaped more by mental accessibility than by objective data. Tversky and Kahneman (1973) establish the mechanism of availability, Gadarowski (2002) and Kliger and Kudryavtsev (2010) demonstrate its effects on stock returns and trading behavior. However, Salas-Velasco (2024) demonstrates that targeted education can meaningfully reduce its influence. The studies reviewed suggest that availability primarily distorts investor attention, causing them to overweight information that is recent and heavily publicized while underweighting less salient but relevant empirical data. Accordingly, corrective interventions should not only provide investors with broader contextual information, but also incorporate educational prompts that increase awareness of the availability heuristic itself (Salas-Velasco, 2024).

6. Compounding Effects: How the Three Biases Interact

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rather, they combine to form the basis for a chain of cognitive errors which can further influence investment decisions. Anchoring frequently serves as the starting point of this process. Investors often become attached to a numerical anchor, for example, a purchase price or a recent market high using it as a reference point for evaluating future outcomes. When the value of an asset falls below that reference point, the decline is perceived as a loss, triggering loss aversion and increasing the investor's reluctance to sell the asset despite evidence that doing so may be beneficial. The availability heuristic can further intensify this effect. During periods of market volatility, highly publicized news stories and recent price movements become especially salient and easy to recall. As a result, investors may place excessive weight on these readily available pieces of information, reinforcing their existing anchors and amplifying the emotional impact of perceived losses. For example, an investor anchored to a stock's previous high price may become even more reluctant to sell after repeated exposure to news emphasizing recent market declines or uncertainty.

These three biases are uniquely suited for a unified intervention because they map directly onto the distinct stages of financial decision making: valuation, information processing, and emotional execution. Anchoring establishes the flawed baseline value an investor fixates on, the availability heuristic serves as the environmental catalyst by using salient media headlines to reinforce that anchor, and loss aversion dictates the irrational behavioral response when an asset drops below the established baseline. Because these biases operate as an intertwined psychological loop, attempting to address them through separate interventions would create a fragmented user experience that fails to disrupt their compounding effects. Addressing all three biases within a single platform ensures that the corrective mechanisms actively reinforce one another, covering the entire lifecycle of an investment decision without cluttering the digital interface.

Commented [8]: edited paragraph to be more clear on how the biases reinforce eachother

Commented [9]: added paragraph to explain why all three biases should be addressed together in one platform

7. Proposed Solution

Investor decisions are rarely made in a vacuum; they are shaped by the interaction of psychological tendencies that push people toward short term, emotionally packed reactions rather than long term strategy. The previous three sections of this paper have shown that loss aversion, anchoring, and availability often reinforce each other, creating a cycle where fear of loss, false reference points, and attention to headlines drive poor trades. The purpose of this section is to formulate an effective solution that could confront these biases together through "nudges", structuring the investment process to redirect investors toward disciplined behavior.

Nudges are deliberate design choices that steer individuals toward better decisions while preserving freedom of choice. In their book *Nudge*, Thaler and Sunstein (2021) propose libertarian paternalism as an ideal approach, combining libertarianism, which preserves freedom of choice, with paternalism, the nudge that helps individuals act in ways that improve their own lives, as defined by them. Nudges guide people toward the choices they would make if they had perfect information, attention, and no influence from cognitive biases. Effective nudges use tools such as defaults and strategically placed options that redirect biases and, in turn, make desirable behaviors more salient. This section proposes a design of an app that could help mitigate the impact of common behavioral biases in investing, allowing consumers to make informed decisions and avoid heuristic-induced losses. This digital application embeds structured decision tools directly into an investor's digital workflow, allowing for efficient use while addressing loss aversion, anchoring, and availability in an accessible experience.

To maximize its impact, the platform operates at the intersection of three distinct behavioral interventions: nudging, debiasing, and education. Though often conflated, these concepts tackle behavioral modification through different mechanisms.A nudge involves the manipulation of choice architecture in decision making without limiting choices or changing economic incentives. Debiasing is concerned with the cognitive process as the aim is to minimize the bias so that the investor analyzes the facts objectively. On the other hand, education seeks to help in judgment in the long term by giving the information needed for making independent decisions. The platform utilizes a combination of these three mechanisms to tackle investor biases .

Commented [10]: added to clarify the difference between nudging, debiasing, and education, and to state how the platform employs a combination of these mechanisms

To address loss aversion and anchoring, the platform would incorporate a rule based portfolio management feature designed as a behavioral nudge consistent with Thaler and Sunstein's (2021) libertarian paternalism framework. Users would be invited to first create a personalized Investment Policy Statement, setting objectives, target asset allocations, and a preferred rebalancing strategy, either on a fixed schedule or when allocations drift beyond percentage thresholds. The feature monitors the portfolio and delivers timely alerts, such as: "*Your equity allocation has grown seven percent above your target. Your IPS recommends rebalancing. Would you like to review now?*" Importantly, this prompt would present rebalancing as a recommendation rather than a mandate, aiming to ensure that investors retain full control over their decisions.

As previously mentioned, loss aversion causes investors to hold losing positions too long, leading to unnecessary losses.[5] This feature directly aims to combat loss aversion by channeling the anchoring heuristic; when the IPS feature allows them to anchor to their own preset threshold, investors will not feel compelled to sell a stock irrationally. This nudge approach not only aims to encourage investors to align their investment strategy with their long-term target but also could prevent them from succumbing to loss aversion during market volatility. To illustrate this feature, consider an investor who begins with a conservative Investment Policy Statement, setting a 40 percent equity and 60 percent bond allocation, with a rule to rebalance when any asset class shifts more than 4 percent from target. During a market downturn, the app alerts the investor that equities have fallen to 35 percent. Left unaided, they might hesitate to buy more stocks, anchored to recent losses and constrained by loss aversion. The platform reframes the decision by reminding them of their original plan: "Your IPS indicates a 40 percent equity target. Rebalancing is recommended." Establishing rebalancing as the default option through careful wording aims to make investors more likely to adopt it. Additional educational information on the impact of loss aversion on portfolio diversification would also be available upon clicking on this alert. This prompt is designed to shift the anchor point from short term price movements back to their pre-set long term goals, helping the investor anchor to their own strategy rather than to market volatility.

Furthermore, to address investor's unwillingness to diversify, the platform could present globally diversified model portfolios during onboarding and explain the historical benefits of diversification. Once the investor selects a target allocation, rebalancing notifications help maintain that diversified portfolio despite future discomfort with foreign assets. This feature is designed to intervene at the point when investors establish their initial portfolio strategy, before loss aversion can discourage exposure to unfamiliar foreign assets. By providing diversification as a structured default option rather than requiring investors to independently seek out international investments, the platform is

designed to reduce the influence of perceived loss risk associated with unfamiliar markets. Once an investor selects a target allocation, the Investment Policy Statement records this commitment and rebalancing notifications help maintain the chosen level of diversification over time. As market conditions change, investors may become reluctant to add to foreign holdings after periods of underperformance or heightened uncertainty. By framing portfolio adjustments as adherence to a previously selected strategy rather than a new investment decision, the platform could reduce the tendency to avoid foreign assets due to anticipated losses. For example, an investor creating an account may initially prefer a portfolio consisting entirely of U.S. stocks because foreign markets feel less familiar and therefore more risky. The platform could instead present a model portfolio containing 70 percent U.S. equities and 30 percent international equities, accompanied by visualizations showing how diversification has historically reduced the impact of downturns in any single country. After selecting this allocation, the investor's Investment Policy Statement records it as a long term objective. Suppose that several months later international stocks experience a period of underperformance and the allocation falls from 30 percent to 25 percent. Without intervention, the investor may hesitate to purchase additional foreign equities because recent losses make further investment feel risky. Rather than asking the investor whether they would like to buy more international stocks, the platform would issue a notification stating that the portfolio has drifted from its target allocation and that rebalancing is recommended. By framing the action as restoring a previously chosen strategy, the platform could reduce the influence of loss aversion and help preserve diversification over time.

These approaches parallel the *Save More Tomorrow* (SMarT) program by Thaler & Benartzi (2004), a field-based behavioral intervention designed to increase employee retirement savings. In SMarT, employees pre-commit to gradually increase savings rates automatically with future pay raises, by using loss aversion and anchoring. Specifically, the program asks employees to commit in advance to increasing their savings rates only when they receive future pay raises, rather than immediately reducing their take-home pay. This design anchors savings increases to anticipated salary increments, making the higher contribution feel psychologically linked to a gain rather than a loss. By tying contributions to raises, the program leverages the "money illusion," where individuals perceive nominal increases positively and are less sensitive to corresponding increases in savings deductions. Thus, employees do not experience a perceived reduction in their disposable income, which significantly diminishes the painful impact of loss aversion. Empirical evidence from the first SMarT implementation reveals that 78% of eligible employees chose to join the program, with 80% of them remaining enrolled through four annual salary raises, and average savings rates increased from 3.5% to 13.6% over roughly 40 months.

Likewise, to mitigate availability bias, the platform changes how information is displayed. Instead of focusing solely on recent price changes or breaking news like popular financial trading platforms, the interface includes long-term return distributions, historical drawdowns, and volatility patterns alongside current data. A study by Schwarz *et al.* (1991) shows that availability plays a role in participants' self-evaluation of their assertiveness. However, researchers also found that the introduction of an external element, like meditation music, was an effective method to reduce participants' tendency to overly rely on ease of recall, reducing the impact of the availability bias. By attributing the difficulty of recall to the music rather than to themselves, participants no longer relied

on their subjective feeling of ease when evaluating their own assertiveness. When the ease of recall was made "diagnostically irrelevant," participants were forced to base their judgments on the actual content of their examples.

Similarly, the platform includes a media salience score, which flags when a stock is receiving unusually high or low coverage relative to its historical baseline. This feature contrasts the structure of today's most popular trading interfaces, where recent news headlines appear prominently on a firm's profile, making them especially salient in investors' minds. The presence of a media salience score could allow investors to consider whether media coverage is driven by strong fundamentals or short-term hype, removing the tendency to make judgments solely based on salient information. For instance, a "high" score displayed next to the stock name would signal a sudden surge in media attention, while a "low" score would suggest a decline in coverage. Next, a pop up placed next to the stock would educate investors on the availability heuristic. This feature follows the approach by Salas-Velasco (2024), which finds that increasing awareness and providing targeted education can significantly reduce the heuristic's impact and promote more efficient investment decisions.

In this proposed platform, anchored thresholds and pre-set rules aim to address loss aversion and anchoring, while contextual displays and salience indicators are designed to counter the effects of availability bias. The use of behavioral nudges allows investors to redirect their biases to support their individual long term goals, helping investors act more rationally in complex, changing markets, where uncertainty is inevitable. However, this approach also raises important limitations, including the risk of overreliance on automated systems leading to the potential overautomation of investment decisions. Additionally, further research is needed to determine the extent of tasks that AI systems can reliably perform within this framework and to ensure that such systems do not inadvertently replicate or amplify the same cognitive biases they are designed to mitigate.

Future research could evaluate the platform through a randomized controlled experiment involving approximately 200 retail investors between the ages of 18 and 30 with more than six months of prior investing experience. Participants would be randomly assigned to either a standard brokerage interface or the proposed nudge-based platform. After completing a brief onboarding exercise, participants would engage in a series of simulated investment decisions involving portfolio rebalancing, international diversification, and responses to highly publicized stocks. The simulation would be structured around three controlled scenarios, each corresponding to one of the behavioral biases identified in this paper: a market downturn intended to activate loss aversion, a price history condition designed to induce anchoring, and a high visibility stock scenario aimed at triggering availability bias.

The effectiveness of the platform could then be evaluated by comparing investment behavior between participants using the intervention and those using a standard brokerage interface. This evaluation would focus on three primary measurable outcome variables: trading frequency, portfolio diversification, and rebalancing behavior. Specifically, trading frequency would be measured by counting the total number of buy and sell orders placed by each participant during the simulation. Portfolio diversification would be tracked by measuring the percentage of the portfolio invested in a single stock compared to the amount spread across global assets. Finally, rebalancing behavior would

be measured by calculating the difference between the investor's actual asset mix and their original target goals.

Commented [11]: added specific metrics that could be measured to test platform success

Beyond these behavioral metrics, post experiment surveys could capture participants' self assessments of their investment decisions and perceived risk. Regression analysis could also be employed to control for variation in financial literacy, prior investing experience, and individual risk tolerance. Such a design would allow researchers to determine whether the proposed nudges meaningfully improve investment decision making relative to a standard investing interface.

Cognitive Bias	**Investor Error Caused By Bias**	**Nudge Mechanism Within Proposed Platform**
Loss aversion	Reluctance to realize losses and avoidance of portfolio diversification due to uncertainty	During onboarding, investors are presented with globally diversified model portfolios and visualizations demonstrating the benefits of diversification. Once a target allocation is selected, it is recorded in an Investment Policy Statement (IPS). When allocations drift from their targets, the platform issues rebalancing notifications that frame adjustments as adherence to a previously chosen strategy rather than a new investment decision, reframing what would be otherwise perceived by investors as a painful loss into an opportunity for redirection.
Anchoring	Reliance on purchase prices or recent market values as reference points, leading to distorted evaluation of performance	The IPS prominently displays target asset allocations and predefined rebalancing thresholds on the fintech interface. Portfolio alerts reference these targets rather than recent price movements, encouraging investors to evaluate performance relative to long-term objectives instead of short-term market fluctuations.

Availability	Overweighting of recent, vivid, or highly publicized information in investment decisions, leading to overreaction to short-term news	Alongside current market information, the interface displays long-term return distributions, historical drawdowns, and volatility ranges generated from historical market data. A media salience score appearing beside a stock's profile flags red when it is receiving unusually high attention relative to its historical baseline, while educational pop-ups explain how excessive media coverage can distort investment judgment. These nudges encourage investors to consider fundamentals over salient headlines when making decisions.

Table 1: Cognitive biases in investor decision making and the corresponding behavioral nudges embedded within the proposed investment platform design

7. Conclusion

The paper has argued that loss aversion, anchoring, and the availability heuristic collectively contribute to distortions in investor judgment. It has further demonstrated that these cognitive biases are systemic in nature, consistently influencing how investors perceive information, assess risk, and make portfolio decisions. At the same time, the findings suggest that the effects of these biases can be mitigated through targeted behavioral education and structured decision making frameworks.

These results therefore indicate that behavioral considerations are a crucial component in the design of financial technologies. As the evidence presented suggests, investor behavior is predictably shaped by cognitive biases; accordingly, fintech tools that assume fully rational decision making are unlikely to operate optimally in real world contexts. This implies that nudges and other behavioral design mechanisms should be incorporated into financial applications to support more disciplined decision making while preserving user autonomy.

One of the main limitations of this study is that the proposed platform has not been empirically validated and therefore requires further evaluation regarding its effectiveness in influencing decision making and its broader implications in real world financial environments. To address this limitation, the paper proposes a randomized experimental design that could be used to evaluate whether the platform's nudges improve investment decisions relative to a standard brokerage interface. Future research should implement and test this framework to determine the extent to which behavioral interventions can reduce the influence of cognitive biases in practice.

Commented [12]: added to clarify the theoretical nature of the proposed platform and to acknowledge the proposed effectiveness testing method

Moreover, the development of the above mentioned model into an actual platform involves risks which require careful design. The use of constant, automated prompts can actually contribute to the formation of user dependency, making users rely solely on the system's suggestions without developing any financial literacy. In addition to this, due to the fact that the platform will have to observe the portfolio information and users' behavior in order to apply the intervention techniques, ample concerns related to data security may emerge. Moreover, there is a possibility of placing too much friction on the user since, in case the nudges or behavioral prompts are not well designed, they can trigger alert fatigue, leading the users to simply ignore the notifications or to leave the platform and switch to another one with a more user friendly interface.

Commented [13]: added to acknowledge the potential risks of using the platform, and risks inherent within the platform design

Furthermore, several of the behavioral interventions informing the platform are supported by evidence from related decision making contexts, including real estate valuation, retirement savings, and student loan decisions, rather than retail investing directly. Although the underlying cognitive mechanisms are well established and their application to retail investing is theoretically plausible, the effectiveness of transferring these interventions to investment platforms has not yet been fully established through direct empirical testing.

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Acknowledgements

I would like to express my sincere gratitude to my research mentor, [redacted] for his support and guidance throughout the research process. His insightful feedback and thoughtful encouragement greatly shaped the development of this paper.

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[redacted] is a student researcher with a strong passion for economics and finance. In college, she hopes to pursue finance and business-related majors to further explore how financial ideas are reflected in real-world markets and consumer decisions.

Mentor Contribution Statement

[redacted] was very supportive during the writing of this research paper. He helped me assess the validity and reliability of the sources used, gave recommendations on readings that would further solidify the foundation of my research, and provided comments that guided my work towards a more focused direction. His mentoring enabled me to do independent research and analysis on this topic.