Fear and Greed in Financial Markets: A Clinical Study of Day-Traders

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The rationality of financial markets has been one of the most hotly contested issues in the history of modern financial economics. Recent critics of the Efficient Markets Hypothesis argue that investors are generally irrational, exhibiting a number of predictable and financially ruinous biases, often attributed to psychological factors—fear, greed, and other emotional responses to price fluctuations and dramatic changes in an investor's wealth. However, recent research in the cognitive sciences and financial economics suggest an important link between rationality in decision-making and emotion (S. Grossberg and W. Gutowski, 1987; A. Damasio, 1994; Jon Elster, 1998; Lo, 1999; George Loewenstein, 2000; E. Peters and P. Slovic, 2000), implying that the two notions are not antithetical, but in fact complementary. For example, in a pilot study of 10 professional securities traders during live trading sessions, Lo and Repin (2002) present psychophysiolog-ical evidence that even the most seasoned trader exhibits significant emotional response, as measured by elevated levels of skin conductance and cardiovascular variables, during certain transient market events such as increased price volatility or intra-day breaks in trend. In a series of case studies, B. Steenbarger (2002) also presents evidence linking emotion with trading performance.

In this paper, we continue this research agenda by investigating the role of emotional mechanisms in financial decision-making using a different sample of subjects and a different method for gauging emotional response. In particular, we recruited 80 volunteers from a five-week on-line training program for day-traders offered by Linda Bradford Raschke, a well-known professional futures trader (see J. Schwager, 1994). Subjects were asked to fill out surveys that recorded their psychological profiles before and after their training program, and during the course of the program (involving live trading through their own personal accounts) subjects were asked to fill out surveys at the end of each trading day which were designed to measure their emotional state and their trading performance for that day.

The results from this experiment confirm and extend those of Lo and Repin (2002) and Steen-barger (2002): we find a clear link between emotional reactivity and trading performance as measured by normalized profits-and-losses (normalized by the standard deviation of daily profits-and-losses). Specifically, the survey data indicate that subjects whose emotional reactions to monetary gains and losses were more intense on both the positive and negative side exhibited significantly worse trading performance, implying a negative correlation between successful trading behavior and emotional reactivity. Also,

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contrary to common intuition regarding typical personality traits of professional traders, the psychological traits derived from a standardized personality inventory survey instrument do not reveal any specific "trader personality type" in our sample. This raises the possibility that different personality types may be able to function equally well as traders after proper instruction and practice. Alternatively, it may be the case that individual differences pertinent to trading success lie outside the domain of behavior that can be assessed through personality questionnaires and may become visible only at deeper physiological and neuropsychological levels, or with a larger or more homogeneous sample of traders. In statistical terms, our psychological instruments may not have sufficient power to distinguish between successful and unsuccessful trading personality-types, and a larger sample size or a more refined alternative hypothesis may yield a more powerful test.

I. Background and Literature Review

Risk-taking as an attribute or characteristic of personal preferences has been investigated extensively from both psychological and economic perspectives. Psychologists have asked whether risk propensity exists as a stable personality trait and how the tendency to take risks manifests itself across different domains of social and personal life. They have also attempted to determine a persistent connection between the biological basis of personality and risk-taking (D. Kuhlman and M. Zuckerman, 2000). Economists have put forward the notion of risk aversion, and considerable research has been devoted to parametrizing and estimating its value for individuals and for various demographic, social, and age groups. Unfortunately, neither psychologists nor economists have been particularly successful in these respective endeavors. In particular, no single psychological questionnaire predicts risk-taking behavior across multiple domains or explains why someone highly risk-averse in financial decision-making contexts would pursue extremely dangerous sports (N. Nicholson et al., 2002). Similarly, the scant differences in risk-aversion coefficients that financial advisors are able to collect from their clients seem to lose much of their value in the face of naive asset-allocation rules (dividing wealth equally among all available assets, or the so-called "$1/n$" heuristic) that Shlomo Benartzi and Richard H. Thaler (2001) have documented among individual investors.

These limitations suggest that risk-taking may be context-dependent, and that characterizing the context along some standardized dimensions may be a more productive line of inquiry. We propose two such dimensions: emotional or "affective" state, and personality traits, both of which can be measured by certain psychological survey instruments.

In various studies, risk preferences have been linked to the affective state of the subject and/or affective characteristics of the task. For example, more risk-taking is reported for negatively framed situations than for positively framed ones (S. Sitkin and L. Weingart, 1995; V. Mittal and W. Ross, 1998). When in a positive mood, people tend to be more risk-averse (A. Isen and N. Geva, 1987; Isen et al., 1988). When positive affect is induced, people report losses to be worse than when no affect is induced (Isen et al., 1988). When the affective state is manipulated through artificially generated outcome histories, a history of success leads to higher risk-taking in gambling experiments (Thaler and E. Johnson, 1990) and in assumed-role decision experiments (Sitkin and Weingart, 1995). In the specific context of real-time financial decision-making, Lo and Repin (2002) demonstrated a clear link between emotion and trading behavior using psychophysiological measurements (skin conductance, breathing rate, heart rate, blood volume pulse, and body temperature) for 10 professional traders during live trading sessions.

A more traditional method for measuring emotional response, and the method adopted in this study, is the University of Wales Institute of Science and Technology (UWIST) Mood Adjective Checklist (MACL), a survey instrument developed by G. Matthews et al. (1990) consisting of 42 adjectives that a subject must rate on a seven-point scale (1 = "not at all true" to 7 = "very true") as to how well each describes his or her mood at that moment. Examples of UWIST adjectives include: happy, pleased, content, miserable, troubled, sleepy, distressed, tired, bored, and serene (see Lo et al. [2005] for a more detailed exposition). The UWIST MACL measures the emotional state of the subject

along the lines of a two-dimensional affect representation, the affect circumplex model of J. A. Russell (1980): "valence," which indicates how pleasant or unpleasant the emotional state is; and "arousal," which characterizes how activated or deactivated the person experiencing the emotion feels. For example, feeling bored would imply a low-activation unpleasant emotional state, whereas feeling excited would imply a highly activated pleasant emotional state. The scores for eight categories that comprise different sectors in the affect circumplex are calculated based on UWIST MACL responses: (1) pleasant, (2) unpleasant, (3) activated, (4) deactivated, (5) pleasant activated, (6) pleasant deactivated, (7) unpleasant activated, and (8) unpleasant deactivated.

With respect to differences in personality among subjects, various assessment methods developed by social psychologists have been used to examine the relationships between specific personality traits and risk-taking in different domains. In particular, Nicholson et al. (2002) examine the relation between personality dimensions from a five-factor personality model and risk propensity in recreational, health, career, finance, safety, and social domains. In a study with more than 1,600 subjects, they use the NEO PI-R personality inventory of R. McCrae and P. Costa (1996), and find that sensation-seeking, which is a subscale of the Extraversion dimension, was found to be highly correlated with most risk-taking domains, while overall risk propensity was higher for subjects with higher Extraversion and Openness scores and lower for subjects with higher Neuroticism, Agreeableness, and Conscientiousness scores.

The five-factor model has been independently developed by several investigators (e.g., L. Goldberg, 1990, 1993; P. Costa and R. McCrae, 1992) and is currently the most widely accepted theory of personality traits; hence we adopt this measure in our study. In particular, we use the shorter (120-item) public-domain version developed by Goldberg (1999) called the International Personality Item Pool (IPIP) NEO instrument, which can typically be completed within 15–25 minutes. Responses from over 20,000 individuals have been used to calibrate this questionnaire (see Goldberg, 1999; International Personality Item Pool, 2001).

II. Experimental Protocol

For this study, we recruited participants from Linda Bradford Raschke's (LBR) five-week on-line training program for day-traders. The LBR training program was conducted through a series of online lessons and chat sessions conducted by Raschke and her colleagues. Each participant was expected to complete a daily set of specific paper-trades (i.e., hypothetical trades) but were also free to engage in actual trades through their personal accounts. The program was completely anonymous: all communication was done through anonymous e-mail addresses of the type tr1234@yahoo.com, where "tr1234" served as a unique identifier for each trader.

Volunteers for our study were recruited through an online announcement during one of the initial LBR training-program sessions. The subjects were told that a study independent of the LBR training would be conducted by the MIT Laboratory for Financial Engineering. All interested traders then received an e-mail inviting them to participate in the "Emotions and Personality in Trading" study and were promised personalized results after the completion of the study; no other incentives were provided. The timeline of the study and subject consent form were provided in the invitation e-mail. The study began on 7 July 2002 and was completed on 9 August 2002 for a total of 25 trading days.

Because our subjects were geographically dispersed throughout the United States, and because the duration of the study was several weeks, the most practical methods for assessing emotional state and psychological profile were online questionnaires. Therefore, we asked the participants to complete several survey instruments prior to, during each day of, and after the training program. Subjects filled out all questionnaires online at our web site, using their trading identifiers to obtain authorized access.

At the start of the training course, all participants in our study were asked to complete three questionnaires: (A1) an anxiety and depression survey, used to screen out subjects with clinical levels of depression and/or anxiety (no subjects were screened out on the basis of this instrument); (A2) the IPIP NEO personality inventory; and (A3) a general demographics survey

that includes basic background information for each subject such as age, trading experience, account size, and educational background. Each subject was also asked to report, as free-form text, his or her trading-related strengths and weaknesses.

At the end of each trading day during the duration of the training program, each subject was asked to complete two questionnaires: (B1) the UWIST Mood Adjective Checklist, for which the responses are then converted into the eight-category affect circumplex model of Russell (1980) to reduce estimation error (the score for each of the eight emotion categories is calculated as the sum of raw scores for individual mood adjectives in that category); and (B2) daily trading information including the total profit/loss on paper-trades, the total profit/loss on actual trades, and the number of actual trades for the day. In their daily routine, the subjects first reported their trading results followed by the emotional-state questionnaire. During the course of the study, the subjects were reminded several times that they had to fill out daily emotion and trading reports.

Finally, at the end of the five-week program, subjects were asked to complete two exit questionnaires: (C1) an Internality, Powerful Others, and Chance (IPC) survey to measure personality traits related to the locus of control (H. Levenson, 1972), which is a term from social psychology that reflects "a generalized expectancy pertaining to the connection between personal characteristics and/or actions and experienced outcomes" (see H. Lefcourt, 1991); and (C2) the same anxiety and depression surveys as in (A1) to check for any significant changes in their levels of anxiety and depression (no subject's score on either survey reached clinically relevant thresholds).

III. Results

During the course of our study, the U.S. stock market experienced a significant decline of over 20 percent (for example, from 20 June to 23 July 2002, the S&P 500 Index dropped from 1,006.29 to 797.70). Therefore, it was not surprising that a number of traders dropped out of our study, expressing their frustration with trading in general. Of the 80 participants who initially enrolled in our study, only 33 subjects

TABLE 1—SUMMARY STATISTICS FOR SUBJECT DEMOGRAPHIC PROFILES AND PERSONALITY TRAITS

Variable	Mean	SD	Median
Entire Sample:			
Extraversion	47.0	25.3	45.0
Agreeableness	35.0	31.1	26.0
Conscientiousness	44.6	29.3	41.0
Neuroticism	34.5	24.9	33.0
Openness	34.3	25.3	28.0
IPC-Internality	36.5	6.2	38.0
IPC-PowerfulOthers	8.7	5.7	8.0
IPC-Chance	8.5	5.7	8.0
Age	46.0	12.9	45.0
Experience (years)	5.9	8.1	3.0
Account Size ($)	$118,004	$269,748	$30,000
Three Years or Less of Experience:			
Extraversion	46.4	24.5	50.0
Agreeableness	21.8	24.5	11.0
Conscientiousness	40.7	26.7	40.0
Neuroticism	36.8	28.6	34.0
Openness	35.6	27.8	27.0
More Than Three Years of Experience:			
Extraversion	47.5	26.5	44.0
Agreeableness	48.7	31.7	54.5
Conscientiousness	48.7	31.7	43.5
Neuroticism	32.2	20.7	30.5
Openness	33.0	22.8	29.5

provided valid responses to the final questionnaires. In addition to demographic information, we asked traders to identify the main strengths, weaknesses, and mistakes in their trading. Table 1 provides a summary of the demographics and personality traits of our sample of 80 participants, each of whom acknowledged that he or she was engaged in high-frequency securities trading (i.e., day-trading) for his or her own personal account. The personality-profile data reflect raw scores for the five main scales of the IPIP NEO five-factor model, and the IPC scores reflect raw scores assessed through the IPC Locus of Control instrument. Account sizes varied from $200 to $1,800,000 with a mean of about $116,000 and a median of $35,000. Subjects' reported trading experience varied from virtually none to 44 years, with an average of 5.75 years and a median of three years. More than half of the subjects indicated that trading was their full-time occupation. When asked to rate their own trading performance, 20 subjects indicated that they "mostly break even"; for 16,

TABLE 2—SUMMARY STATISTICS FOR DAILY EMOTIONAL SCORES OF 69 SUBJECTS

Variable	Mean	SD	Median
Pleasant	7.86	2.71	8
Unpleasant	4.60	2.24	4
Activated	6.85	2.05	6
Deactivated	6.27	2.08	6
Unpleasant activated	14.65	5.52	13
Pleasant deactivated	12.84	4.30	13
Pleasant activated	27.47	7.04	28
Unpleasant deactivated	8.24	3.29	7

TABLE 3—CORRELATION MATRIX OF EMOTION CATEGORIES DERIVED FROM AGGREGATE EMOTION SCORES FOR 69 SUBJECTS OVER 25 TRADING DAYS

EC	Emotional category (EC)						
	P	U	A	D	UA	PD	PA
U	−45.0						
	***						
A	48.4	8.0					
	***	*					
D	37.6	6.1	29.6				
	***	†	***				
UA	−36.1	78.3	14.4	4.7			
	***	***	***	NS			
PD	72.8	−29.9	41.8	57.4	−33.4		
	***	***	***	***	***		
PA	73.4	−30.5	59.5	32.0	−24.6	64.0	
	***	***	***	***	***	***	
UD	−9.5	36.1	5.3	37.9	39.8	−4.8	−13.0
	**	***	NS	***	***	NS	NS

Notes: Correlations are reported as percentages. Key to emotional categories (EC): P, pleasant; U, unpleasant; A, activated; D, deactivated. The p values associated with each correlation are given on the second line in each cell (NS = not significant).

  † Statistically significant at the 10-percent level.
  * Statistically significant at the 5-percent level.
  ** Statistically significant at the 1-percent level.
  *** Statistically significant at the 0.01-percent level.

trading was "mostly profitable"; for 14, "mostly unprofitable"; for 10, "consistently profitable"; and for four subjects, trading was "consistently unprofitable." Among the 64 subjects who provided their demographics, 57 were males and seven were females, with ages ranging from 24 to 70 and a mean age of 45; 34 subjects were college-educated, 17 held graduate degrees, and 13 completed high school only.

A correlation analysis of trading performance and personality traits reveal that four out of the five major personality dimensions exhibit small negative correlation with self-reported and actual trading performance, with Extraversion exhibiting small positive correlation. However, none of these correlations is statistically significant. Older subjects tend to perform worse, or at least more of them report mostly or consistently unprofitable trading (−34 percent, $p < 1$ percent). Account size is positively correlated with better trading performance (31 percent, $p < 5$ percent). Women tend to trade less than men, while older subjects tend to trade less than younger subjects (all with $p < 10$ percent).

Table 2 contains summary statistics for the emotional scores of the 69 subjects who filled out daily UWIST and trading-performance questionnaires, yielding a total of 755 usable individual daily reports over the five-week period. Table 3 contains the correlation matrix for emotional categories, calculated with the raw scores for each emotional category across all days and all individuals. For those subjects who completed meaningful daily reports for three or more days, we computed the correlation coefficients between each emotion category and daily trading performance normalized by the standard deviation of daily profits-and-losses, reported in Table 4.

Table 3 shows that valence and arousal are related but do capture some independent characteristics. The highest correlations are between Unpleasant and Unpleasant Activated (78.3 percent) and Pleasant and Pleasant Activated (73.4 percent), underscoring the importance of valence as a common factor, but also demonstrating the fact that the correlation is not perfect, and hence, arousal is responsible for additional variation. As expected, Pleasant and Unpleasant are negatively correlated (−45.0 percent), and the only other two correlations greater than 50.0 percent in absolute value are between Pleasant Activated and Pleasant Deactivated (64.0 percent) and Activated and Pleasant Activated (59.5 percent).

Table 4 shows that normalized daily performance is highly positively correlated with Pleasant (37.5 percent, $p < 0.01$ percent) and highly negatively correlated with Unpleasant (−31.7 percent, $p < 0.01$ percent) emotional states, but not as highly correlated with the

TABLE 4—CORRELATION BETWEEN PROFITS-AND-LOSSES
AND EIGHT EMOTIONAL-CATEGORY SCORES FOR 69
SUBJECTS AND FOR THOSE IN THE TOP AND BOTTOM
CUMULATIVE PROFITS-AND-LOSSES TERCILES

Emotional category	Correlation with profits-and-losses		
	All traders	Top third	Bottom third
Pleasant	37.5 ***	32.4 ***	52.0 ***
Unpleasant	−31.7 ***	−39.3 ***	−46.2 ***
Activated	9.5 *	10.5 NS	4.5 NS
Deactivated	4.7 NS	−0.2 NS	9.8 NS
Pleasant activated	30.0 ***	19.1 *	36.0 ***
Unpleasant activated	−27.5 ***	−25.2 **	−44.4 ***
Pleasant deactivated	25.8 ***	22.1 **	42.5 ***
Unpleasant deactivated	−13.9 *	−17.4 *	−13.9 *

Notes: Correlations are reported as percentages. The *p* values associated with each correlation are given on the second line in each cell (NS = not significant).

    * Statistically significant at the 5-percent level.
    ** Statistically significant at the 1-percent level.
    *** Statistically significant at the 0.01-percent level.

Activated or Deactivated categories. When viewed from the valence/arousal standpoint, trading performance exhibits correlation with all four combinations of Pleasant/Unpleasant and Activated/Deactivated categories. Given the low correlations for the arousal categories, these higher correlations for the interacted categories may be attributed primarily to valence. A substantially smaller (but still statistically significant) correlation is observed for the trading performance of paper-trades for the Pleasant emotional category, suggesting that paper-trading provides some of the same emotional stimuli of live trading but is not a perfect simulacrum.

Table 4 also shows that, for traders in the top trading-performance tercile, the correlations between profits-and-losses and Pleasant and Unpleasant categories are lower than for the bottom tercile. This suggests that emotional re-

activity may be counterproductive for trading performance, but the differences are not large enough to render this conjecture conclusive. However, subjects whose emotional states exhibited higher correlations with their normalized daily profits-and-losses (Pleasant with gains, Unpleasant with losses), do tend to have worse overall profits-and-losses records, supporting the common wisdom that traders too emotionally affected by their daily profits-and-losses are, on average, less successful.

IV. Conclusions

The results of our study underscore the importance of emotional state for real-time trading decisions, extending previous findings in several significant ways. In particular, although Lo and Repin (2002) document significant emotional response among the most experienced traders, our results show that extreme emotional responses are apparently counterproductive from the perspective of trading performance.

Contrary to common folk wisdom that financial traders share a certain set of personality traits (e.g., aggressiveness or extraversion), we found little correlation between measured traits and trading performance. This may be due to a lack of power because of our small sample size and the heterogeneity of our subject pool. In a larger sample, or in a more homogeneous sample of professional traders, certain personality traits may become more pronounced.

These findings suggest that typical emotional responses may be too crude an evolutionary adaptation for purposes of "financial fitness," and as a result, one component of successful trading may be a reduced level of emotional reactivity. Given that trading is likely to involve higher brain functions such as logical reasoning, numerical computation, and long-term planning, our results are consistent with the current neuroscientific evidence that automatic emotional responses such as fear and greed (e.g., responses mediated by the amygdala) often trump more controlled or "higher-level" responses (e.g., responses mediated by the prefrontal cortex) (see Colin Camerer et al. [2005] for an excellent review of the neurosciences literature most relevant for economics and finance). To the extent that emotional reactions "short-circuit" more complex decision-making

faculties (e.g., those involved in the active management of a portfolio of securities), it should come as no surprise that the result is poorer trading performance.

Finally, the specific emotional context of an individual is also often influenced by external factors such as market events, family history, and even weather and other environmental conditions. Therefore, the fact that the amount of sunshine (D. Hirshleifer and T. Shumway, 2003), the duration of daylight (Mark J. Kamstra et al., 2003), and even geomagnetic activity (A. Krivelyova and C. Robotti, 2003) have been shown to affect stock-market prices may be indirect evidence that affective states are related to financial-market activity. This may provide yet another motivation for multi-factor asset-pricing models where certain common factors are affect-related.

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