RISK TAKING IN THE HEAT OF THE MOMENT: THE ROLE OF AFFECT AND PERFORMANCE

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Abstract

We examine the effects of human affect (pleasant or unpleasant feelings) and past outcomes (gains and losses) on risk-taking in a stock investment simulation in which 101 stock investors rated their feelings while simultaneously making investment decisions for twenty consecutive business days. We find that affect shifts individual's risk behavior: individuals experiencing pleasant feelings engaged in risk-taking after significant gains, while individuals experiencing unpleasant feelings avoided risk-taking after significant losses. Only after accounting for the joint effects of affect and past outcomes, do we find stronger relationships between past outcomes and risk taking.

Key words: Affect, Decision Making, Risk-taking, Prospect Theory

Managers and employees in organizations constantly make decisions that affect their individual and organizational outcomes. A fundamental challenge to these decision makers in organizations is that they often face situations that are too uncertain, ambiguous, and/or complex in nature to handle with their limited cognitive ability or resources (cf., March & Simon, 1958; Eisenhardt & Zbaracki, 1992; Wiltbank, Dew, Read & Sarasvathy, 2006). The challenge is not limited to the constraints in their 'cold' cognitions, as their 'hot' emotions that are also inseparable from their organizational experiences sometimes sway or overrule their decisions (cf., Loewenstein, Weber, Hsee & Welch, 2001; Peters & Slovic, 2000). However, we still have limited understanding of how organizational members make decisions in uncertain and complex environments and under the influence of their hot emotions.

For the last several decades, a great deal of research has been devoted to understanding how managers and employees make decisions when faced with uncertainty (see, Hastie and Dawes, 2001, and Bazerman, 2006, for reviews). A central argument in this long stream of research, which is based on both prospect theory (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992) and the behavioral theory of the firm (Cyert & March, 1992), is that managerial decisions are reference-dependent: individuals tend to avoid risks when experiencing gains or exceeding a reference point or aspiration level and seek risks when facing losses or performing below a reference point (cf., Sitkin & Pablo, 1992; Wiseman & Catanach, 1997; Greve, 2003; Baum, Rowley, Shipilov & Chuang, 2005). This patterned relationship between managerial risk taking and performance relative to a reference point has been supported by numerous studies in various empirical settings (e.g., Fiegenbaum & Thomas, 1988; Jegers, 1991; Lant, Milliken & Batra, 1992; Greve, 1998; Wiseman & & Gomez-Mejia, 1998; Audia, Locke & Smith, 2000; Chattopadhyay, Glick & Huber, 2001; Baum et al., 2005). For example, Greve

(1998) found that decisions to pursue organizational change, a highly risky activity, increased as performance discrepancies from an aspiration level increased.

However, some researchers also find mixed and sometimes contradictory findings (cf., Sitkin & Pablo, 1992; Wiseman & Catanach, 1997). For example, Wiseman and Bromiley (1996) found that performance-aspiration discrepancies reduced, but not increased, risk-taking among declining organizations. Similarly, Lant (1992) in her laboratory study showed a negative relationship between performance-aspiration discrepancy and risk taking. In addition, casual observation does not necessarily support such a patterned relationship. For example, the reduction of risk after gain and the increase of risk after losses, if true on aggregate, should suppress both market bubble or market depression. One explanation of these inconsistent findings is that the predicted relationship between risk taking and performance relative to a reference point has been oversimplified by leaving out important individual, organizational, or contextual factors (cf., Sitkin & Pablo, 1992; Wiseman & Catanach, 1997).

A growing body of research suggests that human affect[1] is one important individual-level factor that may affect both risk perception and risk choice (cf., Slovic, Finucane, Peters & MacGregor, 2002; Rottenstreich & Hsee, 2001; Shiv, Loewenstein, Bechara, Damasio & Damasio, 2005). Yet, scholars have explained the risk-performance relationship predominantly from a cognitive standpoint. In general, the prediction of increased risk after losses and the decreased risk after gains has been supported with an appeal to prospect theory, which indeed makes such predictions in some situations (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992). However, in many situations where decisions yield significant consequences to the decision makers' well-being and their organizations, risky choices are not just made in decision makers'

[1] We use affect as a broad and general term referring to various affective states including mood, a prolonged and diffused affective state associated with no particular object, and discrete emotions, intense prototypical affective experiences directed to certain objects such as anger and fear (cf., Russell, 2003; Forgas, 1995).

cool heads as implicitly assumed in prospect theory. Instead, they are often made in the presence of hot emotions. These hot emotions, in certain conditions, may systematically affect the risk-performance relationship by influencing risk choices and/or their underlying cognitive processes as recent evidence corroborates (e.g., Rottenstreich & Hsee, 2001; Raghunathan & Pham, 1999; Shah, Friedman & Kruglanski, 2002).

In this paper, we explore the role of affective experience and past performance in risk taking. Drawing upon both prospect theory and research on emotion, we develop specific hypotheses that predict decision making under risk as a function of (1) pleasant and unpleasant feelings that decision makers experience at the moment of decision making and (2) their experiences of gains and losses. We examined the predicted relationships in a 20-day stock investment simulation that closely mimicked real-world decision making under risk. Core-affect metrics (Barrett, 2004; Barrett & Russell, 1998; Feldman, 1995) were used to measure momentary feelings of pleasure and displeasure at several points in the decision making process. We observed at times, individuals maintaining risky positions after gains, and decreasing risk after losses. We demonstrate how considering the influences of decision makers' affective states can explain these results.

THE FRAMING EFFECT OF PAST PERFORMANCE ON RISK TAKING

Our starting point is prospect theory, which has been widely used to explain the relationship between risk taking and performance relative to a reference point (e.g., Fiegenbaum & Thomas, 1988; Jegers, 1991; Baum, et al., 2005). As illustrated in Figure 1, prospect theory suggests that past performance relative to a reference point, framed as either a gain or a loss, first goes through certain cognitive processes (path "a"), which in turn, may influence risk taking (arrow “b”). The cognitive processes are graphically represented by the two small diagrams in Figure 1. The first diagram (A) depicts the value function, while the weighting function is in the second diagram (B). The value function depicted in Figure 1 (A) suggests that the region to the left of the reference point, marked by “R,” represents loss and its value function is convex, while the region to the right represents gains and its value function is concave (*“S” shaped value function)*. The curvature of the function implies that individuals receive more benefit from, say, the first $100 of gain (loss) as opposed to the second $100 of gain (loss). The value functions are weighted by projected outcome probabilities reflected in Figure 1 (B), and these functions are more sensitive to changes in probability near the end points (sure chance or no chance) and less sensitive to changes in probability in the middle region (*endpoint sensitivity)*. [2] The over-weighting of low probability events may help explain, for example, why individuals play the lottery even though it has a negative net present value.

Insert Figures 1 about here

A central prediction derived from prospect theory is the framing effect - a phenomenon often referred to as preference reversal or frame dependent preference (e.g., Tversky & Kahneman, 1986). That is, at times individuals are risk averse when a decision is framed as a choice among gains and exhibit risk seeking when decisions are framed as choices among losses. This framing effect is derived from the shape of the utility function relative to the reference point (Figure 1 A). As performance exceeds a reference point (thus, a decision is framed as a choice among gains), the added utility by further increasing performance diminishes, which provides decision makers with less incentive to take risk. In contrast, performance below a reference point

[2] In Figure 1 (B), deviations from the diagonal represent systematic differences between the weights applied to particular probabilities and the probabilities themselves. The curve above the diagonal for the low-probability region reflects the over-weighting of low probability events, while the dip below the high-probability region reflects the under-weighting of high-probability events.

(thus, a decision is framed as a choice among losses) may foster risk seeking because the added utility by increasing performance dramatically increases in this region.

Strictly speaking, this can be predicted only when outcome probabilities are medium to high, such that the overweighting associated with low probability events does not overwhelm the effect eminating from the shape of the utility function. If it does, the prediction may go in the opposite direction (cf., Di Mauro & Maffioletti, 2004). Moreover, this prediction is directly applicable to certain decision making situations with known outcome probabilities. An important question is whether the same prediction is applicable to most organizational situations where the outcome probabilities are generally unknown, i.e., in cases of ambiguity. However, several authors have extended this prediction to situations of ambiguity and found evidence that the framing effect still provides accurate predictions of risk choices (Tversky & Kahneman 1992; Tversky & Fox 1995; Di Mauro & Maffioletti, 2004).

However, given the empirical support found in various managerial decision making contexts (e.g., Fiegenbaum & Thomas, 1988; Jegers, 1991; Lant, Milliken & Batra, 1992; Greve, 1998; Audia, Locke & Smith, 2000; Baum et al., 2005), we propose this predicted relationship between managerial risk taking and past performance relative to a reference point (gain and loss) as the baseline hypotheses of this study, upon which we further theorize how decision makers' affective experience may change this basic relationship:

Hypothesis 1-1: Risk taking will be negatively related to gain (performance above a reference point).

Hypothesis 1-2: Risk taking will be positively related to loss (performance below a reference point).

AFFECT, PROSPECTS, AND RISK TAKING

Recent theoretical and empirical advances in psychology and neurobiology suggest that human affect plays an important role in both risk perception and risk choice (e.g., Isen, 2000; Loewenstein et al., 2001; Rottenstreich & Hsee, 2001; Shiv et al., 2005; Raghunathan & Pham, 1999; Slovic et al., 2002). For example, Shiv and his colleagues (2005) recently found that in an experimental investment setting where expected gains are greater than expected losses, brain-damaged patients who cannot process affective information achieved better investment performance than control patients. The control patients, who could process affect normally, consistently avoided risk after either a gain or a loss. This study provides strong evidence that human affect is an important factor influencing risk taking.

An important question is whether human affect and its related `hot' processes alter the predictions of prospect theory, which suppose 'cold' (cognitive) processes. The literature on affect and decision making suggests two general mechanisms through which human affect can fundamentally influence both the cognitive processes underlying prospect theory and its predicted outcomes: (1) affect as an independent mediator and (2) affect as a cognitive tuner. Below, we explore both mechanisms and propose the related predictions as testable hypotheses. In doing so, we adopt the concept of core affect (Barrett, 2006a; Russell & Barrett, 1999; Russell, 2003) as our basic unit of analysis to understand the broad affect-related phenomena. In particular, we focus on one of the most basic and fundamental dimensions of core affect, pleasant versus unpleasant feelings (Barrett, 2006a; Barrett, 2006b; Russell, 2003; Russell & Barrett, 1999).

Affect as an Independent Mediator

As illustrated in Figure 1, the predictions of prospect theory (represented in arrows "a" and "b") will be suppressed or amplified if there is a third variable, affect, which systematically mediates the relationship between performance relative to a reference point (gain and loss) and risk taking (arrows "c" and "d" in Figure 1). The flip side is that the explanatory power of prospect theory will be enhanced by taking this third variable into account.

Core affect is characterized as the constant stream of transient alterations in an organism's neurophysiological state that represents its immediate relationship to the flow of changing events (Barrett, 2006a; Russell, 2003; Russell & Barrett, 1999). Pleasant and unpleasant feelings, as the most basic dimension of core affect, summarize how good-bad, positive-negative, or appetitive-aversive one is doing in relation to his or her current environment. Thus, any change in the environment that is meaningful to one's goal or wellbeing is likely to induce pleasant and/or unpleasant feelings, a positive change for pleasantness and a negative change for unpleasantness (Frijda, 1986; Lazarus, 1991; Ortony, Clore, & Collins, 1988).

Individuals' wealth is a fundamental element of one's personal environment. Therefore, changes in one's wealth position, framed as gains or losses, are likely to induce a range of pleasant or unpleasant feelings (arrow "c" in Figure 1). This corroborates a number of observations in our daily lives, such as the investment sections in most daily newspapers that are filled with emotion-laden language, Wall Street's wide spread belief that greed and fear drive the financial markets, and many anecdotal accounts that investors often experience strong feelings while engaging in their day-to-day investment activities (e.g., Babin & Donovan, 2000; Lo, 2002). Once induced, those pleasant and unpleasant feelings are likely to influence decision makers' choices in several distinctive ways (cf., Loewenstein et al., 2001; Seo, Barrett, and Bartunek, 2004).

First, an accumulating body of research suggests that affective feelings can influence individuals' choices and behaviors in a direct fashion (arrow "d" in Figure 1), without mediating (bypassing) cognitive processes (e.g., Damasio, 1994; 1999; LeDoux, 1996; Berridge & Winkielman, 2003) or by exercising a dominant power over conscious and/or cognitive processes (e.g., Brehm, 1999; Gray, 1999; Izard, 1993; Loewenstein et al., 2001; Raghunathan & Pham, 1999; Shah, Friedman & Kruglanski, 2002). For example, Winkielman and his colleagues (Winkielman, Zajonc & Schwarz, 1997) found that affectively charged responses in liking ratings and drinking behavior were produced when participants were affectively primed through mere exposure to a stimulus presented for 1/250 of a second, an interval so short that there is no conscious recognition of the stimulus. Loewenstein and his colleagues (2001) also argue in their "risk-as-feelings" framework that affective reactions to situations under risk often diverge from cognitive assessments of those risks. Moreover, affective reactions can exercise a dominant influence over risk choices.

Therefore, it is possible that affective state at the moment of decision making has a direct and additive (main) effect on risk choices in the sense that the choice process completely bi-passes conscious cognitive information processing in the brain. When it occurs, the choice orientations and/or action tendencies inherent in the hedonic quality of experienced affective state (e.g., Gray, 1999; Raghunathan & Pham, 1999; Shah, Friedman & Kruglanski, 2002) are like to drive the direction of individuals' risk preference (cf., Peters & Slovic, 2000). More specifically, pleasant and unpleasant feeling states include their own inherent action tendencies of moving toward or away from (e.g., Frijda, 1987) and behavioral predispositions to approach or avoid (e.g., Cacioppo, Gardner & Berntson, 1999; Bargh & Chartrand, 1999). Thus, we hypothesize that decision makers experiencing pleasant affective feelings will focus more on obtaining possible positive outcomes, which will lead to greater risk taking. In contrast, unpleasant feelings may lead them to focus more on avoiding possible negative outcomes in making their choices, which will lead to greater risk avoidance:

Hypothesis 2-1: Pleasant feelings experienced at the moment of decision making will be positively related to risk taking.

Hypothesis 2-2: Unpleasant feelings experienced at the moment of decision making will be negatively related to risk taking.

Affect as a Cognitive Tuner

A considerable body of literature suggests that affective states extensively influence cognitive processes involved in decision making, including memory (e.g., Erber, 1991; LeDoux, 1993; Meyer, Gayle, Meeham, & Harman, 1990) and judgments (e.g., Johnson & Tversky, 1983; Meyer, Gaschke, Braverman & Evans, 1992; see Forgas, 1995 and Schwarz and Clore, 2003, for reviewers). This body of research points to another possible mechanism through which affective feelings can influence risk taking, that is, via its effect on the cognitive processes underlying prospect theory (arrow "e" in Figure 1). In this case, affective feelings may moderate the effects of gain-loss frames on risk taking in certain ways.

Several scholars have recently explored this possibility and suggest two ways through which affective feelings experienced at the moment of decision making might influence the cognitive processes that underlie prospect theory (e.g., Rottenstreich & Hsee, 2001; Trepel, Fox, & Poldrack, 2005; Loewenstein et al., 2001). First, decision makers' affective states may influence their subjective probability distribution of possible gains and losses and/or risk perception itself in a given situation (e.g., Loewenstein et al., 2001; Slovic et al., 2002; Finucane et al., 2000). For example, scholars have found a general effect known as mood congruence judgment (e.g., Meyer et al., 1992), that is, people experiencing pleasant feelings tend to believe that there are higher chances of occurrence of positive events or outcomes (e.g., Wegener & Petty, 1996), whereas those in unpleasant affective states make higher probability judgments of negative events or outcomes (e.g., Johnson & Tversky, 1983).

Second, pleasant and unpleasant affective feelings may affect individuals' subjective utilities for possible outcomes and/or their weighting functions (e.g., Damasio, 1994; Finucane et al., 2000; Seo et al., 2004). For example, Damasio (1994) in his somatic marker hypothesis suggests that individuals' immediate affective evaluations enable and thus influence their utility judgments of possible expected outcomes. Similarly, according to the feeling-as-information hypothesis (Schwarz, 1990; Schwarz & Clore, 1983; 1988) and more recently risk-as-feelings hypothesis (Loewenstein et al., 2001), people often consider their feelings at the moment of decision making (either correctly or through misattributions) as their evaluative reactions to the imminent utility judgments. In addition, Rottenstreich and Hsee (2001) provide strong experimental evidence that affect causes a shift in utility weighting function, for example, by showing that an affect-rich option (e.g., kiss) is preferred in the low-probability condition, whereas an affect-poor option (e.g., cash) is preferred in the high-probability condition.

Taking these two mechanisms together, we hypothesize that individuals experiencing pleasant feelings at the moment of decision making are likely to perceive that there are greater chances for obtaining positive outcomes (greater gain-probability judgment) and also are likely to assign greater utility weights for those anticipated positive outcomes (gain). As a result, pleasant feelings may create a risk-taking tendency, which will negatively moderate (suppress) the framing effects of cumulative and immediate gains on risk-taking (H1-1). In contrast, unpleasant feelings may increase subjective probability judgments for possible negative outcomes (losses) as well as utility weights for avoiding the anticipated negative outcomes, and thus will create a risk-avoidance tendency. This, in turn, may negatively moderate (suppress) the framing effects of cumulative and immediate losses on risk-taking (H1-2).

Hypothesis 3-1: Pleasant feelings will negatively moderate the (negative) relationship between gain and risk taking.

Hypothesis 3-2: Unpleasant feelings will negatively moderate the (positive) relationship between loss and risk taking.

METHOD[3]

To test our hypotheses, we developed and ran an Internet-based stock investment simulation combined with an experience sampling procedure (e.g., Feldman, 1995; Barrett, 1998; Barrett & Barrett, 2001). Experience-sampling procedures, in which thoughts and feelings are measured at the time they are being experienced, minimize the cognitive biases that can affect memory-based self-reports (Reis & Wheeler, 1991). This is particularly important when studying affective experience because memory biases have been detected when using standard retrospective self-report measures (e.g., Barrett, 1997).

The stock investment simulation consisted of twenty investment sessions, one session for each day during twenty consecutive business days. Once a day during the simulation period, participants logged into the stock investment simulation website, viewed current market and

[3] This paper uses a part of a larger data set that has been used in other papers that address fundamentally different theoretical and empirical questions.

stock information regarding 12 anonymous stocks that were daily updated from the national stock market, checked their current investment performance that would determine their monetary reward after the simulation ($100-$1000), and finally made their investment decisions about which and how many shares of stocks to buy or sell for the day. Just before making their investment decisions for the day, they reported their current affect.

Participants

We recruited 118 private stock investors for the stock investment simulation from six investment clubs located in the New England area. Their ages ranged from 18 to 74 (Mean = 24.7. SD = 13.2), and as is typical in most investment clubs, the majority of the participants were male (86 men / 80%). Their investment experience was 4.3 years on average (SD = 7.4), ranging from 0 to 50 years. The measures described below were collected each time they carried out the stock investment session.

Measurement

Gain and loss. To measure gain and loss, we first took the difference between the participants' most recent asset position and their initial asset position at the first round of the simulation ($10,000). The gain variable is the ratio of this difference and the initial asset position. This ratio was further adjusted by the local stock market return, a ratio of the most recent value of the composite index of the twelve stocks selected for this simulation to its initial value at the first round. The reason for this adjustment was that the participants' cash rewards after the simulation were determined by this adjusted ratio as the ultimate performance indicator, which would not be biased by simple opportunity gains and losses (stock market movements). When the resulting ratio value was positive, this value was coded for gain and zero (non-loss) was coded for loss. If the ratio was negative, the absolute value was coded as loss and zero (none-gain) was coded for gain.

Pleasant and unpleasant feelings**.** Based on recent conceptual and empirical examination of the core affective structure by Barrett and Russell (1998), we selected 18 items (5-point-Likert-scale) that tap into the valence dimension of the affective circumplex. We measured pleasant feelings by averaging the 9-item pleasant items (excited, joyful, enthusiastic, proud, interested, happy, satisfied, calm, and relaxed; alpha = 0.90). Similarly, we computed unpleasant feelings by averaging the 9-item unpleasant items (irritated, afraid, angry, nervous, frustrated, disappointed, sad, depressed, and tired; alpha = 0.86).

Risk taking. Risk taking was measured by three indicators in the participants' investment portfolios. These were combined into a single index of generative-defensive orientation.

First, we measured *the degree of diversification*. Diversification is a well known financial strategy to avoid risk (cf. Bodie, Kane & Marcus, 2001). As a measure of diversification, we used Herfindahl's Index, the sum of the squares of all percentage weights invested in different stocks (0 < Index < 1). A lower score in the Index indicates less risk-taking, while a higher score indicates greater risk-taking.

Second, we measured *the averaged beta coefficient* in a selected stock portfolio. The beta coefficient of each stock, which participants saw every day during the simulation period, is a measure of the volatility of the stock price in relation to the stock market (cf. Bodie et al., 2001). This is also a well known parameter of the stock's potential risk. The participants initially rated their perceived risk for each of the 12 stocks selected for this study on a scale between 0 (low risk) to 4 (high risk), and we found that their perceived risk is highly correlated with the beta of each stock (r = 0.46). When the betas are averaged within a given stock portfolio, they indicate the level of risk that the participants choose in constructing their stock portfolio. A higher averaged beta indicates greater risk taking.

Third, we measured *the averaged one-year return* in a given stock portfolio. The one-year return of each stock is generally considered as a parameter of a stock's potential profitability. It points to the level of profitability that the participants choose in constructing their stock portfolio. We also found that the averaged one-year return of each stock is highly correlated with the participants subjective rating of the stock's risk (r = 0.47). A higher averaged one-year return indicates greater risk taking (focusing on greater return).

A factor analysis (principle component extraction method) showed that these three indicators constituted one factor which explained 61% of the total variance. We used the factor scores (calculated by regression method) as an index for a bipolar continuum of *risk taking*, with a higher score indicating greater risk taking. However, to ensure that the hypothesized effects on risk taking are consistent across these three indicators of risk taking, we also treat these three indicators separately in our analyses.

Procedure

Each day for 4 weeks (20 consecutive business days) during the simulation period, participants visited an Internet website once between 6:00 p.m. and 9:00 a.m. the next morning. Once they accessed the website, participants saw a log-in page. To preserve confidentiality, participants were given a code name and password, and reminded that they needed to avoid any type of interruption as much as possible once logging in to the simulation. Once they logged in using their code name, they were asked to describe their current day, including the amount of time they had spent to catch up on the stock market that day and their initial prediction of the today's national stock market condition.

On the next page, they saw the daily stock market information, including the daily changes and the past-five-day trends of the three major market indices (e.g., the Dow Jones, NASDAQ, and S&P500), as well as of the local market index for the simulation, the composite index of the twelve anonymous stocks that had been randomly selected from the national stock market on the basis of varying degrees of risk and profitability and of various industries and company size.[4] Next, they saw a web page that contained the daily updated information (on the basis of daily closing price) on these twelve individual stocks. The individual stock information was limited to its *current price* (initially set at $100.00 per share but changed in the exact same proportion to the stock's actual price change thereafter), *daily price change* (%), *average price change rate for the past five days, beta coefficient* (a stock's volatility in relation to the market), *one-year stock performance* (change in percentage in stock price over the trailing 52 weeks), *price-earning ratio* (a ratio of stock price to its trailing 12-month earnings per share), and *company size* (sales volume). The individual stock names were manipulated (e.g., Stock A, B, and C) in such a way that participants could not identify the real names.

On the next page, participants saw a report that summarized their most updated investment performance and expected reward so far. All participants began the simulation with a baseline monetary reward of $200. At the end of the simulation, they earned up to $1,000, but never less

[4] The local market index had been tracked over several months prior to the simulation and found to be highly correlated with the national market indexes ($r > 0.8$). During the 20-day period of the simulation, the local market index maintained a relatively good balance of ups and downs (14 ups and 6 downs).

than $100. Their reward was determined by their overall investment return relative to the local market index (explained below).[5]

On the next page, participants were asked to rate the various feelings that comprised their current affective state (*pleasant and unpleasant feelings*) and reported their subjective judgments of the likelihood and the personal importance of obtaining several specific performance outcomes.

On the subsequent page, participants made their own investment decisions for the day – which stocks to sell and which to buy. Each participant was initially given hypothetical cash of $10,000. They were allowed to invest all or a part of the cash on any of the twelve stocks in the local market as long as the cash balance did not go below zero, and were also allowed to trade those stocks freely, with no transaction costs. The web page had been designed in such a way that it automatically performed all mathematical calculations required for investment decision making, and instantly checked for mistakes (e.g., overinvestment). The current (national and local) market and stock information that participants had seen in the previous pages was available for reference in a separate web page.

Before logging out, participants saw their investment summary in a table in the next page and were asked to describe the reasons behind their investment decision for the day in a text box. Next, they reported whether, when, and how long they had experienced any type of interruptions during the tasks for the day. This completed their tasks for the day. This process was repeated daily for the twenty business days.[6]

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[5] Participants were informed at the beginning of the study that their investment return was not determined by the simple increase or decrease of their stock portfolio value per se or by other participants' performance on the simulation, rather by their performance relative to the market. Thus, participants were not motivated to capitalize on market fluctuations or to compete with each other.

[6] To ensure that all the variables were measured in an order that is consistent with the hypothesized causal directions among the variables, the web pages were programmed in such a way that participants could not skip certain web pages or go back to the previous pages to change their original responses. They also could not re-enter the web site in the same day.

Analysis

We used a fixed-effects (within-subject) regression methodology to predict risk taking levels as a function of individuals' asset positions as well as affective state. The fixed-effects methodology is appropriate when we believe there is heterogeneity that is associated with the decision maker and remains constant over the period of analysis (Griliches & Mairesse, 1998). This approach allows us to control for any individual-specific (fixed) effects that might be related to risk taking propensity. The variation in risk taking that we measure is entirely driven by within-individual variation.

We estimated the following model:

$$y_{it} = \beta_0 + \beta_1 p_{it} + \beta_2 A_{it} + \beta_3 d_t + \gamma_i + \eta_t$$

Where y_{it} is the risk taking of individual i in period t; p_{it} is the gain or loss of individual i at the through period $t-1$; A_{it} is the affective state of the individual when making decisions in period t; d_t is a period dummy (recall, there are 20 periods); γ_i is an individual effect, that is, any individual risk preference that is fixed over the 20 periods; η_t is the idiosyncratic error term which is assumed uncorrelated with the other variables. If this error term is correlated with the covariates, then the coefficients of interest (in this model the coefficients of interest $\beta_0, \beta_1, \beta_2$ and β_3) would be biased. Including the fixed effects parameter γ_i may mitigate such problems. For example, if an individual was simultaneously predisposed to experiencing positive affect due to underlying personality traits and similarly predisposed to risk taking behavior, then a regression without fixed effects would incorrectly attribute risk taking to affective state as opposed to an underlying traits. A fixed effects methodology removes this possibility. Similarly, by including a series of period dummies (d_t), we also avoid possible biases stemming from factors related to a specific day (round) during the simulation period.[7]

RESULTS

The means and standard deviations of each variable and the correlations among them are presented in Table 1. For most of the variables, there is substantial within variation (between 47% and 63%), which suggests that the data will support a fixed-effects model. We present the fix-effects regression results in Table 2. All models are fixed effects models that include period dummies (i.e., indicator variables for 19 periods, the first is omitted).

Insert Table 1 and Table 2 about here

Hypothesis 1: The Framing Effects of Gains and Losses

In Model 1, we tested Hypotheses 1-1 and 1-2, the framing effects of gain and loss. First, we found that the coefficient of gain was not significant (b = -0.01, t = 0.68), and thus we cannot reject the null hypothesis that risk taking is not related to gain. However, we did find support for Hypothesis 1-2: risk taking is strongly and positively associated with loss (b = 0.012, t = 7.00, p < 0.01). In this model, the results are partially consistent with the predictions of prospect theory. Only when people experience a loss did they show an increase in risk taking behavior, for example, by selecting stocks with higher beta coefficients and higher one-year-returns and/or by less diversification of these stocks. But, these regression results are not consistent with a decreasing sensitivity to gains.

Hypothesis 2: The Direct Effects of Pleasant and Unpleasant Feelings

[7] Our results are robust to Hierarchical Linear Model (HLM),. HLM is in the family of random-coefficient models. However, interpretation of such models relies on stronger assumptions than the fixed-effects model.

In Hypotheses 2-1 and 2-2, we predicted that individuals' affective states may circumvent cognitive processes and affect risk taking behavior directly. In Model 2, we tested these hypotheses, and we found no support for either hypothesis. The coefficients on pleasant feeling and unpleasant feeling were both insignificant. That is, we found no evidence of a direct effect of affective experience on risk taking.

Hypothesis 3: The Interaction Effects of Affect and Framing

Model 3 tests Hypotheses 3-1 and 3-2, which predict that pleasant and unpleasant feelings will negatively moderate the relationships between gain/loss and risk taking. Consistent with Hypothesis 3-1, we found that the interaction term of gain and pleasant feeling was positive and significant ($b = 0.054$, $t = 3.90$, $p < 0.001$). That is, for individuals who were experiencing a gain and simultaneously experiencing strong pleasantness, their propensity to decrease risk taking was moderated. To get a sense of the magnitude of the effect of pleasant feeling on risk taking, we plotted in Figure 2 the changes in risk position with changes in performance for individuals at different levels of pleasant feelings. As Figure 2 shows, for individuals experiencing pleasant feelings at the mean level or one standard deviation below the mean, the risk factor is clearly and negatively associated with performance above a reference point (gain) as consistent with the predicted framing effect of gain on risk taking (H1-1). However, for individuals experiencing pleasant feelings one standard deviation above the mean, a single standard deviation increase in gain increases the risk factor score by 0.02, showing a slight upward-trend line. Moreover, for individuals experiencing pleasantness at two standard deviations above the mean, the slop of the upward line becomes even steeper as a single standard deviation increase in performance increases risk taking by 0.1. As a result, the risk-aversion effect of gain predicted through Hypothesis 1-1 gets reversed (risk-seeking) when individuals are experiencing pleasant feeling two standard deviations above the mean: they take greater risk as they simultaneously experience greater gains.

Insert Figure 2 and Figure 3 about here

Also consistent with Hypothesis 3-2, the interaction term between unpleasant feeling and loss was negative and significant ($b = -0.043$, $t = -2.75$, $p < 0.01$). Individuals who experienced unpleasant feelings amidst losses decreased their risk exposure. We plotted these relationships in Figure 3. For individuals experiencing unpleasant feelings one standard deviation below the mean (0.14), we found a large and positive association between loss and risk taking as one standard deviation increase in loss increases risk taking factor by 0.25. However, for individuals experiencing unpleasant feelings at the mean level (0.82) and one standard deviation above the mean level (1.52), the relative increase in risk taking factor by a one standard deviation increase in loss reduces to 0.19 and 0.12 respectively. For individuals experiencing two standard deviations above the mean level (0.21), the slope of the line becomes almost flat as one standard deviation increase in loss only increase risk taking factor by 0.06. As a result, we find that the predicted positive effect of loss on risk taking (Hypothesis 1-2) almost disappears when individuals are experiencing a high level (two standard deviations) of unpleasant feelings.

Also importantly, Model 3 demonstrates that after controlling for these interaction effects between feelings and past outcomes, the coefficient of gain, which was previously not significant ($b = -0.01$, $t = 0.55$), becomes significant and negative ($b = -0.09$, $t = 3.56$, $p < 0.001$), now supporting our Hypothesis 1-1. This result indicates that one of the central tenants of prospect theory, the reduction of risk after gains, is applicable to decision making under risk in real-life, ambiguous situations only after taking into account the joint effects of individuals' past decision outcomes framed as a gain or a loss and the feelings that they experience at the moment of decision making.

Finally, to investigate whether the results that we found in Model 3 are consistent across the three different indicators that constitute the risk taking factor, we ran three additional fixed-effects regressions on each of the three risk-taking indicators: the averaged beta, the degree of diversification (concentration), and the averaged one-year return. Model 3-1, 3-2 and 3-3 represent the respective results. In general, we found that the results are consistent with Model 3 with only two exceptions. First, the joint effect of loss and unpleasant feeling on risk taking was not found in Model 3-2 where the degree of diversification was used as a measure of risk taking. Instead, the results were more driven by other factors such as gain, loss, and the joint effect of gain and pleasant feeling. Second, the joint effect of pleasant feeling and gain was still significant ($b = 0.625$, $t = 2.29$, $p < 0.05$) but relatively weak in Model 3-3 where the averaged one-year return was used. Perhaps as a result, the effect of gain on risk taking remained insignificant even after controlling for the joint effects of affect and past outcomes in Model 3-3.

DISCUSSION

Our results suggest that the framing effects of past performance relative to a reference point (gain and loss), one of the central predictions in the managerial decision making literature based on prospect theory, only partially explains decision making under risk in ambiguous situations. When we did not take decision makers' affective experiences into account, we found that only those participants who experienced losses avoided risk.

In certain conditions, strong affective experiences at the moment of decision making led participants to behave in ways that are inconsistent with the framing effects. In particular, we found that when individuals experiencing large gains are also happy, they are not risk-averse but instead risk seeking. Conversely, when individuals experience large losses and are unhappy, they are not risk-seeking.

After taking into consideration decision makers' affective states, however, the core predictions of prospect theory come into focus. We found that while individuals continued to seek risk after losses consistent with the previous results, they also avoided risk after gains consistent with the predictions of prospect theory. These results suggest that it is necessary to consider human affect and its interaction with past gains and losses in order to identify risk taking behavior consistent with the predictions of reference dependence.

Theoretical Implications

The results of this study have several theoretical implications. First, they contribute to the managerial decision making literature, which suggest somewhat contradictory findings regarding the relationship between managerial risk taking and performance relative to a reference point or aspiration level (cf., Sitkin & Pablo, 1992; Wiseman & Catanach, 1997). Our results suggest that considering human affect at the individual or aggregate level may explain some of the contradictory findings in the literature. For example, one possible explanation of the negative association between performance-aspiration discrepancies and risk-taking found in the study of Wiseman and Bromiley (1996) is that the overwhelmingly negative feelings commonly experienced by managers in declining organizations could have reversed the risk-performance relationship.

Second, the results of this study directly contribute to two important building blocks of prospect theory. As noted in our theoretical development, either decision makers' affective experience may influence the subjective probability weights of subsequent gains or losses, or alternatively, it may influence underlying utility functions. We view the former as more likely for two reasons. First, as noted in our theoretical development (e.g., Rottenstreich & Hsee, 2001), careful experimental results suggest that affective feelings have a strong influence on probability weights. Second, for shifts in the utility function to have a large effect on observed risk preferences, emotions would need to make the perceived effect on outcomes extreme.[8] However, the rewards associated with the investment simulation while not insignificant, were not particularly large. The top performer could only earn $1000, while all individuals were all guaranteed $100 in earnings – hardly the realm of extreme gains or losses. Prospect theory is a cognitive theory that assumes, among other things, that individuals over-weight the likelihood of small probability events and underweight the likelihood of high probability events. Thus, our results suggest that affective experience may systematically influence what should be viewed as "small" in the application of the theory.

Our results also have implication for the literature on affect and decision making. As presented in Figure 2, the past research suggests that decision makers' affective experience can influence their risk either directly (the independent mediator model) or indirectly by affecting the cognitive processes involved in decision making (the cognitive tuner model). Contrary to some recent findings (e.g., Au, Chan, Wang, and Vertinsky, 2003; Shiv et al., 2005), we found no direct effects of pleasant or unpleasant feelings on risk-taking. Instead, affective feelings influence risk taking only in interaction with other situational variables such as past gains and losses. Thus, our results suggest that a relatively more salient mechanism through which affect

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[8] The intuition is that individuals may be risk-loving if bets are small relative to wealth. For example, risk taking may persist after $100 gains if the better is a millionaire.

influences risk taking would be via cognitive processing (e.g., weighting outcome probabilities) – amplifying, suppressing, or reversing the effects of situational factors on decision making.

In addition, the results of this study have implications for the behavioral finance literature. Prospect theory suggests counter-cyclical behavior of the stock market. For example, the reduction of risk after gains and the increase of risk after losses, if true on aggregate, would tend to attenuate market trends. However, after a series of gains individuals may feel good, which would reinforce a bull market as the pleasant feelings may continue to foster risk-seeking. Similarly, after a series of losses individuals may experience negative feelings, which would tend to reinforce bear markets as the unpleasant feelings may discourage risk seeking (risk aversion). Thus, our theory may provide a behavioral basis for financial theories of market bubbles and crashes.[9]

Practical Implications

Our results suggest strong emotions will attenuate findings such as Greve (1998) that organizational inertia increases as performance relative to aspiration levels increases. For example, organizational change may be facilitated by strong positive emotions among decision makers and implementers. This helps increase the weight on probabilities of "good" outcomes. Observationally, this makes decision-makers more optimistic and thus adopt more strategic changes. In this sense, such phenomena might be "good". However, in the context of this study, stock investing, this is not necessarily the case. For example, we found that individuals who were performing well *and* feeling strong pleasantness were willing to increase their risk. However, this risk-taking is probably ill-advised as they are increasing the probability of loss even though their rewards are unlikely to rise proportionately (due to the reward structure of the

[9] We thank Ron Borzekowski for this insight.

investment simulation). Similarly, we found that those individuals who were both performing poorly *and* feeling strong unpleasantness became more risk averse. This strategy is also almost certainly sub-optimal as participants have limited liability and are paid $100 in the simulation with certainty. Such a risk-averse strategy was unlikely to improve their performance. Therefore, organizational decision makers may improve their decision making performance by understanding influences of their current affective state on their behavior.

Limitations and Future Research Directions

There are several limitations to the study. First, our research design cannot specifically address whether affective states influence the estimates of probabilities, the weighting of these probabilities or alternatively the underlying valuation of particular outcomes (i.e., utility functions). Instead, we can only conclude that affective experience strongly influences decision making through one of these mechanisms. Future research is needed to determine more precise underlying mechanisms through which affective experiences influence decision making under risk.

Second, the remuneration structure for the participants in this study was designed in a way that it prevented them from incurring serious losses. As a result, the expected return for participating in this simulation was skewed towards the gain side ($100-$1000 cash remunerations); the worst performer still got paid by $100 ($100 loss from the risk-free, initial payment of $200). This imbalance between possible gains and losses in the remuneration structure may have biased the results. In particular, participants may have been more sensitive to rewards and less sensitive to the possible losses, and thus have taken more risk than they would have had the remuneration structure been more balanced. In principle, additional experimental research may examine the key hypotheses of this study in a more loss-sensitive setting. However, since human subject review boards generally prohibit experiments that may result in financial losses for subjects, field studies are probably necessary to determine the importance of this limitation.

Third, as is typical in most investment clubs, participants were predominantly male (80%) and young. In addition, the participants were not randomly selected but instead drawn voluntarily from the six investment clubs, which violates the assumption of independence among the respondents. The gender and age imbalance and the non-randomness in the sample may constrain the applicability of the study results to the general population. Additional examination using a more gender-balanced and randomized sample would be of value.

Finally, this is among the relatively small number of investigations to adopt an event-contingent experience sampling procedure in the study of emotion (e.g., Feldman, 1995; Barrett, 1998; Feldman Barrett and Barrett, 2001). Participants' affective states were measured at the moment they were being experienced during a meaningful event or task. This procedure was enabled by recent advances in internet technology that allowed many critical features such as on-line measurement, dynamic session and ID control, and instant and dynamic data transfer, transformation, and presentation to both investigators and participants. None of these would have been possible using a traditional pen and paper method. We hope this methodological advancement stimulates future studies that apply this method to investigation of affective experience and its effects on decision making under risk.

Conclusion

This study provides strong evidence that both our affective experiences and past outcomes are important factors influencing decision making under risk in an ambiguous, real-life setting. We describe how affective experiences and past outcomes likely influence risk taking. Our thinking and evidence compliments prospect theory, which restricts its focus to the cognitive processes underlying risk-based choice in an unambiguous setting. We invite more scholarly attention to and investigation on the phenomenon of real-life, dynamic decision making under risk.

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TABLE 1
Means, Standard Deviations, Variance Proportions, and Correlations [a]

Variables		Mean	SD	Variance %		1	2	3
				Within	Between			
1	**Gain**	0.94	2.02	52.6	47.4		-0.39	0.25
2	**Loss**	1.41	2.19	53.2	46.8	-0.46		-0.22
3	**Pleasant Feeling**	1.10	0.77	46.9	53.1	0.23	-0.34	
4	**Unpleasant Feeling**	0.83	0.69	49.9	50.1	-0.17	0.24	-0.48
5	**Gain X Pleasant Feeling**	1.33	3.60	54.3	45.7	0.91	-0.41	0.43
6	**Loss X Unpleasant Feeling**	1.26	1.27	54.6	45.4	-0.39	0.86	-0.39
7	**Risk Taking (Overall)**	0.00	1.00	58.9	41.1	-0.17	0.07	0.04
7-1	Beta	2.23	1.32	59.7	40.3	-0.11	0.07	-0.02
7-2	Diversification	0.31	0.26	53.7	46.3	-0.09	0.13	-0.05
7-3	Return	33.45	21.26	63.1	36.9	-0.19	0.03	0.09

Variables		4	5	6	7	7-1	7-2	7-3
1	**Gain**	0.00	0.88	-0.29	-0.05	-0.07	-0.02	-0.02
2	**Loss**	0.08	-0.33	0.74	0.25	0.22	0.33	0.12
3	**Pleasant Feeling**	-0.14	0.43	-0.17	-0.02	-0.02	-0.01	-0.02
4	**Unpleasant Feeling**		-0.02	0.46	-0.02	-0.03	-0.01	-0.01
5	**Gain X Pleasant Feeling**	-0.27		-0.24	-0.01	-0.03	0.01	0.00
6	**Loss X Unpleasant Feeling**	0.49	-0.35		0.16	0.12	0.24	0.07
7	**Risk Taking (Overall)**	0.01	-0.12	0.07		0.94	0.51	0.90
7-1	Beta	0.03	-0.08	0.06	0.80		0.32	0.80
7-2	Diversification	0.02	-0.08	0.10	0.31	0.13		0.23
7-3	Return	-0.01	-0.12	0.04	0.89	0.57	0.13	

[a] N = 1870 (101 participants with 20 rounds)
Means, standard deviations, and correlations below the diagonal were computed for each individual across rounds and then averaged across individuals (averaged within-individual correlations) whereas correlations above the diagonal were computed across individuals for each round and then averaged across rounds (averaged between-individual correlations).

TABLE 2
Fixed Effects Regression Results

	Model 1	**Model 2**	**Model 3**	*Model 3-1*	*Model 3-2*	*Model 3-3*
Dependent Variables Independent variables	**Risk-Taking** (factor)	**Risk-Taking** (factor)	**Risk-Taking** (factor)	*Beta*	*Diversification*	*Return*
Gain	-0.010 (0.68)	-0.008 (0.55)	-0.091 (3.56)***	-0.121 (3.42)***	-0.039 (6.33)***	-0.414 (0.81)
Loss	0.094 (7.52)***	0.093 (7.31)***	0.122 (6.60)***	0.167 (6.58)***	0.024 (5.52)***	1.559 (4.25)***
Pleasant Feeling		-0.029 (0.64)	-0.080 (1.70)	-0.100 (1.54)	-0.002 (0.21)	-1.745 (1.86)
Unpleasant Feeling		-0.006 (0.14)	0.051 (1.04)	0.066 (0.98)	-0.006 (0.52)	1.385 (1.42)
Gain X Pleasant Feeling			0.054 (3.90)***	0.068 (3.57)***	0.015 (4.51)***	0.625 (2.29)*
Loss X Unpleasant Feeling			-0.043 (2.75)**	-0.069 (3.22)***	0.004 (1.03)	-0.881 (2.84)**
Constant	0.257 (3.03)**	0.302 (2.48)*	0.324 (2.60)**	2.413 (14.05)***	0.270 (9.03)***	46.265 (18.69)***
F R-squared	10.00*** 0.11	9.13*** 0.11	9.36*** 0.12	4.65*** 0.06	12.10*** 0.15	30.97*** 0.31
Δ F ΔR^2		0.23 0.00	10.86*** 0.01			

N = 1870 (101 participants with 20 rounds). Absolute value of t-statistic is in parentheses.
* significant at 0.05; ** significant at 0.01; *** significant at 0.001

FIGURE 1

Cognitive and Affective Processes underlying the Effects of Gain and Loss on Risk Taking

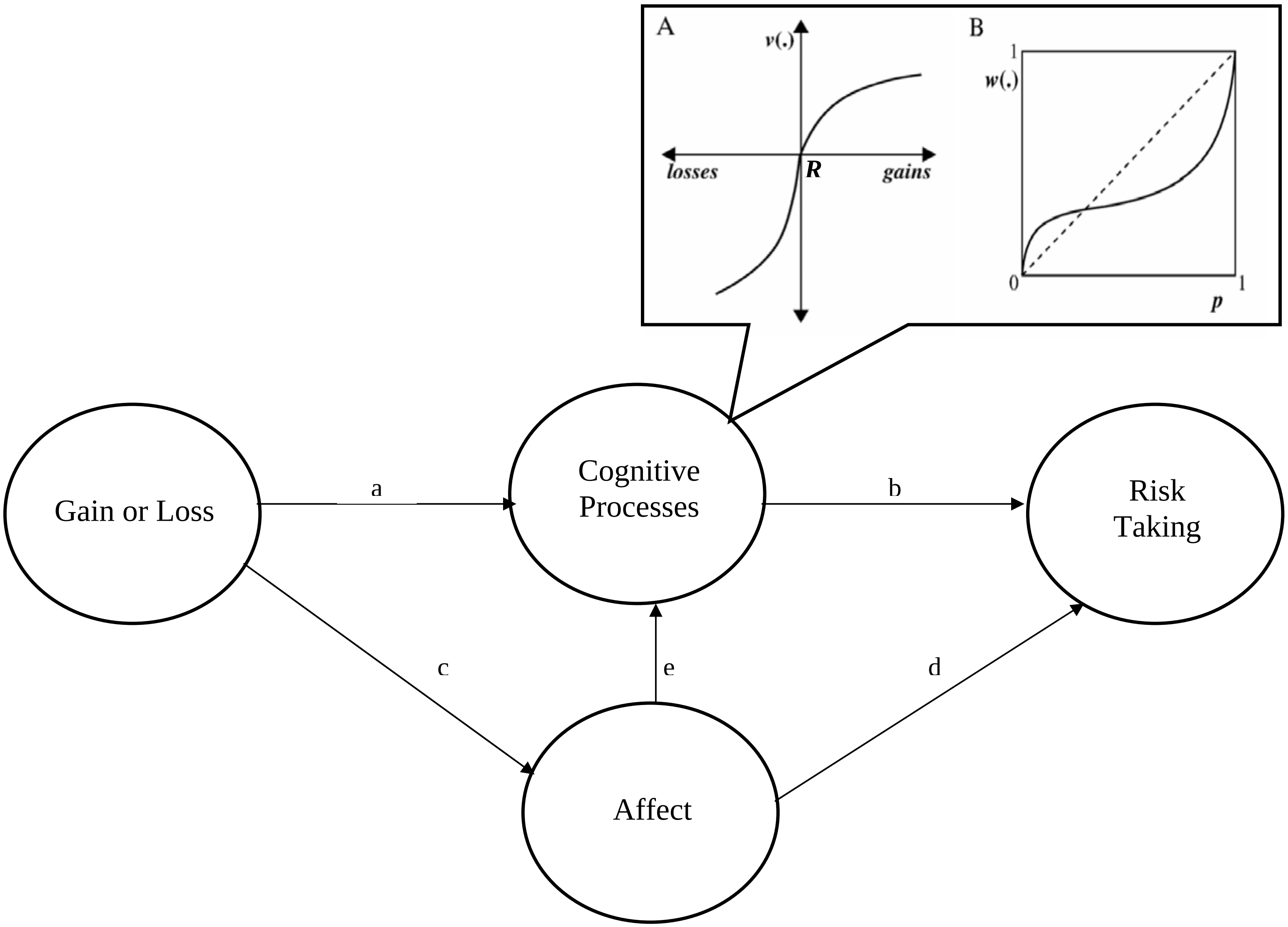

FIGURE 2
Risk Taking with Changes in Gain at Different Levels of Pleasant Feelings

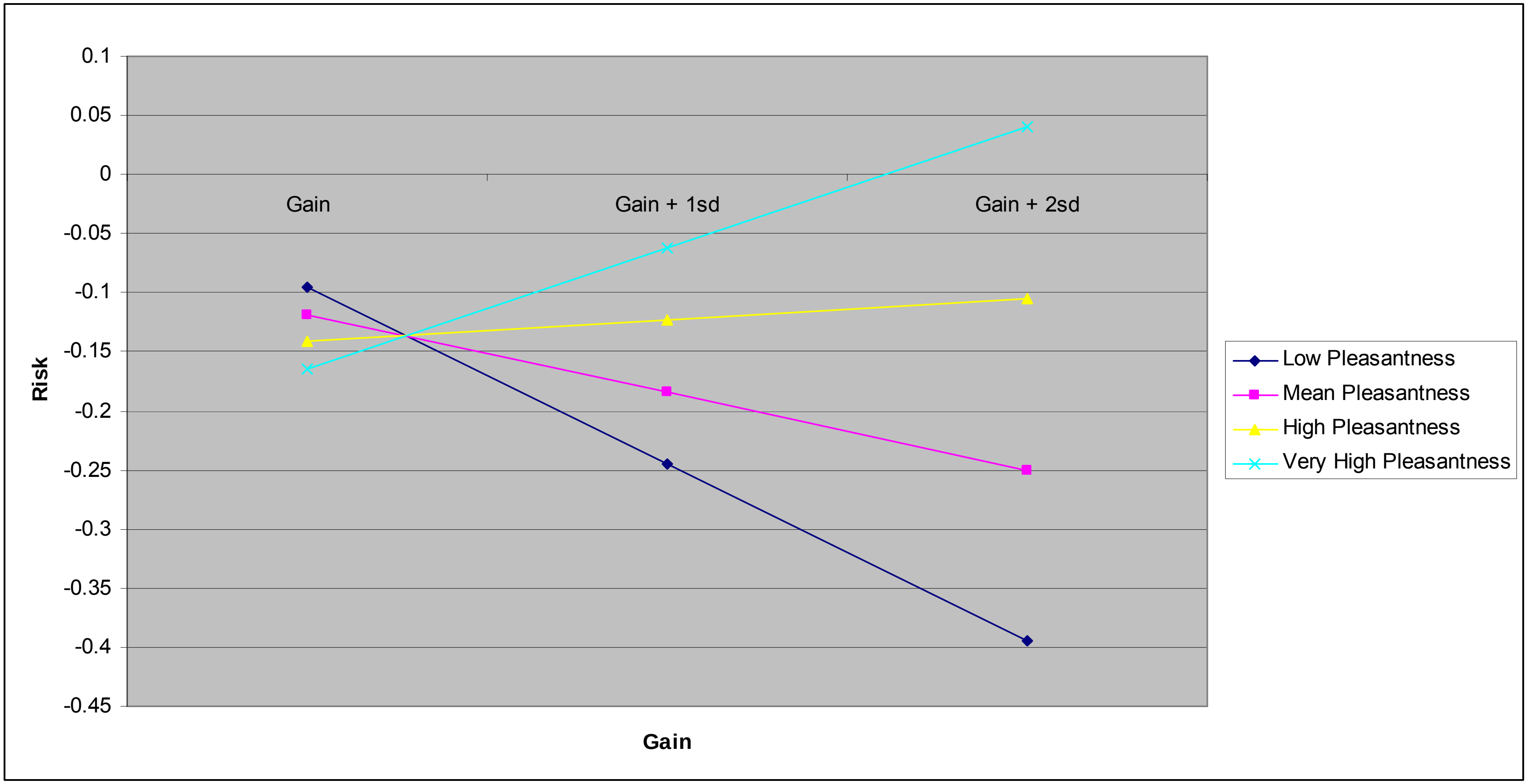

FIGURE 3
Risk Taking with Changes in Loss at Different Levels of Unpleasant Feelings