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Affect and Financial Decision-Making: How Neuroscience Can Inform Market Participants

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We review recent neuroscience literature on the influences of moods, attitudes, and emotions (affects) on financial decision-making. Evidence indicates the existence of separate brain systems, linked to affect processing, that are responsible for risk-taking and risk-avoiding behaviors in financial settings. Excessive activation or suppression of either system can lead to errors in investment choices and trading behaviors. We suggest ways for market participants to become aware of the potential impact of affect on their behavior in order to avoid suboptimal financial decisions. This paper has two overall aims: to educate financial practitioners about the origins of emotions that can adversely impact their performance, and to teach investors how to make better financial decisions.

keywords: *Affect, Finance, Markets, Neuroscience, Decision*

Introduction

Recent financial research has shown that individual investors systematically deviate from optimal trading behavior (Daniel, Hirshleifer, and Teoh [2002], Hirshleifer [2001], Odean and Barber [1998]). Some authors hypothesize that affect (emotions, moods, feelings, and attitudes) plays a prominent role in financial decision making (see Lo and Repin [2002] and Lucey and Dowling [2005] for an excellent review). However, the mechanisms by which affect influences choice remain unclear.[1]

In this paper, we review the finance literature and assemble evidence that affect states influence both investor behavior and market prices. Using recent findings from neuroscience, we describe the neurological basis of affective influences on financial decisions. In light of these new findings, we instruct readers how to manage disruptive affects as they arise in order to improve the quality of their financial choices.

To begin, consider the following paradox: Why do people buy both insurance and lottery tickets? Insurance, which insulates us from unanticipated financial losses, is an investment with negative expected returns. Buying lottery tickets is a gambling behavior that implies the acceptance of a negative expected return in the attempt to earn a larger gain. Ironically, we buy insurance to avoid potential losses, and we buy lottery tickets to pursue potential gains, yet both purchases represent small expected losses. To explain further, we offer an explanation derived from understanding the brain's affective and motivational circuits.

Affect is defined as the subjective and immediate experience of emotion attached to ideas or objects (Sadock [2000]). Affect often has outward manifestations, such as altering normal facial expressions, vocal tones, and physical posture. Positive affect indicates optimism, and the evaluation of a decision based on potential gain. Positive affect motivates us to continue pursuing a course of action. Negative affect indicates pessimism, and the evaluation of a decision based on potential loss. Negative affect motivates us to avoid activities or situations that prompt it.

Affect states give rise to characteristic cognitive and behavioral tendencies. Risk-related biases in financial judgment have been associated with affect and named the "affect heuristic" (Slovic et al. [2002], Finucane, Peters, and Slovic [2003]).

Since Aristotle, scientists and philosophers have loosely hypothesized that two major brain functions are fundamental to almost all human behavior: *reward approach* (pleasure-seeking), and *loss avoidance* (pain avoidance) (Spencer [1880]). These systems can be activated or deactivated independently. When we face potential financial gains or losses, one or both of these systems may be used in decision making.

Neuroscience helps us understand the characteristics of these motivational systems and their consequences for our behavior. We review recent empirical evidence that shows the direct link between brain activation specific to these systems, affective states, and financial decision making.

The paper is organized as follows. The second section discusses the components of the reward and loss

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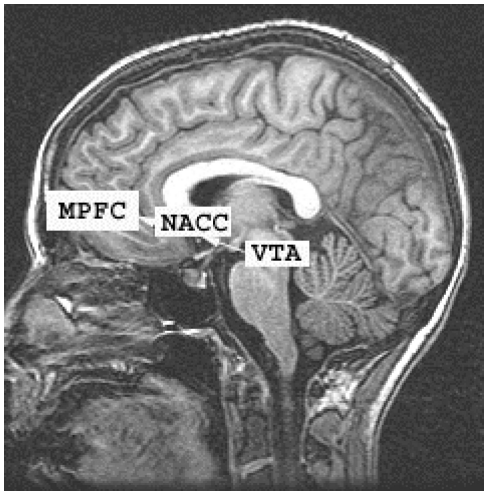
avoidance systems and defines affective states. The third and fourth sections survey empirical findings on the role of affect in financial markets and on trading behavior. The fifth section discusses some of the personal consequences of pathological disruptions in the functionality of these systems. The sixth section discusses the neurochemistry and genetics of risk assessment. The final section concludes, and proposes ways individuals can make better financial choices by taking into account the impact of affect on their decision making.

Reward and Loss Avoidance Systems in Decisions under Risk

Perceiving a potential reward in the environment sets the brain's *reward approach system* into action. Overall, the reward system coordinates the search for, evaluation of, and motivated pursuit of potential rewards. The neurons that carry information in the reward system transmit signals primarily via the neurotransmitter dopamine. The reward system lies along one of the five major dopamine pathways in the brain, the mesolimbic pathway, which extends from the ventral tegmental area (VTA) at the base of the brain, through the nucleus accumbens (NAcc) in the limbic system, to the gray matter of the frontal lobes (MPFC) (Bozarth [1994]) (see Figure 1).

Dopamine has historically been called the "pleasure" chemical of the brain. More recently, dopamine has been found to play a part in functions such as attention, mood, learning, motivation, and reward valuation and pursuit. People who are electrically stimulated in brain regions with high concentrations of dopamine terminals report intense feelings of well-being (Heath [1964]). In fact, the dopaminergic pathways of the reward system are activated by illicit drug use, hence the term "dope" to refer to street drugs. Dopamine activity in the reward system appears to correlate with subjective reports of positive affect (Knutson [2001b]).

FIGURE 1
The Major Structural Components of the Reward System. The dopamine neuron cell bodies located in the ventral tegmental area (VTA) have axonal extensions through the nucleus accumbens (NAcc) and into the frontal lobes, including the medial prefrontal cortex (MPFC).



The personality trait of extraversion is characterized by both reward-seeking and sociability (gregariousness). Neuroscience researchers like Cohen et al. [2005] have found that activation of the brain's reward system is positively correlated with extraversion scores. Cohen et al. [2005] also found that the presence of the dopamine D2 receptor A1 allele correlates with extraversion and the strength of reward system activation when receiving financial rewards.

The brain's *loss avoidance system* is less defined than the reward system. It runs through several regions of the brain's limbic system, in particular the amygdala and the anterior insula. Its activity is mediated by serotonin and norepinephrine (among other neurotransmitters), and can be modulated with antidepressant medication such as selective serotonin reuptake inhibitors (SSRIs). Acute activation of the loss avoidance system can lead to the subjective experience and physiological signs of anxiety (Bechara, Damasio, and Damasio [2000]).

Chronic activation of the loss avoidance system is indicated by the personality trait of neuroticism (Floury et al. [2004]), which is characterized by risk aversion. The prevalence of neuroticism has been weakly associated with the short form ("s"-allele) of the serotonin transporter gene, which leads to a decrease in serotonin sensitivity (Arnold, Zai, and Richter [2004]).

Amygdala activation appears to decrease when potential rewards are missed, showing an inverse correlation with punishment. The brain's insula is involved in the anticipation of aversive affective and noxious physical stimuli (Simmons et al. [2004]) and in selective disgust processing (Wright et al. [2004]). Paulus et al. [2003] show that insula activation is related to risk-averse decision making. They found that 1) insula activation was significantly stronger when subjects selected a "risky" response versus a "safe" response in an experimental task, 2) the degree of insula activation was related to the probability of selecting a "safe" response following a punished response, and 3) the degree of insula activation was related to subjects' degree of harm avoidance and neuroticism as measured by personality questionnaires.

Kuhnen and Knutson [2005] have demonstrated the roles of the reward and loss avoidance systems in portfolio choice and investment error. Their goals were to determine whether anticipatory brain activity in the NAcc and anterior insula would predict risk-seeking versus risk-averse choices, and whether acti-

vating these regions would influence both suboptimal and optimal choices.

Kuhnen and Knutson's [2005] study combined a dynamic investment task with functional magnetic resonance imaging (fMRI). Subjects' actual investment choices during the task were compared to those of a rational risk-neutral agent who maximized expected profit. Suboptimal choices were defined as deviations from this model, and included both "risk-seeking mistakes" (in which people take risks when they should not), and "risk-aversion mistakes" (in which people do not take risks when they should).

Kuhnen and Knutson [2005] found that while NAcc activation preceded both risky choices and risk-seeking mistakes, anterior insula activation preceded both riskless choices and risk aversion mistakes. These findings are consistent with the hypotheses that NAcc activation represents gain prediction (Knutson et al. [2001b]), while anterior insula activation represents loss prediction (Paulus et al. [2003]). The results indicate that anticipatory neural activation contributes to rational choice and may also promote irrational choice. Thus, financial decision-making requires recruiting distinct anticipatory mechanisms for taking or avoiding risks, while remembering that *excessive activation of one mechanism or the other may lead to mistakes*.

Overall, these findings suggest that risk-seeking choices (such as gambling at a casino) and risk-averse choices (such as buying insurance) may be driven by two distinct neural mechanisms involving the NAcc and the anterior insula. The findings are consistent with the notion that activation in the NAcc and the anterior insula relate to positive and negative anticipatory affective states, respectively. Activating one of these regions can lead to a shift in risk preferences. This may explain why casinos surround their guests with reward cues (i.e., inexpensive food, free liquor, surprise gifts, potential jackpot prizes). Anticipating rewards activates the NAcc, which may lead to an increase in risk-seeking behavior.

Affect in Market Pricing

Over the past five years, several finance studies have directly identified affective factors as likely causes of market price anomalies. Cloud cover, for example, has been used as a proxy for negative affect states (Schwartz [1983]). Hirshleifer and Shumway [2002] found that cloud cover in the city of a country's major stock exchange was negatively correlated with daily stock index returns in eighteen of twenty-six national exchanges from 1982–1997. In New York City, there was a 24.8% annual return for all sunny days, and an 8.7% average return for cloudy days. The authors cite psychology literature indicating that sunshine increases market participants' positive affect, and may thus collectively increase their willingness to accept risk.Kamstra, Kramer, and Levi [2001] find that stock returns are significantly related to season. They examine stock returns during the three months between the fall equinox and the winter solstice, and the three months between the winter solstice and the spring equinox. The authors found that variations in the length of day contribute to stock returns. In particular, the market underperformed in the fall quarter and outperformed in the spring quarter. They hypothesize that affective shifts, like the seasonal mood variations of seasonal affective disorder, can alter risk preferences and subsequent investment behavior.

Krivelyova and Robotti [2003] found correlations between strong geomagnetic storms and world stock market underperformance over the following six days. The authors noted that the psychology literature also demonstrates a correlation between geomagnetic storms and signs of depression in the general population over the two weeks following the storms. Depression is an affective disorder characterized, in part, by risk aversion.

Seasonal and meteorological factors may contribute to market price anomalies via collective changes in affect (and thus risk preferences). However, the nature of these effects is still debated. Goetzmann and Zhu [2002] analyzed trading accounts of 79,995 investors from 1991 to 1996, and found that individual investors do not trade differently on sunny days versus cloudy days. However, the authors did note that market maker behavior was significantly impacted by the degree of cloud cover. Wider bid/ask spreads on cloudy days were hypothesized to represent risk aversion among market makers.

If affect states do predict market price movements, how can we measure investors' average affect in order to predict market prices? In the finance literature, sentiment is the closest available measure. Both newsletter writers (Clarke and Statman [1998]) and individual investors (Fisher and Statman [2000]) show increased optimism about future stock market gains (bullishness) following high recent returns. Additionally, Fisher and Statman [2000] found that as the S&P 500 declined over a twelve-month period, investor optimism about the stock market's future also declined.

Fisher and Statman [2000] noted that the percentage of investors who believed the market was overvalued was paradoxically correlated with expectations of future returns from 1998 to 2001. When investors perceived the market as undervalued, they expected to earn lower returns. As sentiment became more optimistic or pessimistic in a positive feedback relationship with past price changes, so did expectations of future gains or losses. Additionally, sentiment levels appear to be negatively correlated with (and somewhat predictive of) future market price changes (Fisher and Statman [2001]).

Whether sentiment is a proxy for the activation of the reward system (bullishness) or the loss avoidance system (bearishness) remains unknown. Positive feelings (like optimism) are a proxy for reward system activation, and it is very likely that the brain's motivational systems are engaged when forecasting future stock market gains or losses.

Emotions and Personality in the Trading Pit

Several researchers have investigated the psychological origins of successful and unsuccessful trading. Quantifiable differences have been found between the personality traits and emotional reactions of successful versus less successful traders. Personality traits represent affective coping and impulse control strategies that differ from individual to individual. We previously discussed the personality trait neuroticism as a function of the loss avoidance system. The personality trait extraversion is correlated with optimism, an affect associated with reward system activation. Preliminary neuroscience evidence has suggested that extraverts have more sensitive reward systems during financial gain processing (Cohen et al. [2005]).

Lo and Repin [2002] took psychophysiological measurements from ten traders during real-time intraday trading and found that traders experienced physiological reactions during periods of market volatility. They also showed that less experienced traders had significantly greater physiological reactions to market volatility than their more experienced colleagues. The authors concluded, "Contrary to the common belief that emotions have no place in rational financial decision-making processes, physiological variables associated with the autonomic nervous system are highly correlated with market events even for highly experienced professional traders."

In a subsequent study, Lo, Repin, and Steenbarger [2005] examined the trading patterns, personality characteristics, and daily affective reactions of eighty traders over twenty-five trading days. Only thirty-three of the traders completed the study, in part because of a 20% market decline during the study period. The authors concluded that personality traits themselves are not important for trading. However, they did find a correlation between the strength of affective reactions and poor trading performance. They conclude, "Our results show that extreme emotional responses are apparently counterproductive from the perspective of trading performance."

The big five personality traits – extraversion, conscientiousness, neuroticism, openness, and agreeableness – are directly related to styles of affective processing and impulse control. Fenton-O'Creevy et al. [2004] conclude from a study of 118 professional traders at investment banks that successful traders tend to be emotionally stable, introverted, and open to new experiences.

Steenbarger [2003] performed personality tests on sixty-four traders at a seminar conducted by "Market Wizard" Linda Bradford Raschke. He found that high conscientiousness scores (a measure of impulse control) were the most reliable predictor of trading success, but that high openness and high neuroticism were correlated with trading problems. He summarizes these findings as "one important lesson: *Success in trading is related to the ability to stay consistent and plan-driven*." Emotional stability and impulse control tend to correlate with successful trading.

Financial Decisions and Mental Health

The neural origins of financial risk-taking can be partially understood by examining the underlying pathologies and treatments of individuals who exhibit disordered financial behavior. Some mental illnesses, as defined by the *Diagnostic and Statistical Manual IV-TR* (American Psychiatric Association [2000]), result in abnormal financial behavior. Brain lesions in the orbitofrontal cortex, a processing center of the reward system, have been found to result in specific abnormalities in financial decision making (Damasio [1994], Shiv et al. [2005]). Taken together, these findings shed some light on the fundamental mechanisms of financial decision making.

Acute mania is a pathological mood state typically characterized by euphoric mood and excessive risk-taking (including with money). Some manic patients who have access to brokerage accounts will rapidly trade stocks, often until the account is drained. One website notes that some manic patients "go on shopping sprees, spend food money to buy lotto tickets, or try to make a killing in the stock market" (Bernhardt [2005]).

Mania is caused by overactive dopaminergic circuits in the brain, including the mesolimbic circuit of the reward system. Treatments for mania include antipsychotic medications that directly block or limit the neural stimulation caused by dopamine release. But these treatments are often rejected by patients because they also dampen the euphoric high that accompanies an acute manic episode.

For another example, consider that the lifetime prevalence of pathological gambling disorder in the U.S. is less than 3.5% (American Psychiatric Association [2000]). Recent neuroimaging studies demonstrate a hypoactivity of the reward circuitry in these individuals. Pathological gamblers often gamble to "feel excitement," which they achieve by activating their pathologically desensitized reward circuits.

Pathological gambling is often treated with naltrexone (Kim et al. [2001]), a medicine that blocks opiate

receptors. In the reward system, mu opiate receptors stimulate dopamine release (Di Chiara and Imperato [1988]). Blocking opiate receptors with naltrexone decreases dopamine release in the nucleus accumbens, which results in decreased subjective feelings of pleasure (Jayaram-Lindstrom et al. [2004]). Gamblers taking naltrexone are not compelled to seek reward system stimulation through further gambling, possibly because they feel reduced pleasure from gambling.

Some subtypes of depression, such as "melancholic" depression, correlate with decreased dopamine activity in the reward pathway. Melancholic depression also correlates with anhedonia (lack of pleasure), excessive sleepiness, and chronic risk aversion, including in the financial markets.

One patient in treatment with this author for depression kept all her assets in cash. Because of her fear of financial risk, she was reluctant to invest in U.S. government bonds because she believed the government might default on payments. These thought distortions were directly related to her depressive illness and its neurochemical basis. Successful treatment with antidepressant medications was followed by small, tentative purchases of bonds and mutual funds.

The role of anxiety in biasing financial decisions is less clear-cut than for mania, pathological gambling, and depression. Pathological anxiety is characterized by exaggerated risk perception and hypervigilance. At higher levels, anxiety may lead to panic and the psychophysiological "fight or flight" response (e.g., "panic selling"). Whether the "fight" or the "flight" response is triggered depends on past experiences, personality traits, anxiety intensity, and learned coping strategies. Isolated mild anxiety leads to an overall reduction in risk-taking behaviors.

Anxiety can lead to either impulsive overtrading, or paralysis and avoidance of the markets. If the reward system is overactivated along with the loss avoidance system, obsessive overtrading may result. If the reward system is underactivated, paralysis and passive anxiety may occur. Mild anxiety and neuroticism correlate with a paucity of serotonin function throughout the brain (Floury et al. [2004]). These disorders are often successfully reversed with serotonin-enhancing medications like fluoxetine (Prozac).

Two mental disorders on the obsessive-compulsive spectrum merit discussion as well. First, compulsive shopping disorder is currently assumed to reside on the obsessive-compulsive/anxiety spectrum of disorders, but its legitimacy as an independent mental illness is still being debated. Moderately successful treatment has been achieved with the SSRI antidepressant (citalopram) (Bullock and Koran [2003]). Second, the disorder of hoarding, whereby sufferers accumulate excessive quantities of one type of good or asset, is also considered a subtype of obsessive-compulsive disorder. Only behavioral and psychotherapy approaches have shown success in treating hoarding (Saxena and Maidment [2004]).

The Neurochemistry of Risk Assessment

An article written by a psychiatrist in February 2000 was headlined "Is the Market on Prozac?" (Nesse [2000]). The article noted that prescriptions for psychoactive drugs increased from 131 million in 1988 to 233 million in 1998. The author went on to speculate, "I would not be surprised to learn that one in four large investors has used some kind of mood-altering drug." He also remarked that some of his patients on SSRI medications "report that they become far less cautious than they were before, worrying too little about real dangers." He wondered whether the clear disregard for risk among many investors at that time was partly attributable to the use of common antidepressant medications.

In fact, many executives are rumored to refer to Prozac as the "teflon-medicine," because it allows them to look past perceived threats, decide quickly without ruminating, and remain more optimistic during stress. In his bestselling book, *Listening to Prozac*, psychiatrist Peter Kramer [1993] frets about the potential use of SSRI antidepressants as "steroids for the business Olympics."

Knutson et al. [1998] gave normal subjects therapeutic doses of the antidepressant paroxetine (an SSRI). Knutson's subjects experienced a reduction in threat perception and an increase in affiliative behaviors. In another study, subjects given the SSRI medication citalopram showed decreased amygdala (fear-related) activations on fMRI (Del-Ben et al. [2005]). The characteristics of decreased threat perception and increased social affiliation mirror the decreased risk perception and herding of excessively bullish investors. It is as if bubble investors are experiencing a partial deactivation of their brains' loss avoidance systems.

In addition, amphetamines are known to increase the brain's extracellular concentration of dopamine. Neuroimaging data collected by Knutson et al. [2004] suggest that amphetamines modulate dopamine signals in the NAcc area of the reward system. Anecdotal reports indicate that time-release amphetamine-derived medications have been used by poker players to win millions of dollars in tournaments. "With Adderall [an amphetamine derivative] in my system, I am like an information sponge, able to process data from several players at once while considering my next action" (Phillips [2005]). The author speculates that the increased focus and wakefulness promoted by amphetamines aids poker playing.

Some medications directly alter risk/return perceptions in behavioral experiments. Rogers et al. [2004] report that a common high blood pressure medication

in the beta-blocker family decreased experimental subjects' discrimination of potential losses during a risky task. "Propranolol [a beta-blocker] produced a selective change in volunteers' decision-making; namely, it significantly reduced the discrimination between large and small possible losses when the probability of winning was relatively low and the probability of losing was high" (Rogers et al. [2004]). Propranolol is also one of the most common treatments for "stage fright," and is occasionally used to treat other types of anxiety and aggressive impulsivity.

Perhaps not surprisingly, other drugs have also been shown to affect financial decisions. Lane et al. [2005a] designed an experiment in which subjects were given a choice between a certain low-value positive expected value option ($0.01) or a zero expected value option with high return variability (the risky option). THC-intoxicated subjects preferred the risky option significantly more than control subjects who had been given a placebo. Additionally, if they lost money after selecting the risky option, THC-intoxicated subjects were significantly more likely to persist with it, while control subjects were more likely to move to the positive expected value option.

Lane et al. [2004] found a similar preference and persistence with the risky option in alcohol-intoxicated subjects when compared to controls. Deakin et al. [2004] showed that a dose of the benzodiazepine valium increased the number of points wagered in a risk-taking task in only those trials with the lowest odds of winning but the highest potential payoff. Lane et al. [2005b] found that administration of the benzodiazepine alprazolam produced increased selection of a risky option under laboratory conditions. The strength of subjects' risk-seeking personality traits may be predictive of how drugs affect their risk-taking behavior (Lane et al. [2005b]).

These studies illustrate that common chemical compounds can alter an individual's propensity for risk. In particular, frequently prescribed antidepressants and anxiolytics (SSRI medications) appear to decrease threat perception and increase social affiliation. Time-release amphetamines increase alertness and smooth the reward system's reactivity to potential financial gains. A common hypotensive medication (a beta-blocker) decreased aversion to potential financial losses. Findings regarding alcohol, marijuana, and benzodiazepines suggest these drugs increase risky financial decision-making.

How to Make Better Financial Choices

Trading Psychology

The use of psychological techniques to improve performance in the business world is increasing rapidly (Goleman [1998]). For example, according to Schwager [2003], Steve Cohen, the principal of SAC Capital, is "unquestionably one of the world's greatest traders." SAC Capital has a former Olympic psychiatrist, Ari Kiev, M.D., on staff to assist traders in improving performance. The use of a psychiatrist by one of the world's greatest traders certainly supports the notion that psychological management can benefit financial risk-takers. It may even suggest that people need psychological support to prevent themselves from succumbing to the most common cognitive, behavioral, and affective biases.

While observing Steve Cohen trade, Schwager [2003] is "struck by his casualness." Schwager notes, "He also seemed to maintain a constant sense of humor while trading." Cohen's sense of humor and casualness demonstrate that he isn't taking his trading gains and losses "to heart." So how can the average financial decision maker maintain such an emotional balance and healthy state of mind?

One method of cultivating dispassion about financial performance is to maintain non-judgmental beliefs and flexible expectations. In particular, practitioners must realize that not every decision requires absolute perfection or they will invariably be disappointed. George Soros [1995] provides an excellent example. Referring to his well-publicized philosophy, "belief in fallibility," he says, "To others, being wrong is a source of shame. To me, recognizing my mistakes is a source of pride. Once we realize that imperfect understanding is the human condition, there's no shame in being wrong, only in failing to correct our mistakes."

Soros is thus protected from a crisis of confidence. For most people, the possibility of being wrong is threatening and can cause anxiety. As Cymbalista [2003] notes, "The difference between Soros and most other traders is that he accepts fallibility, so he starts out by assuming his hypothesis is wrong, rather than right like almost everyone else." By maintaining a belief in fallibility, Soros remains open-minded about his positions, and can minimize denial, disappointment, and anger if he learns his decisions were wrong.

Investor, Heal Thyself

Financial practitioners can improve their financial decision making by learning to interpret and manage affect states. With adequate self-awareness, affect states can be viewed as internal signals. As seen from the examples we cite here, investors are most likely to make subpar financial decisions if they are emotionally reactive or have poor impulse control. In either case, a dysfunction of the reward or loss avoidance systems is likely to result. The affect states that can arise are conditioned by our past experiences, the vividness of the potential consequences, innate genetic endowments, and personality (among many other factors). As

demonstrated in Kuhnen and Knutson [2005], strong affects threaten to override rational decision making and should be appropriately managed for optimal performance.

In clinical psychology, there are a plethora of strategies for regulating affect states. Use of these strategies may benefit financial practitioners who find themselves overwhelmed by affect (fear, euphoria, greed, panic, etc. . .) during their investment decision-making.

The first step in managing affects is to become aware of them. Biais et al. [2000] found that "highly self-monitoring" traders perform better than their peers in an experimental market. While it is important to notice affect states, it is crucial to avoid placing any value judgment on them. Judgments such as "I shouldn't be feeling this" or "I'm really good at this" interfere with the exercise and give rise to further affective reactions (annoyance, disgust, anger, frustration, and self-congratulation, to name a few).

Some common causes of affective reactions among financial decision makers include the size of the potential reward or loss (Knutson et al. [2001b]), the vividness of potential consequences (Loewenstein et al. [2001]), and any counterfactual comparisons it represents (Mellers, Schwartz, and Ritov [1999]). Learn what financial situations cause affect to arise. Too often, affect is left unnoticed and unattended. Place the feelings in a context, and then practice noticing what automatic behaviors you associate with them.

Meditation, peaceful reflection, and contemplation are other disciplines that can be used to improve self-awareness. Financial practitioners should practice noticing the thoughts, feelings, and attitudes that underlie their decision-making. They can search for patterns, relationships, and emotionality, impulsivity, or irritability in these thoughts and feelings. In particular, when observing greed and fear, ask yourself: "What causes this? Where did it come from? What is it related to?" By placing the affective information in a personal context, you can become familiar with your "triggers" and use awareness of your emotional state to generate a personal warning signal. By understanding and contextualizing your emotions, you can more easily detect potentially weak decision situations when they arise.

Self-discipline, a facet of the personality trait conscientiousness, relates to impulse management. It is essential to interrupting the automatic flow among emotions, thoughts, and behaviors. Self-disciplined people are better able to control and channel their impulses toward goals. They can identify and delay acting upon their affects. To illustrate, we note that a survey of 600 foreign exchange traders in Europe and the U.K. by Oberlechner [2004] asked traders to rank the most important characteristics for professional success. From a list of twenty-three, "*disciplined cooperation*" ranked the highest.

Additionally, note that successful financial practitioners systematize as much of their decision-making as possible. Professionals are prepared for contingencies, and they approach mistakes with curiosity, rather than dread, fear, or denial. As Lo and Repin [2002] find, experienced professionals are less reactive to market volatility than novices, which may be due to a classical conditioning process or their internal beliefs.

The brain's two motivational systems evaluate potential gains and losses independently. We are likely to experience relatively strong affects when one system is dominant and are prone to making irrational financial decisions. Our only clue to a personal condition of imbalanced motivational systems lies in our affect states. If we learn to become self-aware, we can perceive when one system is out of balance. Self-awareness, cultivating a "belief in fallibility," exercising techniques of affect management, and visualizing and practicing difficult decision situations can all assist in minimizing the irrational and costly impact of financial emotions. We can take action and learn to be more profitable.

Conclusion

Based on the research we summarize here, it is apparent that recent financial gains and losses change investor behavior. Financial market participants need to monitor their own internal reactions to see how their decisions are biased by their recent experiences, and they must be careful not to let such biases affect decision discipline.

In particular, investors who have experienced a recent loss may note feelings of nervousness and/or other signs of irrational risk avoidance behavior like hesitation in entering new positions, excessive deliberation about further potential losses, and seeing more financial threats than usual. They must take special care not to let that anxiety affect future discipline in trading decisions.

Conversely, investors who have recently earned large gains may be feeling celebratory, extremely intelligent, or somewhat invincible. They must also make sure not to focus solely on potential returns and ignore the risk control and monitoring aspects required in making financial decisions.

Not everyone can maintain a disciplined investment strategy during the simultaneous gains or losses that accompany stock market fluctuations. Our research suggests that investors' undisciplined decisions may be biased in a way that furthers the development of bull and bear markets. When the stock market is rising and most people are experiencing paper gains, many feel hypomanic, they ignore risks, and they overemphasize potential returns. Consequently, the market risk premium tends to decline and stocks rise further, generating more upward movements in the bull market.

When the stock market is falling and most people are incurring paper losses, many become anxious, place more emphasis on the risky attributes of stocks, increase the risk premium they require to invest in stocks, and abstain from buying. This allows the decline in stock prices to continue and a bear market to persist.

Note

1. Other research has examined the potential role of emotion in decision-making (Bernheim and Rangel [2004], Camerer, Loewenstein, and Prelec [2005], Loewenstein et al. [2001]). Also, economists have begun to incorporate emotion into models of individual choice (Bernheim and Rangel [2004], Caplin and Leahy [2001]). This research, however, did not focus on financial choices.

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