Running head: GAMBLING AND INVESTMENT DECISION MAKING

Gambling and Investment Decision Making:

A Comparison of Similar Situations

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fulfilment of the requirements for the degree Master of Arts

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Abstract

Stock markets are like horse races: both offer uncertain payoffs determined by trading or betting activities. Are investing and gambling behaviours also similar? 48 participants bet in a simulated horse race, invested in a simulated stock market, and completed a questionnaire designed to predict investment/gambling behaviour. Aside from how much/little people invest/bet (*Boldness-timidity* of betting/investing behaviour) no other observed behaviours were consistent across both tasks. Few questionnaire items were reliably correlated with gambling or investment behaviour. Results suggest knowledge of gambling behaviour may not generalise to stock market investment behaviour and vice versa. Results also suggest that the structural similarity of situations alone is not sufficient to produce consistent behaviour across situations.

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Table of Contents

Abstract	iii
Acknowledgements	iv
Gambling and Investment Decision Making: A Comparison of Similar Situations.....	1
Cross-situational Consistency.....	2
Similarities Between Investing and Gambling	4
Structural Similarities between Horse Race Betting and Investing.....	5
Research on Investment Decision Making and Gambling.....	8
Method	16
Participants.....	16
The Tasks.....	16
The Questionnaire.....	25
Procedure	29
The Stock Market Investment Task.....	30
Horse Race Betting Task	30
Questionnaire Completion Task	32
Results.....	33
Task-Order Effects.....	33
Stock market	33
Horse Race.....	45
Stock market – Horse race comparison	54
Questionnaire	60
Discussion	68

Stock Market Simulation	68
Horse Race Simulation	70
Horse Race Betting, Stock Market Investing Comparison	70
Questionnaire	72
Limitations	73
Implications	75
Future Directions	76
References	78

List of Figures

Figure 1. Screen shot of the investment simulation task interface	18
Figure 2. Screenshot of Horse Racing Fantasy - Field of Horses and Enter Bets window.....	22
Figure 3. Screenshot of Horse Racing Fantasy – Race window.....	23
Figure 4. Screenshot of Horse Racing Fantasy – Race Results window	24
Figure 5. Screenshot of Horse Racing Fantasy – Player Results window.....	25
Figure 6. Screenshot of Horse Racing Fantasy – Alternative Field of Horses window.....	31
Figure 7. Mean amount of \$ bet per race.....	54

List of Tables

Table 1 Indicators used to measure stock market behaviour.....	34
Table 2 Principle components analysis of stock market investment indicators.....	41
Table 3 Indicators used to measure horse race betting behaviour.....	46
Table 4 Principal components analysis of horse race betting indicators.....	52
Table 5 Stock market investment simulation and horse race betting simulation parallel indicators.....	55
Table 6 Significant correlations among questionnaire items.....	61

List of Appendices

Appendix A: Questionnaire.....	85
Appendix B: Original Overconfidence Questionnaire.....	92
Appendix C: Participant Instructions.....	93
Appendix D: Horse race mini questionnaire (1).....	96
Appendix E: Horse race mini questionnaire (2).....	98

Gambling and Investment Decision Making: A Comparison of Similar Situations

“To gamble. To bet. To speculate. To invest.” (Brenner, 1990, pg. 90). What do these activities have in common? All are decisions involving money, all are very popular activities, and all are decisions made under risk. In Canada, the popularity of gambling has surged in recent years. Seen as a way to increase government revenue without increasing taxes, the proliferation of gambling establishments in Canada has led to a dramatic increase in gambling, and a substantial increase in provincial revenue. Provincial governments made \$6 billion in revenue from government-run gambling in 2001, up from \$1.7 billion in 1992 (Statistics Canada, 2002). In Ontario, 5 of 6 residents report they have gambled in the last year (Wiebe, Single, & Falkowski-Ham, 2001). Indeed, gambling is a popular activity.

Investment is also a popular activity. There are few topics in western culture that receive more media coverage than that of financial investment information. In 2001, managed mutual/investment funds and direct investment in stocks made up almost a quarter of Canadians' financial assets (Statistics Canada, 2001).

A central element to both gambling and investment is risk. Though the risk construct has been conceived of in many ways, “every conception of risk requires that there be uncertainty about the outcomes of prospective actions; if the outcomes are guaranteed then there is no risk.” (Yates, 1992, pg. 11). In the case of gambling, uncertainty lies in predicting the outcome of a game of chance or the results of a contest, and in the case of investment, uncertainty lies in predicting whether an investment will appreciate or depreciate in value. In both activities, one risks money in hopes of a favourable outcome; therefore, gambling and investment decision making are both situations in which people make decisions under risk.

Given the similarities between investing and gambling, should we expect similar behaviour between these two situations? The main purpose of this study is to determine if horse race betting is correlated with stock market investing. The second purpose of this study is to see if individual differences in one or both of these behaviours (investing and betting) are correlated with items on a questionnaire designed to predict investment and gambling behaviour.

Participants were asked to complete a computer-controlled investment simulation task, a computer-controlled horse race betting simulation task, and a questionnaire. Behavioural measures derived from the stock market investment and horse race betting data were correlated, and the questionnaire analysed in search for items that would reliably predict these measures.

Cross-situational Consistency

The idea that people may behave similarly in a stock market investment situation and a gambling situation is derived from the common assumption that "similar situations lead to similar behaviours". Is there evidence that this is true? The debate surrounding cross-situational consistency has been lively and enduring in psychology. Personality trait theorists have long argued the existence of stable (personality) traits or dispositions that are predictive of a person's behaviour across both similar and dissimilar situations (e.g. Allport 1937, Funder 1991). This argument, however, has had little empirical support. As early as 1928, Hartshorne and May (1928) failed to find consistency in children's "honesty" across different situations. Subsequent research also failed to reveal much evidence that people behave consistently across situations (for a review of these studies see Mischel, 1968, or Bem & Allen, 1974). Some researchers responded to this research by challenging the traditional notion of traits or dispositions, and arguing that perhaps the characteristics of a situation were of greater importance than previously acknowledged (e.g. Mischel, 1968; Mischel & Peake, 1982).

In line with the more general findings discussed above, research on the cross-situational consistency of risk-taking behaviour has also failed to generate much empirical support (e.g. Slovic, 1962, Zuckerman, 1979). Most of this research, however, has examined cross-situational consistencies across dissimilar situations. For example, Slovic (1972) found inconsistencies in responses when he compared behaviour on a multiple choice questionnaire task (measuring speed versus accuracy) to behaviour on a paper and pencil gambling task. Another study found inconsistencies in risk-taking behaviour across situations that were as diverse as gambling and skydiving (Keyes, 1985).

In a more relevant study, Kuhlman (1976) compared individual differences in behaviour across three different gambling games: roulette, craps, and blackjack. His findings were mixed. He found participants' wager size was consistent across games, whereas their odds preferences were not. He also found that none of the four different personality measures employed in his study (authoritarianism, desire for social approval, locus of control, and optimum level of stimulation) were predictive of participants' bet size.

Will people behave similarly in a horse race betting situation and an investing situation? Mischel (1968) reviews evidence that an individual's behaviour is often quite consistent over time if the situations are similar. He also argues that "the more dissimilar the evoking situations, the less likely they are to lead to similar or consistent responses from the same individual." (Mischel, 1968, p. 177). If this is the case, how similar must those tasks be and in what ways must they be similar?

Similarity exists in many ways; some similarities we may refer to as superficial (e.g., similar colour, size, shape, weight, sound), while others we may refer to as analogical/structural

(e.g. a dog is like a human, life is like a tree). Stock market investing and horse race betting have few superficial similarities, but many analogical/structural similarities.

It may be useful to conceptualise structurally similar (yet superficially different) situations as decision making situations that are merely *framed* differently. The notion of “framing” was developed by Tversky and Kahneman (1981), and essentially refers to how the wording, format or context of a question or decision making situation can influence the answer or decision. Research suggests that different decision frames often result in different decisions (for a review see Plous, 1999). If we conceive of stock market investing and horse race betting as essentially risk-taking situations that have been framed differently, perhaps these structurally similar situations will produce inconsistent behaviour.

In contrast, however, research suggests risk-taking tasks with greater structural similarity involving similar payoffs (e.g. all social, all financial etc.) produce high intertask behavioural consistency (e.g. Slakter, 1969), and as similarity decreases, so too does this behavioural consistency (Weinstein, 1969). If investing has many structural similarities to racetrack betting, then we should expect similarities between stock market investing and horse race betting behaviour. For example, people who buy only safe or conservative stocks should place only safe bets at the racetrack.

Similarities Between Investing and Gambling

Though there are few superficial similarities between gambling and investing in the stock market, there are many analogical/structural similarities; both require money to participate, involve risk, and generate winners and losers (Thorngate & Rajabi, 2002). There is a similarity of language between the two activities; investors often “play the markets”, and the odds on a horse are determined by the “betting market”. They also appear to produce similar pathologies.

Steinberg & Harris (1994) claim those engaging in 'problem gambling in the financial markets' comprise part of their clinical caseload of problem gamblers. Loony (1999) notes compulsive gamblers prefer riskier investments.

Some professionals working in finance have noted also the similarities between gambling and investing. In a survey of Connecticut stockbrokers, approximately 60% of respondents believed there was very little difference between investing in the more speculative areas of the stock market and gambling at a casino (Steinberg & Harris, 1994).

Even though there are structural similarities between gambling and investing, people have different attitudes towards the activities (Kassinove, 1998). Though few would doubt investing is a reasonable, if not responsible activity, people tend to have negative attitudes towards gambling in general, and horse race betting in particular. This is ironic as among the plethora of gambling activities, horse race betting has arguably the most in common with stock market investing.

Structural Similarities between Horse Race Betting and Investing

Horse race betting is based on what is known as the parimutuel betting system. A simplified explanation of this system is as follows. When someone (a punter) places a bet on a horse, the bet is added to the total amount bet by all the punters for each race (the betting pool). The odds on horse A are theoretically the ratio of the amount bet on Horse A to the amount bet on all other horses. For example, if \$3,000 were bet on Horse A and \$9,000 bet on all the other horses, the odds of winning on Horse A would be 3:9 or 1:3. The more money placed on a horse relative to the betting pool, the higher the odds. In other words, the more people that bet a particular horse is likely to win, the lower the payoff will be should the horse win. In reality, this is an oversimplification as figures are rounded off, a percentage of the betting pool is taken by the

racetrack to cover operating expenses, taxes, etc., and the odds are calculated based on the remaining amount of money (for a detailed description see Anslic, 1968).

The parimutuel betting system has several analogical/structural similarities with that of a stock market. The number of punters who place bets on a particular horse believing it is likely to win determines, in part, the odds on that horse. Similarly, the number of investors who purchase a stock (believing it will increase in value), in part, determines the value of a stock. In much the same way stock brokers search for undervalued stock to make their fortune, punters search for odds that are out of line with the “true odds” (Oddschecker, n.d.), that is, a horse whose chances of winning are underestimated by other punters. Brenner (1990) defines stock market speculation as “... an act where one backs one’s own *opinion* against the established one or against ‘the market’s’” (pp. 91). According to this definition, horse race betting, is very similar to stock market speculation.

There are other analogical/structural similarities between horse race betting and stock market investing. Punters often gather information about horses in a race to improve their “true odds” estimates (Figlewski, 1979) assuming that more information improves their forecasting ability. This is an activity shared with stock market investors. In the same way some stock market analysts base their predictions on market patterns and historical data (Bodie, Kane, Marcus, Perrakis, & Ryan, 1993), punters base their idea of the “true odds” on the past performance of the horse under similar conditions. In the end, because information sources vary and ways of analysing this information differ, the “true odds” of a horse or the “real value” of a stock, is arguably a matter of opinion.

The similarity between horse race gambling and speculative markets has been noted in the literature (for review, see Rosecrance, 1985). Figlewski (1979) and Ali (1977) concluded that

horse racing betting has many elements in common with speculative markets and several papers have argued that horse racing may be a useful venue to test the efficient market hypothesis, essentially that stock prices fully reflect all available information (Snyder, 1978; Figlewski, 1979).

There are economists who are not comfortable with comparing investing to gambling (Bodie, et al., 1993), and are quick to point out that investment, as opposed to gambling, does not necessarily represent expected loss in the long run (i.e. it does not have a negative expected value). As Barrett (2000) states, investment is not a “zero sum game” (p. 60). While in games of chance where probabilities are fixed, such as a slot machine or a roulette wheel, one may expect loss in the long run, the same is not necessarily true for games where there is arguably an element of skill.

In the case of horse race betting, the use of available information (quality of the track, health of the horse, etc.), can provide informed punters with a considerable advantage over those who do not pay attention to such information (Allcock & Dickerson, 1986; Figlewski, 1979). For example, for the professional punter, one of the most potentially lucrative times to bet at the racetrack is on the weekend or at a high profile race. In these races, there tend to be many occasional/amateur punters betting indiscriminately without researching their bet. It is in these races that the “market odds” on a horse are more likely than at other races to be out of line with the “true odds” (Rosecrance, 1985). The advantage professional punters have can be sufficient enough to allow some to survive off their winnings (Rosecrance, 1988). Presumably for these punters, horse race betting is not a “zero sum game”.

Research on Investment Decision Making and Gambling

Even though there are numerous similarities between gambling and investing, those studying gambling and stock market investing have tended to employ quite different research approaches. Social psychologists are often more apt to examine how the average person behaves in a given situation, and offer theories to explain that behaviour rather than examine individual differences across situations. Yates (1992) refers to this research approach as the *Decision Theory Approach*. In the *Decision Theory Approach*, the situation is often modified through some manipulation of variables, the average behaviour of participants is examined, and individual differences are ignored. This approach is typical of decision making research.

In contrast to the *Decision Theory Approach*, personality psychologists tend to examine how the individual behaves across situations, and offer theories to explain that behaviour. Yates refers to this research approach as the *General Trait Approach*. The *Decision Theory Approach* and *General Trait Approach* do well at characterising the research on investment decision making and gambling decision making. The literature on gambling has delved extensively into individual differences in a search for stable personality traits or dispositions that are predictive of gambling behaviour (for reviews see Wildman, 1997; Walker, 1992). This research generally aims to identify those who are at risk of becoming problem gamblers. Research on investment decision making, as previously noted, is more limited. The existing literature tends to examine discrepancies between average behaviours of investors and behaviours prescribed by rational models of decision-making (for review see Slovic, 1972; Hilton, 2001). When such discrepancies occur, researchers in this field, often economists, look to psychology to provide explanations. What is much less frequently addressed in the investment literature is who is, and who is not, employing these 'irrational investment strategies'.

Prospect Theory and the Disposition Effect. One of the main ‘irrational behaviours’ economists look to psychologists to explain is what Shefrin & Statman (1993) refer to as the ‘disposition effect’. This refers to the tendency for investors to hold onto losing stocks too long, and sell winning stocks too early. The effect was also observed in Thorngate and Rajabi’s (2002) study of stock market investment behaviour. Shefrin & Statman (1993) explain this behaviour using Prospect Theory (Tversky & Kahneman, 1979).

According to Prospect Theory, people are, on average, more risk seeking when faced with a potential loss as opposed to a potential gain. That is, when faced with potential gain, they tend to choose the more conservative (less risky) option, whereas when faced with potential loss they tend to choose the risky option. Shefrin & Statman (1993) argue that selling a losing stock is in essence making a decision to take a sure loss as opposed to holding onto a stock, which may continue to depreciate, or may turn around and begin to increase in value. There has been much research examining Prospect Theory, yet most of this has been based on the *Decision Theory Approach*. As a consequence there has been little research examining who is, and who is not, more risk seeking when faced with potential loss. Examining whose behaviour is, and whose behaviour is not in accordance with the predictions of prospect theory may prove beneficial in determining who is likely to hold onto losing stocks too long.

Gamblers’ Fallacy and Doubling Down. In the Thorngate and Rajabi study (2002), participants reported not wanting to sell off losing stocks for two reasons: they did not want to sell at a loss (thus supporting Prospect Theory), and they thought the share price would sooner or later rebound. The authors characterise this latter belief as the Gamblers’ Fallacy. Related to the representativeness heuristic and “the law of small numbers” (Tversky & Kahneman, 1971), the Gamblers’ Fallacy is the notion that after a run of bad luck, one’s chance of a successful outcome

increases (Plous, 1993). Turner (1998) argues that the Gamblers' Fallacy arises from an incomplete understanding of random events. He speculates that people having erroneous beliefs regarding random events (such as Gamblers Fallacy) are more susceptible to problem gambling.

Arising from these erroneous beliefs or incomplete understanding of random events may be the common strategy employed in gambling of *doubling down*. Similar to 'chasing losses' (Breen & Zuckerman, 1999), according to the doubling down strategy, following a loss one should 'double' the amount lost in an effort to recoup the lost bet. The label doubling down, however, more generally refers to the act making riskier bets following loss by either increasing the amount bet, or by betting on more long-shot events in hopes of winning back that which was lost. The effects of this strategy are potentially disastrous (Turner, 1998).

Possibly related to the doubling down strategy is a seemingly irrational investment behaviour. At times referred to as dollar-cost averaging, or escalating commitment, it refers to the tendency for investors to invest more in a losing stock (Odean, 1998; Wilson & Zhang, 1997). This was also observed in the Thorngate & Rajabi's (2002) study. The 'logic' of these investors is that it will be easier to make money if the stock starts to increase, but in reality it may be an escalating commitment to a losing strategy. This type of behaviour has been noted in decision research and is referred to as the "sunken cost effect" (see Plous, 1993). If there is behavioural consistency between the horse race betting and investment situations, we might expect those who tend to hold onto/invest more in losing stocks (strategies resembling the disposition effect/dollar-cost averaging) would also be more likely to make 'riskier' bets (i.e., bet on longer shot horses, or employ a doubling down strategy) following a loss in a horse race betting situation.

Though the behaviours/strategies outlined above (disposition effect, gamblers fallacy, doubling down, dollar-cost averaging) have been researched separately, little research has been done examining individual differences in these behaviours/strategies, or whether people's behaviours/strategies are consistent across similar situations (such as investing and gambling). One individual difference variable that has been examined in both investing and horse race betting studies is *explanatory style*.

Explanatory style. Explanatory style is a cognitive variable that refers to how people regularly explain the causes of bad events (Peterson, Buchanan, & Seligman, 1995). These explanations exist along three dimensions: internal ("It's me") vs. external, ("It's someone else"), stable ("It's going to last forever") vs. unstable (It's short-lived"), and global (It's going to affect everything that happens to me") vs. specific ("It's only going to influence this") (Peterson, Buchanan, & Seligman, 1995). Someone with an optimistic explanatory style attributes the causes of bad events to be external, unstable, and specific to the situation, whereas those with pessimistic explanatory style make the opposite attributions along these dimensions. The explanatory style construct is generally measured with the Attributional Style Questionnaire (Peterson, Semmel, Von Baeyer, Abramson, Metalsky, & Seligman, 1982), though other measures have also been employed such as the Expanded Attributional Style Questionnaire (Peterson & Villanova, 1988) or the Betting Attributional Style Questionnaire (Atlas & Peterson, 1990).

One study to examine explanatory style and investment decision making was conducted by Sorley (1999). His study examined how the construct of *explanatory style* predicted individual risk preference in the financial markets. Participants completed the Expanded Attributional Style Questionnaire and a mini-test/questionnaire similar to that employed in Prospect Theory

research. His results confirmed the predictions of Prospect Theory (that people are, on average, more risk-seeking when faced with potential loss than potential gain) when average responses on the mini-test/questionnaire were calculated. However, he found Prospect Theory did not adequately predict the behaviour of those with a pessimistic explanatory style. These participants were much less risk seeking when faced with a potential loss. He also found that those with a pessimistic explanatory style were more likely than those with optimistic explanatory style to sell their investments when faced with loss.

Explanatory style has also been examined by those investigating racetrack-betting behaviour. Atlas & Peterson (1990) had punters at a horse racetrack complete a modified version of the Attributional Style Questionnaire, called the Betting Attributional Style Questionnaire. They also had participants keep a diary that included a measure of what they referred to as rumination; the degree to which they were thinking about past and future races (measured on a 7 point scale). Though they did not find a significant relation between pessimistic explanatory style and betting behaviour, they found that horse race bettors with pessimistic explanatory style tended to ruminate after a lost bet, and subsequently made larger wagers in subsequent races, losing more money in the end. The authors did not report participants' odds preferences.

Though Atlas & Peterson's (1990) findings only indicate an indirect connection between explanatory style and betting behaviour, it is important to include this research in light of the absence of literature examining individual differences in an investment situation and a horse race betting situation. Implied from this study, we might expect those with a pessimistic explanatory style to be more likely to make larger, riskier bets following a loss than those with an optimistic explanatory style. It is interesting to contrast this prediction with Sorley's (1999) findings. According to his findings, we should expect those with pessimistic explanatory style to adopt a

more 'conservative' approach, and be more likely to sell off investments when faced with a loss. A measure of explanatory style seems to predict different behaviours in the investment decision making task and the horse race betting task.

Overconfidence. Overconfidence manifests itself in many ways and has been studied extensively in psychology (for a review see Plous, 1999). Generally, overconfidence is a bias in judgement that reflects the extent to which one overestimates his/her abilities, or feel they are better than average. In other words, it is the extent to which a person is more confident than they are correct (Myers, 1993). Overconfidence has been examined in the investment decision literature to explain irrational trading behaviour. Hilton (2001) argues that overconfident traders will tend to trade more often since they believe each trade made will be profitable. The literature partially supports this argument. Though they did not measure overconfidence, Barber & Odean (2000a) found individual differences in how frequently investors traded stocks. They found those who traded more, earned less profit and incurred greater trading costs. In a follow-up study they found that men traded more frequently than did women (Barber & Odean, 2000b). In a grasp for meaning, they concluded that overconfidence leads to excessive trading since there is evidence that men are more overconfident than women.

A more direct measure of overconfidence and its relation to trading behaviour may be found in a study by Biais, Hilton, Mazurier, & Pouget (2002). They administered a mini-test of overconfidence to participants in a trading game and found the more overconfident the investors, the smaller the profit they earned. Thorngate and Rajabi (2002) used a self-report questionnaire item to measure confidence ("Are you confident about what you do?") and found that the more confident participants reported themselves, the less likely they were to sell shares in a declining stock (perhaps evidence that the more confident the investor, the more likely he/she is to exhibit

the disposition effect). This did not, however, have any influence on the participants' net worth at the end of the task.

Questionnaire. The literature reviewed above suggests several constructs that may differentiate individuals in their investment or gambling decision making. Some of these constructs have instruments or tests associated with them. In these cases, items that seemed to have face validity in predicting either investment decision making or gambling decision making were chosen and incorporated into the questionnaire (see Appendix A). Because questionnaire items can vary greatly in how related they are to the task at hand, and because items more specific to the task may be more accurate in predicting behaviour (Thorngate & Rajabi, 2002; Warneryd, 1996), some have been modified to be more specifically related to horse race betting and some modified to be more specifically related to stock market investing.

In some instances, the investment literature has drawn on psychological theories to explain irrational behaviours (for example, Prospect Theory). These irrational behaviours have often been identified by having participants answer questions in the form of mini experiments or scenarios such as those employed in Prospect Theory research or research on overconfidence. The results of these 'tests' are usually averaged across individuals to get a value indicating whether or not the phenomenon under investigation is present. In Prospect Theory research, for example, respondents on average choose to be risk seeking in the domain of losses, and risk averse in the domain of gains (Tversky & Kahneman, 1971). These mini-tests are rarely used to identify who is and who is not risk seeking when facing loss and vice versa, or who is and who is not overconfident. The questionnaire employed in this study uses the 'mini-tests'/experiments in this manner.

Constructing a new questionnaire has advantages and disadvantages. A new questionnaire does not have normative data so its reliability and validity are unknown. Established questionnaires, however, that have accrued a body of research literature and have established psychometric properties tend to measure only one construct (for example, the Attributional Style Questionnaire measures explanatory style only). The purpose of the proposed questionnaire is not to measure one construct, such as explanatory style, then examine the relationship between that construct and the tasks under investigation (horse race betting and investing). The aim of the questionnaire is to predict, as accurately as possible, behaviour in the investment decision task and the horse race betting task and gain some insight into which constructs may or may not predict that behaviour. Because there appears to be more than one construct that may aid in predicting that behaviour, it does not make sense to employ a pre-existing instrument measuring only one.

In summary, there are two major predictions in this study. First, it is expected that stock market investing behaviour will be similar to horse race betting behaviour. More specifically, it is expected that individual scores on measures (indicators) derived from the stock market investment data will be positively correlated with comparable indicators from the horse race betting data. For example, indicators measuring the disposition effect or escalating commitment in the stock market investment task will be positively correlated with indicators measuring doubling down-type betting strategies in the horse race betting situation or, indicators measuring average transaction size from the stock market investment task will be positively correlated with average bet size from the horse race betting task.

The second major prediction is that individual differences in one or both of these behaviours (betting and investing) will correlate with items on a questionnaire designed to predict

investment and gambling behaviour (see Methods section). More specifically, it is expected that behavioural indicators from the two tasks will be significantly related to questionnaire items such as: (a) age and sex ; (c) scores from the Prospect Theory mini-test; (d) scores measuring participants' explanatory style; and (e) scores on the mini-test of overconfidence.

To date, no study has investigated whether people behave similarly in a stock market investment situation and a gambling situation. This study aims to address this gap in the literature, and to further understanding of the constructs and decision making biases that may be related to investment and gambling decision making.

Method

Participants

Forty-eight participants ($N=48$) took part in this study (38 men and 10 women), the majority of whom were Carleton University introductory psychology students receiving course credit for their participation. The mean age was 21.9 years. The participant who made the most money in the stock market investment task and the horse race betting task combined was awarded \$100.00 cash.

The Tasks

It was not realistic, nor ethical, to ask participants to wager real money at the racetrack or to invest their own money in a real stock market to study investment and gambling decision making. The computer simulations employed in this study offer a way of studying these activities without having participants risk their own money.

The study took place in room A428 Loeb, Carleton University during one session. Each participant was asked to complete both the stock market investment simulation task and the horse race betting simulation task on a personal computer. Both tasks were presented to the participant

on a computer monitor only (no mouse or keyboard). The experimenter sat opposite the participant at another desk with a separate monitor. A visual barrier separated the experimenter from the participant to prevent non-verbal communication. In each task participants instructed the experimenter to buy/sell stock or place bets on his/her behalf (explained in more detail below). This method of completing the tasks was chosen in order to reduce the amount participant training required.

The screen capture software Cybercam (<http://www.smartguyz.com/products/cybercam/>) was used to record participants' on-screen behaviour as they completed the horse race simulation.

The stock market investment task. One of the tasks participants completed was the investment task. The investment task was a computer stock market simulation program written in Visual Basic and used in previous studies of investment decision-making (Thorngate & Rajabi, 2001, See Figure 1 below).

In this task, participants were asked to buy or sell shares of stock in a simulated stock market by trading shares in three, hypothetical companies: Azco, Boco, & Cleo. On the top left-hand corner of the interface was a box containing numerical information relevant to the task. From this box, participants could see that they could trade shares in the three hypothetical companies. This box also kept a running total of the number of shares of each company they owned, the price per share, and the total value of their investments in that stock. Participants were also given information regarding their bank balance (amount of money not invested in stocks), and their net worth (their bank balance plus the value of all investments owned).

Figure 1. Screen shot of the investment simulation task interface

Also present on the investment task interface were a number of buttons. These buttons, located to the right of the information box just described, were used to buy or sell shares in each stock. If participants wished to buy or sell shares, they would ask the experimenter to do so on their behalf, eliminating the need for training on the mechanics of using the interface. Participants would tell the experimenter the stock name and the quantity they wished to buy or sell. The experimenter would then select one of the buttons and a dialog box would appear to enter the number of shares they wish to buy or sell. The computer program would not allow them to make a purchase that was larger than their bank account. Once the participant was satisfied and wished to modify his/her portfolio no further, he/she instructed the experimenter to continue to the next week of trading. To do so the experimenter selected the button located to the right of

the buy/sell buttons labelled “Next Week”. This button caused the simulation to move onto the next simulated trading week.

Located below the previously described elements was a graph. Plotted on the vertical axis of this graph was *stock price* (ranging from \$0 to \$200), and on the horizontal axis was *week* (ranging from 1-36). Coloured lines matching the font colour of the company name in the information box represented each company’s share price per day. When the simulation moved to the next trading week, the graph was updated with the new share prices for each of the three companies, as was the information box at the top of the screen. Participants then had another opportunity to buy and sell shares and the process was repeated for the next week of trading. This was repeated until the end of the simulation (36 trading weeks).

The investment task was amenable to a number of different configurations. Starting portfolio composition, bank account balance, or starting price per share for each company were all items that could be manipulated to achieve differing configurations of the investment simulation task. Other ways of altering the configuration of the task included: 1) manipulating the volatility of the market in general, or any given stock in particular; and 2) whether a given stock’s trajectory ended on week 36 as a net increase or decrease.

Participants started the task with \$1,000.00, \$400.00 in their bank accounts and 20 shares of each of the three different stocks (Azco, Boco, and Cleo) at \$10.00 per share. The trajectories of the share prices for these companies were essentially random walks; one stock would usually rise in price, one would usually fall, and one was volatile stock that in the long run did not significantly appreciate or depreciate in price.

The assignment of company name to the rising, falling and volatile stocks was counterbalanced across participants in order to control for company name/position effects.

The Horse Race Betting Task. The gambling task used in the study was a commercial horse race simulation game called *Horse Racing Fantasy* (version 9.15) created by Clubhouse Enterprises (Horse Racing Fantasy, 2002, <http://www.horseracegame.com>). *Horse Racing Fantasy* offers a number of advantages over other horse racing simulations examined. There was more realism in the program, and therefore arguably more external validity. It also allowed the experimenter to set up races between horses whose statistics were derived from historical data, and the program generated betting pools.

The simulation allowed participants to have considerable variety in how they chose to bet. Though they were required to be on each race, they could bet as much money as permitted by the size of their bank account. They could also, for example, choose to make conservative bets by betting on a horse with more favourable odds, or they could choose to make riskier bets that would result in higher payoffs should the horse have won.

Employing software such as *Horse Racing Fantasy*, not designed for use in an experiment, also had its disadvantages. It was difficult to manipulate some aspects of the interface, such as the information presented to the participant. The program was also difficult for participants to learn and therefore required training (see Procedure). This was partly remedied by employing a similar procedure to the investment task. Participants were presented with the interface and instructed the experimenter to place bets for them. This helped eliminate problems associated with learning to use the *Horse Racing Fantasy* interface.

In order to make the game easier to learn, and make the data simpler to collect, some limitations were placed on participants' behaviour. Races included only 5 horses per race, participants were limited to one bet per race, and only win bets (as opposed to place, show, exacta, etc.) were permitted. This allowed participants to vary each bet in two ways. They could

bet on a more or less risky horse (i.e. horses higher or lower odds), or they could change the size of their bet.

To begin, participants were presented a list of horses and asked to place bets on whichever horse they desired. The first screen presented to the participants contained the *Field of Horses* window and the *Enter Bets* window (see Figure 2).

On the bottom left corner of the *Field of Horses* window was a box containing information about the race. It indicated the number of horses, their odds, age, sex, speed, etc. On the right bottom corner of the window were a series of buttons. None of these buttons were applicable to the task except the continue button, which the experimenter selected once the participant had placed his/her bet.

The *Enter Bets* window (at the bottom of Figure 2) allowed the experimenter to place the participants bets by selecting the *Horse Number* from the drop down list box, entering the bet amount in the *Bet Amount* box, and pushing the button 'Place Bet'. Once the bet was placed, participants were presented with the *Race Window* (see Figure 3) and then could sit back watch the race. Each race lasted between 1 and 2 minutes. At the end, race results were displayed in the *Race Results* window (see Figure 4). Following this, the participant's results were presented in the *Player Results* window (see Figure 5). The experimenter would then set up the next race and the process would repeat until 7 races were complete.

Figure 2. Screenshot of Horse Racing Fantasy - Field of Horses and Enter Bets window

Field of Horses

Race 2 9/26/2002 1 1/16 miles
 3-Year-Olds and Up
 Purse: \$75,000
 Point Value: 50

CHURCHILL DOWNS Dirt Track
 Track Heavy
 Allowances from Scale Weights

Field of Horses

PP	Horse	Odds	Age/ Gender	Wt.	Speed	Stamina	Condition	Running Style	Likes Track?
1	Decidedly	8:5	5	119	Very Good	Very Good	Excellent	Flex/Mid Pack	OK
2	Desert Vixen	6:5	5 F	116	Good	Very Good	Excellent	Flex/Mid Pack	Yes
3	Relaxing	6	4 F	116	Good	Good	Excellent	Far Back	OK
4	Royal Native	8	5 F	116	Good	Very Good	Excellent	Near Pace	OK
5	Regret	7:2	4 F	116	Very Good	Very Good	Excellent	On Lead	Yes

Display Option
☒ Horse Traits
☐ Betting Pools
☐ Race Records

Recalc Odds
 Review PPs
 Assign Jockey
 Enter Bets
 Save Race
 Continue Exit
 Adjust Setup Details
 Print Race Setup
 Sound Call to the Post

Enter Bets

Bet Entry
 PP1 Bet Amount: 5
 New Bettor Maximum Bet: 500

☒ Win
☐ Place
☐ Show
☐ Win/Place/Show
☐ Exacta
☐ 2-Horse Exacta Box
☐ 3-Horse Exacta Box

Horse Number:
 2nd Horse:
 3rd Horse:

Bets Made

Delete Bet

Place Bet Continue Help

The horse racing task included 7 races, lasting a total of approximately 20 min, mirroring the average time spent by participants on the investment decision making task. The program started all players with \$1000.00. The participant could not bet more than he/she had in his/her account.

The configuration of each race (i.e. track condition, number of horses, odds on each horse, etc.) was held constant throughout the study so that each participant bet on the same set of races. Horses taking part in each race were chosen such that participants could easily discern horses more favoured to win from those less favoured to win. No horses with the same odds appeared in the same race. The order of races was randomised across participants.

Figure 3. Screenshot of Horse Racing Fantasy – Race window

Figure 4. Screenshot of Horse Racing Fantasy – Race Results window.

Race Results - Race 4 11/5/2002 \$75,000 Point Value: 50
3-Year-Olds and Up, 1 1/16 miles, Allowances From Special Weights

Order of Finish:

PP	Horse	Age/Gender	Weight	Margin	Odds to \$1
1	War Admiral	5	119	Neck	8:5
2	Sham	3	115	1 3/4 L	8:5
3	Hill Prince	4	119	5 3/4 L	4
4	Princess Rooney	5 F	116	2 1/2 L	6
5	Unbridled	4	119		5

Payoffs for \$2 Bet:

Win	Place	Show
\$4.60	\$2.40	\$2.20
	2.60	2.20
		2.20

1 - 2 Exact: \$8.20

Time of Race:

PIMLICO, Track Fast
Pace :23.07 :46.12 1:09.77 1:33.73 1:39.96
Winner :23.07 :46.12 1:09.77 1:33.73 1:39.96
Track Variant: 0.17 Winner Speed Rating: 121.2

Comments

Horse Times:
1 War Admiral :23.07 :46.12 1:09.77 1:33.73 1:39.96
2 Sham :23.28 :46.38 1:10.02 1:33.80 1:40
3 Hill Prince :23.58 :46.94 1:10.48 1:34.22 1:40.29

Figure 5. Screenshot of Horse Racing Fantasy – Player Results window

Player Results

Betting Results:

Bettor	Bet Amount	Horses(s)	Bet	Payoff
Matthew	\$100	Ruffian	to Win	\$310.00

Jockey Results - Matthew

Finishing Position

Odds to \$1

Points Earned

Dollars Earned

Exit

Player Statistics

☒ Betting ☐ Jockey ☐ Trainer

Player	Total Bets	Profit(Loss)	Bets Made	Bets Won	Bet Win %
Joe	\$0	\$0.00	0	0	0%
Matthew	\$215	\$112.00	14	4	29%
PP1	\$200	(\$200.00)	1	0	0%
PP2	\$505	\$345.00	2	1	50%

The Questionnaire

The questionnaire may be found in Appendix A. It is divided into 7 parts, A to G.

Part A: Demographic questions. Items in Part A: 1 to 4 were added to the questionnaire to collect demographic information such as age and gender.

Part B: Thorngate & Rajabi items. Thorngate & Rajabi (2002) found that some items on their self-report questionnaire correlated with behaviour on the investment decision making task. These items were therefore added to the questionnaire as items 1-8. Item 9 addresses the idea that people differ in their understanding of random events. Item 12 ("I am knowledgeable about horse racing") was added as a partner to item 7 from Thorngate & Rajabi (2002) ("I am knowledgeable about investing"). Item 10 ("Making money on the stock market is primarily due to luck."), item 11 ("Making money betting on horse races is primarily due to luck."), and item 13 ("A stock that has either decreased in value or remained the same for last few days is likely to

increase in value in the next few days.”) were added because they seemed like pertinent questions.

Part C: Risky prospects. Part C, Items 1- 6 were designed to assess the kinds of choices participants are likely to make in gain or loss type situations.

Research inspired by Prospect Theory has generally been conducted using mini-test/questionnaires. These mini-test/questionnaires require respondents to choose between two options, usually a risk free option (“A sure gain/loss of \$100) and a risky option (“ A 50% chance to win/lose \$200, or a 50% chance to win/lose nothing”). Respondents are then asked to answer a number of questions framed as potential gains (“ a sure gain/ a chance to gain”) or as potential losses (“a sure loss/ a chance to lose”). The results of these types of studies are the basis on which Prospect Theory was founded.

Sorley (1999) used a 12-item questionnaire similar to that employed in most prospect theory research. His questionnaire employs a number of different scenarios framed as either loss situations or gain situations. Six items were taken from Sorley’s questionnaire and added to the present one.

Part D: Explanatory style. Part D, Items 1- 5 address the construct of explanatory style. To measure explanatory style, Sorley used the Expanded Attributional Style Questionnaire (Peterson & Villanova, 1988) and Atlas and Peterson (1990) used an adjusted form of this questionnaire they called the Betting Attributional Style Questionnaire (BASQ). The BASQ is an 8 item scale with 4 items presenting general hypothetical bad events, such as “You lose your job.”, and 4 presenting hypothetical bad events specifically related to horse racing, such as “Gambling at the horse races you lose the first five bets of the night”. The current questionnaire used five items: three general hypothetical negative events; one hypothetical negative event related to horse

racing and one hypothetical event related to stock market investing. The first four items were taken directly from the BASQ and the last item was created specifically for this questionnaire. For each question, participants were asked to provide one major cause of the hypothetical event, then to rate the event on three seven point scales representing: 1) internality vs. externality (totally due to others – totally due to me); 2) stability vs. instability (never present – always present); and 3) globality vs. specificity (just this situation – all situations). Those people with internal, stable, and global attributions (corresponding to higher scores on the scales) were considered to employ a pessimistic explanatory style, whereas those with external, unstable, and specific attributions (lower scores on the scale) were considered to employ an optimistic explanatory style (Atlas and Peterson, 1990).

Part E: Overconfidence. Part E, items 1-10 are concerned with measuring overconfidence. This mini-test of overconfidence is very similar to that originally constructed by Russo & Schoemaker (1989). Their test measured people's confidence concerning general knowledge questions. People were asked to provide confidence intervals such that they were 98% sure the correct answer to the question is within the interval. Overconfident participants gave intervals that did not include the right answer. The overconfidence score is the percentage of questions in which the true answer falls outside the given interval. The greater the percentage, the more overconfident the respondent. In their study, Russo and Schoemaker (1989) gave the measure to Harvard MBA students, and asked them to give two numbers such that they were 98% sure their answers would fall within their chosen range. The logic goes, if they had calibrated their abilities accurately, only 2 % of their answers would fall outside their ranges. They found, on average, 54 % of the answers fell outside the given ranges.

For use in the current questionnaire, however, Russo & Shoemaker's (1989) test was slightly modified as it contained several items unsuitable for Canadian respondents. For example, on Russo and Shoemaker's test they asked respondents to give estimates of distances in miles. These items were changed to kilometres. Russo & Shoemaker's (1989) original mini-test may be found in Appendix B and the modified version used in this questionnaire, in Appendix A.

Another possible manifestation of overconfidence has to do with whether someone believes that they will perform better than most others at a task. With this in mind, included are items 11 ("I am better at investing than the majority of people") and 12 ("I am better at gambling than the majority of people").

Part F: Attitudes toward money. Part F, Items 1-6 are drawn from the Money Scale (Furnham, 1984). Because both gambling and investment decision making are activities that intimately involve money, it seemed intuitively appealing to add items from a scale that measured peoples' attitudes toward money. Furnham (1984) developed a scale with 54 statements. Respondents were asked to indicate how much they agreed or disagreed with the statements by circling a number on a Likert scale. A factor analysis of his scale revealed 6 factors: (1) Obsession; (2) Power/Spending; (3) Retention; (4) Security/Conservative; (5) Inadequate; and (6) Effort/Ability. For this study, the one item that loaded most heavily on each factor was incorporated into the questionnaire. In two cases, these questions referred to employment. Because many participants were students, the employment questions were ignored and the item scoring the next highest on that factor was added. The attitudes toward money questions were included in Part F, items 1-6.

Procedure

Participants were asked to come to room A422, Loeb Building, on the campus of Carleton University, Ottawa, Ontario, and complete the tasks. Once they read the briefing form and signed the informed consent sheet, they completed: (1) the investment simulation task; (2) the horse race betting task; and (3) a paper and pencil version of the questionnaire (see Appendix A). Task order was completely counterbalanced across participants.

Before each simulation, participants in this study were given instructions on how to complete it. Included in Appendix C is a transcript of the instructions. When giving these instructions, care was taken not to inadvertently suggest investing or betting strategies. Included in the horse race instructions was a very brief overview of the nature of odds at the racetrack.

In order to motivate participants, they were told that the person who made the most money when their results from the stock market simulation and the horse race simulation were combined, would win \$100 cash.

In pilot studies, participants were asked to think aloud as they performed the tasks. However they continuously had to be reminded to do so. When asked why, they reported that it was a complicated task and they kept forgetting to do so. Though it may have yielded much useful data, to simplify the tasks, participants were not requested to think aloud in this study.

Once the participant received the appropriate instruction and had questions answered, the first task began. For the purposes of description below, assume the participant completed the investment decision making task first, the questionnaire second, and the horse race betting task last.

The Stock Market Investment Task.

Participants were asked to pretend that a relative had just passed away and had bequeathed a total inheritance of \$1,000: \$400 in a bank account, and 20 shares of each of the three different stocks, Azco, Boco, and Cleo at \$10 per share. This hypothetical scenario was borrowed from Study 1 of Thorngate and Rajabi's (2002) paper, and was explained in the instructions given to the participants before completing the task (see Appendix C). Participants could then instruct the experimenter (serving as broker) to buy or sell stocks on their behalf until 36 trading weeks were complete. The stock market investment simulation took approximately 20 minutes to complete.

Data in the stock market simulation task were saved by the computer simulation programme. Each time the 'Next Day' button was pressed, the following eight pieces of information were recorded: (1) the number of shares of each company owned after trading that week (three pieces of information); (2) the price of each share that week (3 pieces of information); (3) the amount of money the participant had in his/her bank account at the end of each trading week; and (4) his/her net worth at the end of each trading week. From these simple measures, more complex measures were derived (see results section).

Horse Race Betting Task

Like the investment task, participants were also presented with a hypothetical scenario in the horse race betting task. They were asked to pretend a relative had just left them an inheritance of \$1000 on condition that they use the money to see how they would fare on a night at the racetrack. Participants were then asked to begin the simulation (the mechanics of the betting process are described in detail above). As noted previously, when participants placed their bets, they did so based on information presented to them in the *Field of Horses* window (Figure 2). It was initially assumed that participants would make betting decisions based on the horses' odds.

During pilot studies, however, several participants noted that they often incorporated several of the other pieces of information available to them, such as weight, stamina etc. (see Figure 2), in addition to the horses odds when making their betting decision. In response to this possibility, participants were instructed to ignore all information except for the odds when making their betting decisions.

In case instruction was not enough to have participants base their betting decisions on the horses' odds, another remedy was attempted. As noted previously, it was impossible to alter the interface of *Horse Racing Fantasy* in order to remove the other information that participants may have been attending to. There was, however, an option on the *Field of Horses* window that allowed one to vary the information on the screen (see Figure 6 below). To gauge whether this difference in information made any difference to betting behaviour, half the participants were presented with this alternative *Field of Horses* window, and half with the *Field of Horses* window discussed above (see Figure 2).

Figure 6. Screenshot of Horse Racing Fantasy – Alternative Field of Horses window.

Field of Horses

Race 59 2/18/2003 3 furlongs

3-Year-Olds and Up
Purse: \$75,000
Point Value: 50

GOLDEN GATE FIELDS Dirt Track
Track Fast
Allowances from Scale Weights

Field of Horses

PP	Horse	Odds	Age	Gender	Wt.	Win Pool	Place Pool	Show Pool
1	Ruffian	9.5	3	F	102	2700	903	701
2	Red o' Roses	5	5	F	118	1221	501	332
3	Silver Charm	5.2	4		122	2058	539	571
4	Mom's Command	2	5	F	120	2430	739	552
5	All Along	4	5	F	118	1472	578	422

Display Option

- ☐ Horse Traits
- ☒ Betting Pools
- ☐ Race Records

Recalc Odds

Review PP's

Assign Jockey

Enter Bets

Save Race

Continue **Exit**

Adjust Setup Details

Print Race Setup

Sound Call to the Post

To determine further how much participants relied on the different pieces of information displayed in the two conditions, they were asked to complete an additional questionnaire in which they rated the importance of the information displayed to them. Depending on which interface they were presented, they either completed *Horse race mini questionnaire (1)* (Appendix D), or *Horse race mini questionnaire (2)* (Appendix E). One of these two questionnaires was completed by participants immediately upon completing the simulation.

As noted previously, participants' betting behaviour was recorded using screen capture software. This allowed the review and recording of data after the simulation was complete. Just as data were collected per trading day in the investment decision making task, data were collected for each race in the horse race betting task. The following seven pieces of information were recorded by hand to a spreadsheet: (1) the odds of the horse bet on; (3) the rank order of the horse bet on (i.e., expected finish based on pre-race odds); (4) the amount of the bet; (5) how much the participant won (\$0.00 if they lost); (6) net worth at the end of the race; and, (7) net worth at the end of all 7 races. As with the investment decision making task, several indices of gambling behaviour were derived from the data (see Results section).

The horse race betting task took approximately 20 minutes to complete.

Questionnaire Completion Task

Participants were presented with and asked to complete a paper and pencil version of the questionnaire (Appendix A). Questionnaire completion took approximately 20 minutes. The entire study took approximately 1 hour to complete.

Results

Data collected in the study were analysed in several different ways. Twenty-five behavioural indicators were derived from the investment data and 23 from the horse race betting data. To start, data from each task were analysed separately and principal components analyses were performed on each data set in order to reduce the complexity of the data. Behavioural indicators from the investment task were then correlated with behavioural indicators from the horse race betting task. Following, the correlation matrix, resulting from correlating extracted components from each task, was examined. In an attempt to ascertain the relation between the best linear combination of components from each task, canonical correlation was performed between the principal components extracted from the horse race betting task and the investment task. Finally, the questionnaire was analysed to see if any items or item aggregates predicted any of the behaviours/strategies employed by participants in either of the tasks.

Task-Order Effects

Forty-eight one way between groups analyses of variance were performed to ascertain whether order had any effect on any of the indicators in either the horse race betting simulation or the stock market investment simulation. There were none.

Stock market

Indicators. From the raw data collected in the stock market investment task, 25 indicators were derived that were thought to provide measures of stock market investment behaviour (see Table 1). Recall that the trajectory of the stock prices over 36 weeks allowed participants to adopt a strategy that would lead to a net gain. With one rising, one falling, and one volatile stock, had participants sold all shares in the losing and volatile stocks, then invested heavily in the rising stock, they would have ended the simulation with substantially more money than they had

when they began. Conversely, had participants held onto the losing stock (the disposition effect) and/or invested further in the losing stock (escalating commitment) they would have ended 36 simulated weeks of trading losing money.

At the end of the simulation participants on average lost money, this was similar to Thorngate and Rajabi's (2002) findings. Participants' average *Net gain/loss* (indicator a) was -\$4.16. This figure, however, is not very meaningful as there was considerable variability ($SD = \$391.70$). The most successful participant ended with a net gain of \$966. The least successful participant ended trading with \$0.00 after investing everything into the falling stock; in that case the company went bankrupt and the stock became worthless.

Extremely large individual differences in investment strategy are apparent in the ranges of the indicators listed in Table 1. As the configuration of the stock market was such that those employing the investment strategies outlined above would lead to reliable outcomes of gain or loss, comparing those who made money with those who lost money was a useful way to examine individual differences in investment strategy

Table 1

Indicators used to measure stock market behaviour

Indicator Name	Mean	SD	Range
(a) Net gain/loss	-\$4.16	\$391.72	\$-1000.00 to \$965.97
(b) Amount of rising stock held at the end	21.94	21.09	0 to 68
(c) Amount of falling stock held at the end	32.15	60.70	0 to 347

Indicator Name	Mean	<i>SD</i>	Range
(d) Amount of volatile stock held at the end	32.38	51.19	0 to 210
(e) Average number of transactions per trading week	.7951	.3529	.03 to 1.58
(f) Average number of shares traded per transaction	14.07	10.24	2.83 to 51.06
(g) Average \$ amount per transaction	134.1	101.88	27.63 to 580.96
(h) Average proportion of net worth invested per trade	.7322	.1577	.33 to 1.00
(i) Frequency of purchases following increase in stock value	7.54	3.71	0 to 16
(j) Frequency of purchases following decrease in stock value	7.25	3.85	1 to 16
(k) Frequency of sales following increase in stock value	6.15	4.12	0 to 17
(l) Frequency of sales following decrease in stock value	5.96	3.46	0 to 13
(m) Frequency of neither purchasing nor selling following increase in stock value	37.67	8.16	20 to 54
(n) Frequency of neither purchasing nor selling following decrease in stock value	37.17	7.05	25 to 56
(o) Total number of shares purchased following increase in stock value	89.67	112.81	0 to 761

Indicator Name	Mean	<i>SD</i>	Range
(p) Total number of shares purchased following decrease in stock value	99.52	88.34	1 to 487
(q) Total number of shares sold following increase in stock value	94.53	104.95	0 to 635
(r) Total number of shares sold following decrease in stock value	82.77	74.95	0 to 381
(s) Total \$ amount purchased following increase in stock value	\$978.43	\$1273.38	\$0.00 to \$8563.41
(t) Total \$ amount purchased following decrease in stock value	\$829.66	\$689.94	\$10.03 to \$3301.96
(u) Total \$ amount sold following increase in stock value	\$1084.64	\$1199.21	\$0.00 to \$7080.52
(v) Total \$ amount sold following decrease in stock value	\$812.17	\$920.62	\$0 to \$6015.45
(w) Correlation between stock price and the number of shares owned *	.12		-.79 to .97
(x) Correlation between stock value change and the number of shares traded *	.151		-.43 to .58
(y) Correlation between stock value change and \$ amount worth of stock traded *	.134		-.44 to .50

* Values are correlation coefficients, but were transformed to z scores in order to determine mean and perform all subsequent analyses.

Twenty-six out of the 48 participants (54%) gained money by the end of 36 weeks of trading. Their average net gain was \$252 on their original \$1,000 ($SD = \$214$, range = \$14 to \$966). Twenty-two of the 48 participants (46%) on average lost money, with their average net loss totalling \$-306 ($SD = \335, range = \$-12 to \$-1000).

Recall that the configuration of the stock market was such that the three stocks each followed a different trajectory; one was expected to increase in value (the rising stock), one was expected to decrease in value (the losing stock), and one was expected to neither increase or decrease in value (the volatile stock). Therefore, as would be expected, the 26 participants who had a net gain ended with significantly more shares in the rising stock ($M = 27.5$ shares) than the 22 participants who lost money ($M = 15.36$), $F(1,46) = 4.22$, $p < 0.05$. Similarly, those who had a net loss in the simulation ended with more shares of the losing stock ($M = 49.64$) than the rising stock ($M = 17.35$). This difference, however, was not significant. There were no other significant differences in the number of shares owned between those who gained and those who lost money in the simulation.

The most successful participant ended with the second highest number of shares of rising stock (67), and none of the falling or volatile stock. The least successful participant ended trading with 40 of the falling and 210 of the volatile stock. Both strategy and bad luck accounted for this dismal performance for both the companies associated with these stocks went bankrupt by week 26. The second least successful participant, who ended trading with \$ 2.29, had no shares of the rising or volatile stock and 347 shares of the falling stock.

These results show clear individual differences in investment strategy. Some participants tended to invest heavily in, and refused to sell shares of the declining stock (these participants were also those who lost money in the simulation). Others sold their shares in the declining stock

and invested in the rising stock ending the simulation with a net gain. These results provide evidence that both the 'disposition effect' and 'escalating commitment' were strategies/behaviours present in the stock market investment task.

Indicators (i) to (y) in Table 1 were developed to examine participants' responses to stock increases or decreases. Frequency indicators, (i) to (n), were merely a count of the number of times the participant bought, sold, or neither bought nor sold stock after that stock had either increased or decreased in the last week of trading. In the same manner indicators (o) to (r) were the sum of the number of shares, and indicators (s) to (v) were the sum of the dollar amount bought or sold after a stock had either increased or decreased in the last week of trading. Indicators (w), (x), and (y) are, as their names suggest, correlations. For indicator (w) *Correlation between stock price and the number of shares owned*, the number of stocks owned was regressed upon the corresponding dollar value of that stock. This was done across all three stocks. The result was a correlation coefficient for each person that was representative of whether the participant tended to own more expensive stock (+ve r value), or own more inexpensive stock (-ve r value). Similar to the previous measure, indicator (x) *Correlation between stock value change and the number of shares traded*, resulted from regressing the change in value of the stock from the last trading week, i.e. how much the stock went up (+ve value change) or down (-ve value change) with how many shares the participant bought or sold. The resultant indicator is a measure indicating whether participants tended to buy shares in stock that increased in the last week and sell shares in stock that decreased in the last week (+ve r values), or whether participants tended to sell stocks that increased in the last week and buy stocks that decreased in value in the last week (-ve r values). Indicator (y) *Correlation between stock value change and \$ amount worth of stock traded*, is essentially the same except that \$

value of stock is used instead of the # of stocks bought or sold. Both indicators were used in order to be sensitive to whether participants were making decisions based on the \$ amount of the transaction rather than # of shares/transaction. The averages, standard deviations, and maximum/minimum values may be found in Table 1.

Though individual differences were apparent in the ranges of these indicators, of seventeen one-way, between-groups ANOVAs (one performed on each indicator), only one indicator was sensitive enough to distinguish between participants who gained money from those who lost money. Indicator (*w*) *Correlation between stock price and the number of shares owned* was significantly different between those who lost money ($r = -.19$) and those who gained money ($r=.37$), $F= 5.735$, $p<.05$.

It is curious that though these indicators have face validity as a measure of the extent to which the disposition effect or dollar cost averaging are present, they do not distinguish those who gained money from those who lost money. It is possible that these indicators are insensitive.

Simplifying the Data / Creating more Sensitive Measures. As may be expected, many of the indicators discussed above are highly correlated with each other, indicating they may be measuring similar behaviours. For example, (*o*) *Total number of shares purchased following increase in stock value* is highly correlated ($r= 0.98$, $p<.0001$) with (*s*) *Total \$ amount purchased following increase in stock value*. This may also be seen when correlating 'opposite' indicators. For example, (*b*) *Amount of rising stock held at the end* is negatively correlated with (*c*) *Amount of falling stock held at the end* ($r= -0.29$, $p<.05$). Perhaps combining correlated indicators would result in measures that are more sensitive and more reliable for comparing the investment simulation to the horse race betting simulation in subsequent analyses. For these

reasons, Principal Components Analysis (PCA) with a Varimax rotation was performed on the data set. PCA is considered the solution of choice for such a situation (Tabachnick & Fidell, 1996).

PCA produced 5 components with eigenvalues greater than 1. To determine the number of components to be considered important in this analysis, the Scree test was used (Cattell, 1966). In a Scree test, eigenvalues are plotted against the extracted components. As the number of components increases, the eigenvalues rapidly decrease. If one attempts to fit the graph with two lines, one with a steep slope (fitting the larger eigenvalues) and one with a gentle slope (fitting the smaller eigenvalues), the point at which the lines cross separates the components that are accounting for larger amounts of variance from those offering diminishing returns (Tabachnick & Fidell, 1996).

Four components passed this test and were considered in the analysis. They accounted for approximately 78% of the variance (loadings on components and percents of variance are shown in Table 2). Though Table 2 includes all loadings greater than .1, only variables with loadings in excess of .63 were interpreted. According to Comrey and Lee (1992), loadings above .63 are considered to be 'very good' measure of the component, and those above .71, 'excellent' measures of the component.

As may be seen in Table 2, the six indicators loading highest positive on the first component, all loaded higher than 0.9. These indicators represented either how many stocks the participant purchased (e.g. (o) *Total number of shares purchased following increase in stock value*) or how much money the participant spent per transaction (e.g. (s) *Total \$ amount purchased following increase in stock value*) regardless of changes in stock value. Following the top 6, the remaining indicators loading highest on this component were indicators (t) *Total \$ amount purchased*

following decrease in stock value, (r) Total number of shares sold following decrease in stock value, and (f) Average number of shares traded per transaction. Because these indicators represent the magnitude or quantity with which a participant bought or sold stock, the first extracted component was interpreted as representing the *Boldness-timidity* of their purchasing behaviour. This component accounts for approximately 35% of the variance.

Table 2

Principal components analysis of stock market investment indicators

Indicator	Component loadings			
	1 ^a	2	3	4
(s) Total \$ amount purchased following increase in stock value	.95			
(o) Total number of shares purchased following increase in stock value	.94			
(u) Total \$ amount sold following increase in stock value	.93			
(q) Total number of shares sold following increase in stock value	.92			
(v) Total \$ amount sold following decrease in stock value	.91			
(g) Average \$ amount per transaction	.90			
(t) Total \$ amount purchased following decrease in stock value	.82			
(r) Total number of shares sold following decrease in stock value	.75			
(f) Average number of shares traded per transaction	.72			

Indicator	Component loadings			
	1 ^a	2	3	4
(e) Average number of transactions per trading week		.95		
(j) Frequency of purchases following decrease in stock value		.86		
(n) Frequency of neither purchasing nor selling following decrease in stock value		-.82		
(k) Frequency of sales following increase in stock value		.78		
(m) Frequency of neither purchasing nor selling following increase in stock value		-.77		
(i) Frequency of purchases following increase in stock value		.72		
(l) Frequency of sales following decrease in stock value		.68		
(y) Correlation between stock value change and \$ amount worth of stock traded			.91	
(x) Correlation between stock value change and the number of stocks traded			.89	
(b) Amount of rising stock held at the end			.73	
(w) Correlation between stock price and the number of shares owned			.70	
(h) Average proportion of net worth invested per trade.			.68	

Indicator	Component loadings			
	1 ^a	2	3	4
(c) Amount of falling stock held at the end				.85
(p) Total number of shares purchased following decrease in stock value				.80
(a) Net gain/loss				-.76
Percent of variance	35.43	19.8	14.54	8.18

^aComponent Labels

- 1 – Boldness-timidity
- 2 – Activity
- 3 – Sensitivity to Value Change
- 4 – Disposition effect/Escalating commitment

The second component had the highest loading from indicator (e) *Average number of transactions per trading week*, followed by high-positive loading from indicators (j), (k), and (i), measuring frequency of either purchasing or selling regardless of increase or decrease of stock value in the last week. In addition, indicators measuring the frequency of doing nothing, indicators (n) and (m), load high-negative on this component. Because all these indicators represent the frequency with which a participant engaged in transactions or whether the participant was an active or inactive investor, the second extracted component has been interpreted as *Activity*. This component accounts for approximately 20% of the variance.

Indicators loading highest positive on the third component include those corresponding to how much a change in the value of a stock is predictive of how much (in both \$ and # of shares) a participant is likely to buy or sell of that stock (Indicators (y) & (x) respectively). Therefore, this component has been labelled *Sensitivity to Value Change*. This component accounts for approximately 15% of the variance

The fourth component accounts for approximately 8% of the variance, and has been interpreted as representing *Disposition Effect / Escalating Commitment*. Indicators loading highest on this component represent the extent to which participants hold onto shares in the losing stock or purchase stock that has declined in value. These indicators, in order of highest loadings to the lowest loadings are: indicator (c) *Amount of falling stock held at the end*, and indicator (p) *Total number of shares bought after decrease in the last week*. It is interesting to note that indicator (a) *Net gain/Loss* loads high-negative on this component reflecting in this investment simulation, that the strategy/behaviour this component represents was a losing one. Other indicators worth mentioning that strengthen the labelling of this component include the high-negative loading on this component with indicator (w) *Correlation between stock price and # shares owned*.

Individual participant scores on the identified components were derived using the regression method available in the SPSS statistical computer package. Four one-way, between-groups ANOVAs were performed on each of these new scores to determine whether these new components were more successful at distinguishing those who ended the simulation with a net gain from those who ended with a net loss. People who lost money scored significantly higher on the extracted component, *Disposition effect / Escalating Commitment* ($M = 0.59$), than those who gained money ($M = -.50$) $F(1,46) = 20.04, p < .0001$, however, no other components separated the two groups.

The components extracted in the PCA provide insight into participant behaviour in this task. The first component *Boldness-timidity* accounts for the largest amount of variance, and is therefore one of the dominant constructs/variables describing stock market investment behaviour. Similar results were found in Thorngate & Rajabi (2002). The existence of the fourth

component, *Disposition effect / Escalating Commitment*, provides evidence that this behaviour/strategy is present in this study. We know, in this study, that falling prey to the disposition effect or escalating commitment leads to loss. That this component is the only one that distinguishes those who made money from those who lost money, is further evidence that this component is properly labelled.

Horse Race

Indicators. Similar to the investment simulation, several indicators thought to provide measures of horse race betting behaviour were derived from the raw data collected during the simulation (see Table 3). Like the investment simulation, the horse race betting simulation allowed participants to pursue an optimum strategy; each race had a predetermined winner. In 6 out of the 7 races it was the horse that was most favoured to win (i.e. the top ranked horse), and in the remaining race it was the horse that was second most favoured to win. The order of these races was randomised across participants. With the benefit of hindsight, a participant's optimum strategy would have been to continually bet on the most favoured horse. Had participants tended to bet on long-shot horses or place riskier bets on horses following a loss (doubling down), they would have ended the simulation losing money.

Table 3

Indicators used to measure horse race betting behaviour

Indicator Name	<i>M</i>	<i>SD</i>	Range
(a) Net gain/loss	\$289.86	\$1275.75	\$-1000.00 to \$5496.00
(b) Average \$ amount per bet	\$246.22	\$173.28	\$6.00 to \$824.00
(c) Frequency of bets on the top ranked horse	3.06	1.78	0 to 6
(d) Frequency of bets on the lowest ranked horse	.56	1.05	0 to 4
(e) Average proportion of net worth bet per wager	.25	.16	.01 to .62
(f) Frequency of larger bets following a win	1.90	1.40	0 to 5
(g) Frequency of larger bets following a loss	1.35	1.10	0 to 4
(h) Frequency of smaller bets following a win	.38	.61	0 to 2
(i) Frequency of smaller bets following a loss	1.13	.87	0 to 4
(j) Frequency of the same bet following a win	.50	.74	0 to 4
(k) Frequency of the same bet following a loss	.75	1.04	0 to 4
(l) Frequency of riskier bets following a win	.94	.81	0 to 3
(m) Frequency of safer bets following a win	.19	.39	0 to 1
(n) Frequency of riskier bets following a loss	.85	.99	0 to 3
(o) Frequency of safer bets following a loss	1.52	.85	0 to 3
(p) Frequency of bets on the same ranked horse following a win	1.65	1.66	0 to 5

Indicator Name	<i>M</i>	<i>SD</i>	Range
(q) Frequency of bets on the same ranked horse following a loss	.85	.85	0 to 3
(r) Total \$ amount bet following wins	\$994.46	\$1122.39	\$0.00 to \$5543.00
(s) Total \$ amount bet following losses	\$619.00	\$484.63	\$0.00 to \$1750.00
(t) Total \$ amount bet on riskier horses following a win	\$283.88	\$414.35	\$0.00 to \$2000.00
(u) Total \$ amount bet on safer horses following a win	\$27.08	\$82.83	\$0.00 to \$470.00
(v) Total \$ amount bet on riskier horses following a loss	\$132.44	\$216.20	\$0.00 to \$1200.00
(w) Total \$ amount bet on safer horses following a loss	\$318.35	\$333.97	\$0.00 to \$1410.00

As noted in the Methods section, in order to use some of the indicators described above as measures of risky behaviour, it was important to make sure participants were making decisions based on the horses odds and not the other information available to them in the *Field of horses* window (see Figure 2). Recall that half of the participants were presented with a screen containing the information: *Odds, Age/Gender, Weight, Speed, Stamina, Condition, Running Style, and Likes Track*. (see Figure 2), and the other half were presented with a different screen that contained the information: *Odds, Age/Gender, Weight, Win Pool, Place Pool, Show Pool* (see Figure 6). To test whether participants were making decisions based on the odds of the horse, they were asked to fill out a questionnaire (see Appendices E and F). These questionnaires

requested that participants rate how important the information was to them as they made their betting decisions (1 is very important and 7 is not important at all)

With the exception of one participant, everyone rated the odds as the most important piece of information they used in making their betting decision, $M = 1.6$ (1 was a rating of 'Very Important' and 7, 'Not at all Important' - see Appendices D & E). This result indicates that though presented with other information, participants reported basing their betting decisions primarily on the horses' odds. There was no difference in *Odds* importance ratings between the groups receiving the different interfaces.

Following, 23 one-way, between-groups analyses of variance were performed to see if the different interfaces had any effect on any of the 23 different indicators. No significant differences were found. Therefore the horse race betting task data from the two groups receiving different interfaces were pooled and analysed as one group.

At the end of the horse race betting simulation, participants on average gained money ($M = \$289.88$). This value, however, was significantly effected by two participants who won a considerable amount (\$5,496 and \$3,585). The median may be a more informative figure ($Mdn = \$ -50$). As expected, the two participants making the most money in the simulation placed the majority of their bets on the top ranked horses, both doing so in 5 out of the 7 races.

Large individual differences in betting strategy, similar to the stock market investment task, may be seen in Table 3. These differences are apparent in the ranges of the indicators listed. The configuration of the horse race betting task is such that those employing the betting strategies outlined above will generally lead to predictable outcomes of gain or loss. Therefore, as in the stock market investment task, comparing those who made money with those who lost money is a useful way to examine individual differences in betting strategy.

Twenty-two out of the 48 participants (46%) gained money at the end of the 7 races. Their average net gain was \$1,270 in addition to their original \$1,000 ($SD = \$1,262$, range = \$180- \$5,496). Of the remaining 25 participants (54%), their average loss was \$561.50 ($SD = \390.13, range = \$ -42.00 to \$ -1000.00). The seven least successful participants ended the task with \$0.00, losing their initial \$1000.00. All seven of these people bet all they had on the last race - a strategy shared by 19 of the participants, including the two who made the most money. Those two people however, chose a winning horse. One participant, due to his/her pattern of wins and losses, happened to end with exactly the \$1000 he/she started with.

People could vary how risky they wanted to be in two ways: (1) they could bet on more or less risky horses (horses with high or low odds); or (2) they could vary how much they bet. Different horses with different odds competed in each race. To standardise this measure across races the odds were translated to 'rank order'; the horse most favoured to win was ranked as #1 and least favoured to win, #7. Indicators (c) and (d) were merely a count of the number of times people bet on the top ranked and lowest ranked horses.

Participants who made money in the horse race simulation ended the task betting more frequently on the top ranked horse, ($M = 4.27$) than those who lost money ($M = 2.03$), $F(1,46) = 30.63$, $p < .0001$. Those who had a net loss bet more frequently on the lowest rank horse ($M = 0.85$) than those who won money ($M = 0.23$), $F(1,46) = 4.44$, $p < .05$. There was, as would be expected, a significant positive correlation between *Net Gain/loss* (indicator a) and *Frequency of bets on the top ranked* horse (indicator c) ($r = 0.51$, $p < 0.0001$). Though there was also a negative correlation between *Net Gain/Loss* (indicator a) and *Frequency of bets on the lowest ranked* horse (indicator d) ($r = -0.12$), this correlation was not significant.

Indicators (f) to (k) (see Table 3) are a count of the number of times participants either made larger, smaller, or the same bets following loss or gain. Indicators (l) to (q) are a count of the number of times participants made riskier, safer, or the same bet following loss or gain. Indicators (r) and (s) is the sum total of \$ the participant bet following a win, and indicators (t) to (w) are the sum amount of money participants bet on riskier or safer horses following a win or loss. The averages, standard deviations, and maximum/minimum values may be found in Table 3.

Participants who made money in the horse race simulation ended the task increasing the size of their bet following a win more frequently ($M = 2.82$) than those who lost money ($M = 1.12$), $F(1,46) = 27.44$, $p < .0001$), and making bets on the same ranked horse following a win ($M = 2.77$) more frequently than their counterparts who lost money ($M = .69$), $F(1,46) = 30.65$, $p < .0001$. As noted previously, these were also the same people who tended to bet on the top ranked horse.

In contrast, participants who lost money in the simulation increased the size of their bets following a loss more frequently ($M = 1.73$) than those who gained money ($M = .91$), $F(1,46) = 7.56$, $p < .05$. They also made riskier bets following loss more frequently ($M = 1.35$) than those who gained money ($M = .27$) $F(1,46) = 19.59$, $p < .0001$), and bet more money on riskier horses following loss ($M = \$215.65$) than their winning counterparts ($M = \$34.09$), $F(1,46) = 10.017$, $p < .01$. As noted previously, the configuration of the horse race betting simulation was such that those engaging in doubling down type behaviours /strategies would tend to lose money. These data provide evidence that these behaviours/strategies were present, and that those engaging in them did indeed tend to lose money.

Simplifying the Data / Creating more Sensitive Measures. As many of the stock market indicators were intercorrelated, so too were many of the horse race betting indicators, for example (t) *Total \$ amount bet on riskier horses following a win* and (n) *Frequency of riskier bets following a loss* ($r = .63, p < .0001$). Therefore, as with the investment simulation, a PCA with a Varimax rotation was performed to reduce the complexity of the data. Of the seven components with eigenvalues greater than one generated in this analysis, three passed the Scree test and will be discussed. These three components accounted for 56.61% of the variance.

Loadings on components and percents of variance accounted are shown in Table 4. As in the PCA done on the stock market investment indicators, the criterion for meaningful correlation was .63.

As may be seen in Table 4, the high-positive loading of indicators (p) *Frequency of bets on the same ranked horse following win*, and (c) *Frequency of bets on the top ranked horse* may in conjunction with the high-negative loading of (g) *Frequency larger bets following a loss*, may be taken as evidence that the first component measures in part the extent to which participants prefer riskier or safer horses. Other indicators with high-positive loadings include (f) *Frequency of larger bets following a win*, and (r) *Total \$ amount bet following a win*. These loadings suggest that the component also measures the extent to which participants become more confident and bet more when they believe they have a winning strategy, and more cautious when their strategy is not reinforced. The first extracted component has been interpreted as representing the extent to which participants are *Cautious-risky* in their betting strategy. This component accounts for approximately 30% of the variance.

Table 4

Principal components analysis of horse race betting indicators

Indicator	Component loadings		
	1 ^a	2	3
(p) Frequency of bets on the same ranked horse following a win	.91		
(f) Frequency larger bets following a win	.88		
(c) Frequency of bets on the top ranked horse	.88		
(r) Total \$ amount bet following wins	.74		
(g) Frequency larger bets following a loss	-.73		
(d) Frequency of bets on the lowest ranked horse	-.68		
(o) Frequency of safer bet following a loss	-.63		
(e) Average proportion of net worth bet per wager		.85	
(b) Average \$ amount per bet		.80	
(s) Total \$ amount bet following losses		.79	
(w) Total \$ amount bet on safer horses following a loss		.67	
(v) Total \$ amount bet on riskier horses following a loss			.84
(n) Frequency of riskier bets following a loss			.67
Percent of variance	30.19	15.47	10.95

^aComponent Labels

1 – Cautious-risky.

2 - Boldness-timidity.

3 - Risk following loss

Indicators loading highest on the second component include (e) *Average proportion of net worth bet per wager* and (b) *Average \$ amount per bet*. These indicators, along with the positive loadings from all other indicators measuring amount bet, represent the magnitude or quantity of betting. Therefore, the second extracted component has been interpreted as representing the *Boldness-timidity* of participants betting behaviour. This component accounts for approximately 15% of the variance.

The remaining component reflects a distinctive betting style in response to loss. Loading highest on the third component are indicators (v) *Total \$ amount bet on riskier horses following a loss* and (n) *Frequency of riskier bets following a loss*. Recall that ‘doubling down’ refers to the act of making riskier bets following loss, by either increasing the amount bet, or by betting on more long-shot events (in hopes of winning back that which was lost). Though it is tempting to label this component ‘doubling down’, it would not be entirely correct to do so. An essential part of doubling down is placing larger bets following a loss. This behaviour is measured by the indicator (g) *Frequency larger bets following a loss*. This measure, however, had a loading of less than .1 on this component, indicating that it is not measuring this element of the strategy. This component has therefore been interpreted as representing the participants *Risk following loss*. This component accounts for approximately 11% of the variance.

Two of the three components in the horse race betting task tended to distinguish winners from losers. Participants who won money on the horse race betting task showed significantly more caution on the first component, *Cautious-risky* ($M = 0.55$), than those who lost money ($M = -0.47$), $F(1,46) = 16.58$, $p < .0001$, indicating that, in this simulation, being cautious paid off. Similarly, those who lost money scored significantly higher on the third component *Risk following a loss* ($M = 0.39$) than those who won money ($M = -0.47$), $F(1,46) = 10.65$, $p < .005$.

There were no significant differences between those who won money and those who lost money on the *Boldness-timidity* component.

Other analyses. Participants showed an interesting tendency to make larger bets as the simulation progressed. A one-way completely within groups analysis of variance revealed a significant main effect of race number on bet amount ($F(6,282)=14.7, p<.0001$). Looking at the graph in Figure 7, one can easily see that participants tended to bet much greater amounts from the first to the last race. This tendency has been noted in previous studies of horse race betting behaviour (Johnson & Bruce's, 1993).

Figure 7. Mean amount of \$ bet per race

Stock market – Horse race comparison

The following analyses address the main purpose of the study, to determine if horse race betting behaviour is correlated with stock market investing behaviour. First, from the correlation

matrix formed by indicators from each of the tasks, a priori predictions of correlations between parallel indicators were examined. Following, components extracted from each of the tasks were compared to determine whether any of the components from one task were predictive of the other. Finally, a canonical correlation analysis was conducted to determine how well the best linear combination of the extracted components from one task predicted the best linear combination of components from the other task.

Raw indicators. Though examining the extracted components by the two Principal Components Analyses may provide more sensitive measures, it is also important to address several *a priori* predictions beforehand. Recall that both the investment decision making task and the horse race betting task collected several indicators of gambling and investment behaviour. These measures are listed in Table 1 and Table 3. In order to compare these measures it was necessary to determine which indicators from one task were comparable with indicators from the other. Table 5 organises these indicators such that measures judged to be parallel or similar are located in the same row.

Table 5

Stock market investment simulation and horse race betting simulation parallel indicators.

	Stock Market Indicators	Horse Race Indicators	<i>r</i>
#1	(a) Net gain/loss	(a) Net gain/loss	.1
#2	(b) Amount of rising stock held at the end	(c) Frequency of bets on the top ranked horse	-.1
#3	(c) Amount of falling stock held at the end	(d) Frequency of bets on the lowest ranked horse	.04

	Stock Market Indicators	Horse Race Indicators	<i>r</i>
#4	(e) Average number of transactions per trading week	(b) Average \$ amount per bet	-.02
#5	(f) Average number of stocks traded per transaction	(b) Average \$ amount per bet	.52*
#6	(g) Average \$ amount per transaction	(b) Average \$ amount per bet	.52*
#7	(h) Average proportion of net worth invested per trade	(e) Average proportion of net worth bet per wager	.17
#8	(i) Frequency of purchases following increase in stock value.	(f) Frequency larger bets following a win	-.03
	—	(l) Frequency of riskier bets following a win	-.10
#9	(j) Frequency of purchases following decrease in stock value	(g) Frequency larger bets following a loss	.17
	—	(n) Frequency of riskier bets following a loss	-.11
#10	(k) Frequency of sales following increase in stock value	(h) Frequency smaller bets following a win	.19
	—	(m) Frequency of safer bets following a win	-.01
#11	(l) Frequency of sales following decrease in stock value	(i) Frequency smaller bets following a loss	-.22

Stock Market Indicators		Horse Race Indicators	<i>r</i>
—		(o) Frequency of safer bets following a loss	-.17
#12	(m) Frequency of neither purchasing nor selling following increase in stock value	(j) Frequency of the same bet following a win	.02
—		(p) Frequency of bets on the same ranked horse following a win	.04
#13	(n) Frequency of neither purchasing nor selling following decrease in stock value	(k) Frequency of same bet following a loss	.09
—		q) Frequency of bets on the same ranked horse following a loss	-.10
#14	(o) Total number of shares purchased following decrease in stock value	(u) Total \$ amount bet on safer horses following a win	.05
#15	(s) Total \$ amount purchased following increase in stock value	(u) Total \$ amount bet on safer horses following a win	.03
#16	(p) Total number of shares purchased following decrease in stock value	(v) Total \$ amount bet on riskier horses following a loss	.22
#17	(t) Total \$ amount purchased following decrease in stock value	(v) Total \$ amount bet on riskier horses following a loss	-.07
#18	(q) Total number of shares sold following increase in stock value	(t) Total \$ amount bet on riskier horses following a win	-.05

	Stock Market Indicators	Horse Race Indicators	<i>r</i>
#19	(u) Total \$ amount sold following increase in stock value	(t) Total \$ amount bet on riskier horses following a win	-.06
#20	(r) Total number of shares sold following decrease in stock value	(w) Total \$ amount bet on safer horses following a loss	.02
#21	(v) Total \$ amount sold following decrease in stock value	(w) Total \$ amount bet on safer horses following a loss	.01

It was predicted that the parallel indicators outlined above would indicate the extent to which participants behaved similarly across the two tasks. With only two exceptions, none of the predicted correlations reached statistical significance. As may be seen in Table 5, set #5 *Average number of shares traded per transaction* correlated significantly with *Average \$ amount per bet* and #6, *Average \$ amount per transaction* correlated significantly with *Average \$ amount per bet*. This is in itself an important finding. Though individual differences were found in each task separately, the only individual differences that were correlated were those measuring the size of stock purchased and size of race bet. That none of the other indicators are correlated provides evidence that, besides the size with which participants bet/traded, individual differences in one task are not expressed in the same way in the other task.

Comparing Components. It is possible that there were few significant a priori predictions in the previous analysis due to the insensitivity of the measures. Recall that four components were extracted from the stock market task and three from the horse race betting task. Scores on these components were calculated for each participant and a new correlation matrix was formed to examine any relations between the extracted components from the two tasks. Since all 12

comparisons arising from the new correlation matrix are post hoc, if we apply the Bonferroni correction we have a new significance level of $\alpha = 0.004$. According to this conservative criterion *Boldness - timidity* in the stock market investment task and *Boldness - timidity* in the horse racing task was the only correlations that approached significance ($r = .390$, $p = 0.008$). This result support conclusions from the previous analysis; participants who tended to make large trades in the stock market simulation also tended to make large bets in the horse race betting simulation.

Canonical correlation. Canonical correlation between the extracted components from the two simulations made it possible to determine how well the best linear combination of the extracted components from one task predicted the best linear combination of components from the other. The overall canonical correlation was significant, $F(12,129) = 2.69$, $p < .005$. Further analysis revealed that only the first canonical correlation was significant ($r = .62$, $p < .005$). In an attempt to further understand the results of the canonical correlation, the structure coefficients of each variable were examined. Recall that the structure coefficients of a variable are similar to a loading on a component or factor. They represent the correlation between that variable and its corresponding canonical variate (i.e. the best linear combination of the group of variables of interest). The analysis of the structure coefficients involved indicated that the first canonical correlation (and the only significant one) was primarily a correlation between the horse race betting simulation *Boldness-timidity* component (loading 0.87) and a combination of the stock market investment simulation *Boldness-timidity* component (loading 0.51) and *Disposition effect/Escalating Commitment* (loading 0.76).

These results further confirm what was found by examining the component correlation matrix. They provide further evidence for the similarity of the *Boldness-timidity* construct across

both situations. They also, however, indicate that *Disposition Effect / Escalating Commitment* is important in the relationship between the two situations; participants falling prey to the *Disposition Effect / Escalating Commitment* in the stock market simulation tend to be the same people who make bigger bets in the horse race betting game. It is difficult to know how to interpret the role of the *Disposition Effect / Escalating Commitment* component. This aspect of stock market investment behaviour has not surfaced as important in the relationship between these two tasks in any of the other analyses. Though it is important to note this finding, it is also possible that it surfaced in the canonical correlation analysis due to lack of rotation solution. Results from canonical correlation are often times difficult to interpret due to, among other things, the lack of a rotated solution (Tabachnick & Fidell, 1996).

Questionnaire

Do any questionnaire items reliably predict behaviour in either the stock market investment or the horse race betting tasks? Recall the questionnaire was constructed from a variety of different sources and contained 6 different sections (see Appendix A). Section A collected basic demographic information. Section B (*Thorngate and Rajabi Items*) contained items from Thorngate & Rajabi's (2003) experimental examination of stock market investment behaviour, and section C (*Risky Prospects*) was a mini-test similar to those used regularly in Prospect Theory research. Section D (*Explanatory Style*) measured participants' explanatory style. Section E (*Overconfidence*) was a mini-test of overconfidence, and section F (*Attitudes toward money*) contained items from Furnham's (1984) Money Scale.

Principal Components Analysis with Varimax rotation was initially performed on the questionnaire data. Of the 11 components with eigenvalues greater than 1, only two components passed the Scree test. These components together only accounted for approximately 26% of the

variance. In addition, questionnaire item loadings on these components were difficult to interpret. Therefore principal components analysis of the questionnaire was not found to be useful and scores on each item or aggregate from each section of the questionnaire were examined separately.

Questionnaire items with questionnaire items. Section D (*Explanatory Style*), and the mini-test sections (sections C & E), contained questionnaire items that were meaningful only when analysed in conjunction with other items in their section. When the remaining 21 questionnaire items were intercorrelated, most of the significant correlations that surfaced made intuitive sense; for example, the more participants reported they liked to gamble (Q: B-3), the more they reported they enjoyed spending money (Q: B-1), liked to take risks (Q: B - 4), and the knew about horseracing (Q: B-12). These correlations may be found in Table 6.

Table 6

Significant correlations among questionnaire items (Excluding sections C, D & E).

Questionnaire Item	Questionnaire Item	<i>r</i>
B-3) I like to gamble.	B-1) I enjoy spending money.	0.40
B-4) I like to take risks.	B-3) I like to gamble.	0.66
B-7) I am knowledgeable about investing.	B-6) It is important to be rich.	0.29
B-10) Making money on the stock market is primarily due to luck.	B-6) It is important to be rich.	-0.32
B-11) Making money betting on horse races is primarily due to luck.	B-10) Making money on the stock market is primarily due to luck.	0.37
B-12) I am knowledgeable about horse racing.	B-3) I like to gamble.	0.40

Questionnaire Item	Questionnaire Item	<i>r</i>
_____	B-4) I like to take risks.	0.29
_____	B-10) Making money on the stock market is primarily due to luck.	0.33
E-11) I am better at investing than the majority of people.	B-6) It is important to be rich.	0.40
_____	B-7) I am knowledgeable about investing.	0.65
E-12) I am a better at gambling than the majority of people.	B-2) I enjoy saving money.	0.31
_____	B-3) I like to gamble.	0.29
_____	B-10) Making money on the stock market is primarily due to luck.	-0.34
_____	B-12) I am knowledgeable about horse Racing.	0.46
_____	E – 11) I am better at investing than the Majority of people.	0.30
F-1) I feel that money is the only thing that I can really count on.	B-6) It is important to be rich.	0.31
_____	B-13) A stock that has either decreased in Value or remained the same for last Few days is likely to increase in value in the next few days.	0.35

Questionnaire Item	Questionnaire Item	<i>r</i>
F-2) I sometimes buy things that I don't need or want to impress people. _____	B-11) Making money betting on horse races is primarily due to luck.	-0.33
	E-12) I am better at gambling than the Majority of people.	0.40
F-3) I often say 'I can't afford it' whether I can or not.	B-7) I am knowledgeable about investing.	-0.39
F-4) I always know how much I have in my bank account(s). _____ _____	B-7) I am knowledgeable about investing.	0.31
	B-10) Making money on the stock market is primarily due to luck.	-0.33
	E – 11) I am better at investing than the Majority of people.	0.31
F-5) Most of my friends have more money Than I do.	B-13) A stock that has either decreased in Value or remained the same for last Few days is likely to increase in value in the next few days.	0.33
F-6) I believe that the amount of money that a person earns is closely related to his/her ability or effort.	B-6) It is important to be rich.	0.38

Questionnaire Item	Questionnaire Item	<i>r</i>
_____	13) A stock that has either decreased in value or remained the same for last few days is likely to increase in value in the next few days.	0.35
_____	E – 11) I am better at investing than the majority of people.	0.39
_____	F-1) I feel that money is the only thing That I can really count on.	0.36

Note. $r > 0.28, p < 0.05$; $r > 0.31, p < 0.03$; $r > 0.38, p < 0.01$; $df = 46$

Predicting the Tasks. As noted above, components extracted from the stock market investment and horse race betting tasks offered more sensitive, simpler measures of behaviour in each task than the raw indicators. Therefore, faced with the massive number of correlations and the potential for many type I errors, questionnaire analysis was limited, by and large, to correlations between questionnaire items and task components, rather than raw indicators.

Part A :Demographics. Recall that 10 females and 38 males participated in the study. Given these large unequal sample sizes, gender differences may have been obscured. Some of the demographic information collected, however, was reliably correlated with simulation components. Males scored significantly higher on the *Boldness-timidity* construct in the horse race task ($M = .15$) than women ($M = -.56$), $F(1,46) = 4.27, p < .05$. In the stock market task, men also scored on average higher on the *Boldness-timidity* component ($M = .11$) and the *Activity* component ($M = .05$) than did females ($M = -.44$ and $-.18$ respectively). These differences, however, were not significant. These results demonstrate modest support for previous research

indicating that males tend to trade more frequently (Barber & Odean, 2000b), and make larger trades/transactions (Thorngate and Rajabi, 2002). No other significant differences were found.

Part B: Thorngate and Rajabi items. This part of the questionnaire contained 13 statements that were reliably predictive of stock market behaviour in Thorngate & Rajabi's (2003) study of investment decision-making. Participants either agreed or disagreed with each statement by circling a number on a likert scale. There was only one significant correlation between these questionnaire items and components on either task. The more people reported they enjoyed saving money (Q: B - 2), the lower was their score on the *Boldness-timidity* ($r = -0.29, p < .05$) component in the stock market investment task. This result is consistent with results found by Thorngate & Rajabi (2002). Though not large enough to reach significance levels, it is worth noting that the correlation between this questionnaire item and the *Boldness-timidity* component from the horse race betting task was in the same direction ($r = -0.14$).

Correlations between the remaining items in this section and comparable stock market indicators were all consistent in direction with those found by Thorngate and Rajabi (2002), however the current study failed to replicate the magnitude of these correlations. These results, therefore, can only provide modest support for their findings.

Part C: Risky prospects. Recall that in this section of the questionnaire there were six questions. Each question had respondents choose between two options, a risk free option (e.g., "A sure gain/loss of \$100) and a risky option (e.g., "A 50% chance to win/lose \$200, or a 50% chance to win/lose nothing"). Respondents were asked to answer three of these types of questions framed as potential gains ("a sure gain/ a chance to gain") and three framed as potential losses ("a sure loss/ a chance to lose").

According to Prospect Theory people are more risk seeking when faced with losses than when facing gains. To test these central predictions of Prospect Theory, a one-way, within-groups analysis of variance was performed. Of the three questions for each prospect type, participants made significantly fewer risky prospect selections for gain situations ($M = .81$, $SD = .82$) than for loss situations ($M = 1.77$, $SD = .95$), $F(1,47) = 33.46$, $p < .0001$, confirming the predictions of Prospect Theory and replicating the finding of Kahneman and Tversky (1979).

Though the above results confirm the finding that people, on average, are more risk seeking when facing losses than when facing gains, this does not characterise all participants. Of the 48 participants in this study, 33 (67%) were more risk seeking in the domain of losses and 15 were not. These two groups of people, however, did not score significantly differently on any of the stock market or horse race betting task components. These results suggest that knowing who is and who is not more risk seeking when facing losses or gains is not predictive of stock market investment or horse race betting behaviour.

Part D: Explanatory style. Explanatory style is a cognitive variable that refers to how people regularly explain the causes of bad events (Peterson, Buchanan, & Seligman, 1995). For each question in the questionnaire, participants provided one major cause of a hypothetical negative event, then rated this cause on three, seven-point scales. These scales represented three dimensions: 1) internality vs. externality; 2) stability vs. instability; and 3) globality vs. specificity.

As done in previous research (Peterson, Buchanan, & Seligman, 1995; Sorley, 1999), an average score per person was calculated for each dimension. Following, a composite score was derived by adding the scores together and dividing by the number of questions (in this case 5). A median split was subsequently performed on the composite scores. Participants scoring above the

median (those with internal, stable, and global attributions), were considered to employ a pessimistic explanatory style and were classified as pessimists. Those scoring below the median (those with external, unstable, and specific attributions), were considered to employ an optimistic explanatory style and were classified as optimists.

Some research suggests that those with pessimistic explanatory style tend to be less risk seeking when faced with a loss (Sorley, 1999). To examine whether this finding was replicated in the current study, a 2 (optimist/pessimist) X 2 (gain and loss prospect) analysis of variance (with prospect type selection employed as the repeated measures variable) was performed. Results failed to replicate Sorley's findings that pessimists were significantly less risk seeking than their optimistic counterparts.

Further analyses of variance employing the optimism/pessimism distinction as the between-groups variable, failed to uncover any significant differences with respect to any of the investment or gambling components. Composite scores were also not significantly correlated with any of the task components.

Part E: Overconfidence. Overconfidence is a bias in judgement that reflects the extent to which one is likely to overestimate or feel better than average in his/her abilities. In the current study a mini-test of overconfidence very similar to that originally constructed by Russo & Schoemaker (1989) was used to measure people's confidence concerning the accuracy of their answers to general knowledge questions.

People were asked to provide confidence intervals such that they were 98% sure the correct answer to the question was within the interval. Overconfidence is measured by calculating the number of questions where the true answer falls outside the interval given. The higher the number, the more overconfident the respondent.

The average percentage of answers outside the confidence interval was 72%. This number is higher than reported in other research using this instrument (60% reported by Biais, Hilton, Mazurier, & Pouget, 2002; 54% reported by Russo and Schoemaker, 1989). The overconfidence measure did not correlate reliably with any of the components extracted from either the investment or horse race simulations. The same was also true of Items E-11 (“I am better at investing than the majority of people”) and E-12 (“I am a better at gambling than the majority of people”).

Part F: Attitudes toward money. Questions measuring participants Attitudes toward money did not reliably predict any of the components from either task. Correlations of questionnaire items with raw indicators generated no thematic consistencies, and seemed to be no more than what would be expected due to chance rather than providing any meaningful insight.

Discussion

There were three notable findings in this study. First, large individual differences occurred in both the stock market investment simulation and the horse race betting simulation. Second, with the exception of how much/little people invest/bet (*Boldness-timidity* of investing/betting behaviour), most individual differences in the stock market simulation did not correlate with individual differences in the horse race betting situation. Third, the questionnaire yielded few items predicting individual differences in either simulation.

Stock Market Simulation

Three findings were of interest in the stock market investment task results. One, there were very large individual differences in behaviours/strategies employed by participants in the simulation. Two, behaviour observed in the stock market investment task is consistent with previous investment research, both in the laboratory and in the ‘real world’. The third notable

finding is, the construct *Boldness-timidity* was the most prominent individual difference identified in the task.

The disposition effect, escalating commitment, and individual differences in the frequency with which participants traded stocks, were strategies/behaviours identified in the present study that have also been noted in studies of ‘real-life’ investing (e.g. Shefrin & Statman, 1993; Odean, 1998; Wilson & Zhang, 1997; Barber & Odean, 2000a). There were also several findings that were consistent with Thorngate & Rajabi’s (2003) experimental examination of investment decision making: (1) there were large individual differences in the both the magnitude and frequency with which participants traded and, (2) though there was a winning strategy, people in this study on average lost money. These similarities with previous research suggest the stock market simulation used is sensitive to behaviours identified in previous laboratory and ‘real-world’ research, suggesting the stock market simulation used in this study has at least some external validity.

In the stock market investment simulation a total of 25 stock market investment indicators were derived from the raw data. In analysing this data, it was the quantity or magnitude of a participant’s average transaction that was the most prominent feature of trading behaviour. This finding was also noted in Thorngate and Rajabi’s (2002) study. A thorough review of the literature, however, failed to uncover any discussion of this aspect of trading behaviour. Barber & Odean (2000a) found individual differences in the frequency with which investors traded stocks (as was found in the present study), but the results presented here suggest trading frequency is a separate dimension, distinct from the *Boldness-timidity* component. It may be useful to further examine this dimension of trading behaviour to determine if the *Boldness-timidity* construct is an identifiable characteristic of real-life investors.

Horse Race Simulation

There were two notable findings in the horse race simulation. One, like the stock market simulation, there were very large individual differences in betting behaviour, and two, behaviour in the horse race betting task is consistent with research on the behaviour of 'real-world' horse race bettors.

Individual differences in betting strategy/behaviour were clearly apparent in the horse race betting simulation. Some participants tended to make riskier bets after losing, a behaviour similar to the strategy of doubling down which has been discussed in the gambling literature (Turner, 1998; Breen & Zuckerman, 1999). Other participants exhibited a clear preference for safe versus risky bets and vice versa. This is also consistent with other gambling research (Wildman, 1997; Kuhlman, 1976).

As noted above, individual differences in the present study are consistent with other gambling research. Furthermore, there are similarities between this study and the (limited) amount of research conducted on the practices of 'real-world' horse race bettors. In the present study, participants (on average) tended to bet more money with each race. This finding is consistent with Johnson & Bruce's (1993) finding that 'real' horse race bettors also have a tendency to bet larger amounts on later races.

These results suggest that the horse race betting simulation employed is sensitive to behaviours identified in 'real-world' gambling, in general, and 'real-world' horse race betting in specific. The simulation, therefore, has some external validity.

Horse Race Betting, Stock Market Investing Comparison

The main purpose of this study was to determine if horse race betting is correlated with stock market investing. Results suggest that participants are consistent in the magnitude or

quantity with which they buy/sell stock or bet on horses, as measured by the common component *Boldness-timidity*. There are, however, no other consistencies. For example, there is no evidence that those who fell prey to the disposition effect or escalating commitment in the stock market simulation were the same people who made larger or riskier bets following a loss (doubling down) in the horse race betting simulation. The fact that the extracted component *Disposition Effect / Escalating Commitment* from the stock market investment task and component *Risk following loss* from the horse race betting task were not correlated provides strong evidence that participants in this sample did not consistently respond to loss across these two situations.

These results are consistent with Kuhlman (1976) who found wager/bet size to be the only consistent individual difference across three different gambling games (roulette, craps, and blackjack). Though he did not examine response to loss or gain, he did find that participants' odds preferences were inconsistent across games. This finding is in-line with results presented here; those who demonstrated a preference for the rising stock in the stock market simulation did not demonstrate a preference for safer bets in the horse race betting simulation, and vice versa.

Results are also in-line with Thorngate and Rajabi (2002) who found participants *Boldness-timidity* was consistent across simulations, whether they were presented with stable or volatile market conditions. Thorngate & Rajabi (2002) did not, however, examine indicators that were sensitive to how participants responded to gain or loss. In view of the present findings it would be interesting to determine if participants respond to gain or loss in the same ways across these different market conditions.

Questionnaire

The second purpose of this study was to determine if individual differences in one or both of these behaviours (investing and betting) are correlated with items on a questionnaire designed to predict investment and gambling behaviour.

One notable finding was that most questions on the questionnaire failed to predict the components in the two tasks. This finding is not surprising, as questionnaires measuring personality or attitudes generally do not have a good track record when correlated with observed behaviour (e.g. see Mischel & Peake, 1982; Petty, Wegener & Zanna, 1993; Kuhlman, 1976).

Males tended to be more *Bold* than females in the horse race simulation and the stock market simulation. Though males were also *Bolder* in the stock market simulation, the difference was not significant. This pattern of results is consistent with those of Thorngate & Rajabi (2003), and provides modest evidence that gender is a reliable predictor of *Boldness-timidity* in both the tasks.

The second part of the questionnaire (*Part B: Thorngate and Rajabi Items*) replicated in direction but not in size correlations found by Thorngate and Rajabi (2002), suggesting further study is required before commenting on the value of these items in predicting investment decision making behaviour. Results from *Part C (Risky Prospects)* confirmed the prediction of Prospect Theory, and replicated the findings of Kahneman and Tversky (1979). These results also indicate that using the tendency to be more or less risk seeking (when facing loss or gain) as an individual difference measure does not reliably predict behaviour in a stock market investment or a horse race betting situation.

Investigating how explanatory style fared in predicting behaviour in either of the two tasks proved futile. The results did not confirm Sorley's (1999) findings that those with a

pessimistic explanatory style are more likely (than optimists) to sell their investments when faced with a loss. Nor did the results confirm Atlas & Peterson's (1990) findings that horse race bettors with pessimistic explanatory style tend to make larger wagers following a lost bet. There are several possible reasons for these findings: (1) the explanatory style construct is not related to investment or betting behaviour; (2) general conceptual constructs such as explanatory style fare poorly when correlated with observed behaviour (as noted previously); or (3) the questionnaire was too pared down to properly measure explanatory style (see below).

In his study of individual differences across different gambling games, Kuhlman, (1979) measured four different personality measures (authoritarianism, desire for social approval, locus of control, and optimum level of stimulation). He found that these measures generally fared poorly at predicting the individual differences in gambling behaviour found in his study. Though explanatory style is not a personality variable *per se*, results presented here support Kuhlman's (1979) findings.

Results from *Part E (Overconfidence)* are consistent with Thorngate and Rajabi's (2002) finding that overconfidence does not correlate with trading profits. This is a second study that contradicts results found by Biais, Hilton, Mazurier, & Pouget (2002). It is interesting to note that, in the current study, participants scored higher on the mini-test of overconfidence than has been previously noted in the literature.

Limitations

Criticisms of using computer simulations. Some argue the difference in level of arousal experienced between an actual gambling situation and a laboratory setting makes the latter unrepresentative of the former (Anderson & Brown, 1984). Though laboratory gambling simulations have been used extensively to study gambling decision making in the past (see

Wildman, 1997), the simulations employed often bear little resemblance to real gambling situations (e.g., participants are asked to bet on which light is likely to come on), and are hence criticised as unrealistic. The horse race simulation used was as faithful as possible to the 'real life' task. The same may be argued for the investment simulation.

Are there grounds to believe that participants' behaviour in an investing or gambling computer simulation resembles behaviour in either of these 'real world' situations? Results from this study have many similarities to 'real world' research providing evidence that behaviour in the stock market simulation or the horse race betting simulation is at least somewhat representative of decision-making in a 'real' investment, or horse race situation. As it was not realistic, nor ethical, to ask participants to wager real money at the racetrack or invest their own money in a real stock market, this possible loss of external validity was a necessary trade-off for the experimental control attained by using simulations.

Consistently inconsistent people. There is research that suggests that consistency itself is a variable that differs from person to person (Bem & Allen, 1974). None of the measures employed in this study were sensitive to the possibility that such people participated in the study. It is possible that were such participants present in the sample in sufficient quantity, their presence may have obscured behavioural similarities between the two tasks if they were indeed present.

Representativeness of sample. There is evidence that student samples are not representative of the general population, at least with respect to gambling behaviour, as age has an effect on risk taking (Wildman, 1997). The current study, however, was primarily a within-participants study (participants' behaviour on one simulation was compared to their behaviour on the other simulation). Thus, by the nature of the design, age effects should have been controlled. That said,

there may be age differences with respect to people's consistency between situations. This study was not sensitive to this possibility.

Insensitivity/inadequacy of measures. It is possible that the indicators employed in the study failed to measure what they purported to, or were too insensitive, and therefore failed to provide meaningful data. The insensitivity issue was at least partially addressed by combining indicators using principal components analysis. It is still possible, however, that these combined measures were still not sensitive enough.

Questionnaire construction. In constructing the questionnaire, sections from other questionnaires were incorporated to form a new questionnaire. In so doing, some parts of the questionnaire chosen to measure a particular construct (such as explanatory style) or test for the presence of a decision making bias (such as overconfidence) may not, in fact, have measured that construct or bias at all. It is possible that this may account for the current study failing to support some previous research in the area.

Implications

The results of this study have two major theoretical implications. First, based on the results of this study, aside from how much/little people invest (*Boldness-timidity* of betting/investing behaviour), knowledge of stock market investment behaviour may not generalise to gambling behaviour and vice versa. Second, results from this study suggest people behave differently across risk taking situations with little superficial similarity even though they may be structurally similar. This finding suggests that, in the future, if there is to be a meaningful discussion of cross-situational consistency, it is essential to delve further into what is meant by 'similar' when we talk of similar situations.

As noted above, laboratory style risk-taking tasks often employed in decision making research, often bear little resemblance (i.e. lack superficial similarity) to actual gambling games. If people do behave differently across risk-taking situations that are structurally similar yet superficially different, it may be for this reason these studies have had questionable external validity and have failed to shed much light on gambling behaviour (Wildman, 1997). This leads to the speculation: if one wants to study how someone behaves while playing poker, for example, perhaps the best way to do so is to study that person truly playing poker.

Recall that situations that are superficially similar, yet structurally different can be conceived of as situations that are framed differently. There is an abundance of evidence that suggests the framing of a decision making situation can have a significant effect on a person's decision (see Plous, 1999). Perhaps it is because these two structurally similar tasks (investing and betting) are 'framed' differently (i.e. they are superficially different) that they are resulting in inconsistent behaviour. Perhaps results presented here are simply more evidence of framing effects.

Future Directions

Results of the current study suggest that our knowledge of stock market investment behaviour may be limited in how much we can generalise to gambling behaviour, and vice versa. How much can knowledge of behaviour on one kind of gambling task (e.g. black jack, roulette, etc) be generalised to behaviour on another. Can research from poker be used to understand horse race betting or slot machine gambling? The same question may be asked of research on investment decision making. Can investment research conducted in the past be used to understand on-line investing?

It is hoped that the current study inspires future researchers to examine some of these questions. It is also hoped that the current research has shed some light on gambling and investment decision making.

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Appendix A: Questionnaire

Part A

- 1) Age _____
- 2) Gender _____
- 3) Highest level of formal education attained _____
- 4) Occupation (or if student your major) _____

Part B

Please indicate how strongly you agree or disagree with the following statements by circling 1 number.

- 1) I enjoy spending money.

I strongly disagree	1	2	3	4	5	6	7	I strongly agree
------------------------	---	---	---	---	---	---	---	---------------------

- 2) I enjoy saving money.

I strongly disagree	1	2	3	4	5	6	7	I strongly agree
------------------------	---	---	---	---	---	---	---	---------------------

- 3) I like to gamble.

I strongly disagree	1	2	3	4	5	6	7	I strongly agree
------------------------	---	---	---	---	---	---	---	---------------------

- 4) I like to take risks.

I strongly disagree	1	2	3	4	5	6	7	I strongly agree
------------------------	---	---	---	---	---	---	---	---------------------

- 5) I am patient.

I strongly disagree	1	2	3	4	5	6	7	I strongly agree
------------------------	---	---	---	---	---	---	---	---------------------

- 6) It is important to be rich.

I strongly disagree	1	2	3	4	5	6	7	I strongly agree
------------------------	---	---	---	---	---	---	---	---------------------

7) I am knowledgeable about investing.

I strongly disagree	1	2	3	4	5	6	7	I strongly agree
---------------------	---	---	---	---	---	---	---	------------------

8) I am confident about what I do.

I strongly disagree	1	2	3	4	5	6	7	I strongly agree
---------------------	---	---	---	---	---	---	---	------------------

9) If I tossed a coin 9 times in a row b is more likely to occur than a .

(a) H H H H H H H H T
(b) H T H H T H T T H

I strongly disagree	1	2	3	4	5	6	7	I strongly agree
---------------------	---	---	---	---	---	---	---	------------------

10) Making money on the stock market is primarily due to luck.

I strongly disagree	1	2	3	4	5	6	7	I strongly agree
---------------------	---	---	---	---	---	---	---	------------------

11) Making money betting on horse races is primarily due to luck.

I strongly disagree	1	2	3	4	5	6	7	I strongly agree
---------------------	---	---	---	---	---	---	---	------------------

12) I am knowledgeable about horse racing.

I strongly disagree	1	2	3	4	5	6	7	I strongly agree
---------------------	---	---	---	---	---	---	---	------------------

13) A stock that has either decreased in value or remained the same for last few days is likely to increase in value in the next few days.

I strongly disagree	1	2	3	4	5	6	7	I strongly agree
---------------------	---	---	---	---	---	---	---	------------------

Part C

Following are a set of choices involving money. Imagine you are actually faced with the choice described in each situation. Please indicate the decision you would make in each case. There are no right and wrong answers. We are only interested in your preferences.

1) Which of the following would you prefer? Circle A or B.

A:	50% chance to win \$1000
50% chance to win nothing; | B: | A sure gain of \$500 |
|----|--|----|----------------------|

2) Which of the following would you prefer? Circle A or B.

A:	50% chance to win \$2500
50% chance to win nothing; | B: | A sure gain of \$500 |
|----|--|----|----------------------|

3) Which of the following would you prefer? Circle A or B.

A:	50% chance to win \$4000
50% chance to win nothing; | B: | A sure gain of \$2000 |
|----|--|----|-----------------------|

4) Which of the following would you prefer? Circle A or B.

A:	50% chance to lose \$1000
50% chance to lose nothing; | B: | A sure loss of \$500 |
|----|--|----|----------------------|

5) Which of the following would you prefer? Circle A or B.

A:	50% chance to lose \$2500
50% chance to lose nothing; | B: | A sure loss of \$500 |
|----|--|----|----------------------|

6) Which of the following would you prefer? Circle A or B.

A:	50% chance to lose \$4000
50% chance to lose nothing; | B: | A sure loss of \$2000 |
|----|--|----|-----------------------|

Part D

1. You and your family have a serious argument.

A. Write down one major cause:

B. Is the cause of this due to something about you or something about other people or circumstances? (circle one number).

totally due to others	1	2	3	4	5	6	7	totally due to me
			half and half					

C. In the future, will this cause again be present? (circle one number).

never present	1	2	3	4	5	6	7	always present
			half and half					

D. Is this cause something that affects just this type of situation, or does it also influence other areas of your life? (circle one number).

just this situation	1	2	3	4	5	6	7	all situations
			half and half					

2. You experience financial difficulties

A. Write down one major cause:

B. Is the cause of this due to something about you or something about other people or circumstances? (circle one number).

totally due to others	1	2	3	4	5	6	7	totally due to me
			half and half					

C. In the future, will this cause again be present? (circle one number).

never present	1	2	3	4	5	6	7	always present
			half and half					

D. Is this cause something that affects just this type of situation, or does it also influence other areas of your life? (circle one number).

just this situation	1	2	3	4	5	6	7	all situations
			half and half					

3. Gambling at the horse races, you lose the first five bets of the night.

A. Write down one major cause:

B. Is the cause of this due to something about you or something about other people or circumstances? (circle one number).

totally due	1	2	3	4	5	6	7	totally due
to others				half and half				to me

C. In the future, will this cause again be present? (circle one number).

never	1	2	3	4	5	6	7	always
present				half and half				present

D. Is this cause something that affects just this type of situation, or does it also influence other areas of your life? (circle one number).

just this	1	2	3	4	5	6	7	all
situation				half and half				situations

4. The stock you invested in crashes and you lose all your money.

A. Write down one major cause:

B. Is the cause of this due to something about you or something about other people or circumstances? (circle one number).

totally due	1	2	3	4	5	6	7	totally due
to others				half and half				to me

C. In the future, will this cause again be present? (circle one number).

never	1	2	3	4	5	6	7	always
present				half and half				present

D. Is this cause something that affects just this type of situation, or does it also influence other areas of your life? (circle one number).

just this	1	2	3	4	5	6	7	all
situation				half and half				situations

5. You give an important talk in front of a group, and the audience reacts negatively.

A. Write down one major cause:

B. Is the cause of this due to something about you or something about other people or circumstances? (circle one number).

totally due to others 1 2 3 4 5 6 7 totally due to me
half and half

C. In the future, will this cause again be present? (circle one number).

never present 1 2 3 4 5 6 7 always present
half and half

D. Is this cause something that affects just this type of situation, or does it also influence other areas of your life? (circle one number).

just this situation 1 2 3 4 5 6 7 all situations
half and half

Part E

For each of the following ten items, provide a low and a high guess such that you are 98 percent sure the correct answer falls between the two.

	98% confidence range	
	Low	High
1) Number of students currently attending Carleton University		
2) Length of the Nile river in kilometres.		
3) Population of Ottawa.		
4) Height of Mount Everest in meters.		
5) Diameter of the moon in kilometres.		
6) Weight of an empty Boeing 747 in kilograms		
7) Year in which Wolfgang Amadeus Mozart was born.		
8) Gestation period (in days) of an Asian Elephant.		
9) Air distance from London to Tokyo in kilometres		
10) Deepest known point in the ocean in meters.		

11) I am better at investing than the majority of people.

I strongly disagree 1 2 3 4 5 6 7 I strongly agree

12) I am a better at gambling than the majority of people.

I strongly disagree 1 2 3 4 5 6 7 I strongly agree

Part F

1) I feel that money is the only thing that I can really count on.

I strongly disagree	1	2	3	4	5	6	7	I strongly agree
------------------------	---	---	---	---	---	---	---	---------------------

2) I sometimes buy things that I don't need want to impress people.

I strongly disagree	1	2	3	4	5	6	7	I strongly agree
------------------------	---	---	---	---	---	---	---	---------------------

3) I often say 'I can't afford it' whether I can or not.

I strongly disagree	1	2	3	4	5	6	7	I strongly agree
------------------------	---	---	---	---	---	---	---	---------------------

4) I always know how much I have in my bank account(s).

I strongly disagree	1	2	3	4	5	6	7	I strongly agree
------------------------	---	---	---	---	---	---	---	---------------------

5) Most of my friends have more money than I do.

I strongly disagree	1	2	3	4	5	6	7	I strongly agree
------------------------	---	---	---	---	---	---	---	---------------------

6) I believe that the amount of money that a person earns is closely related to his/her ability or effort.

I strongly disagree	1	2	3	4	5	6	7	I strongly agree
------------------------	---	---	---	---	---	---	---	---------------------

Appendix B: Original Overconfidence Questionnaire

For Each of the following ten items, provide a low and a high guess such that you are 90 percent sure the correct answer falls between the two.

	90% confidence range	
	Low	High
1) Martin Luther King's death.		
2) Length of the Nile river.		
3) Number of countries that are members of OPEC.		
4) Number of books in the Old Testament.		
5) Diameter of the moon in miles.		
6) Weight of an empty Boeing 747 in pounds		
7) Year in which Wolfgang Amadeus Mozart was born.		
8) Gestation period (in days) of an Asian Elephant.		
9) Air distance from London to Tokyo (in miles).		
10) Deepest known point in the ocean (in feet).		

From Russo and Schoemaker (1989)

Appendix C: Participant Instructions.

[To be read by the experimenter]

“Thank you for participating in this study. Now that you have read the informed consent form you have a general idea of what this study is about. You will be asked to complete a computerized stock market investment task, a computerized horse race betting task, and a questionnaire. Your goal in the two computer tasks is to make as much money as possible in each. The participant who makes the most money in the horse race and stock market task combined will win a 100\$ coupon to a local Ottawa store. The first task you will complete is the Investment task.”

[tasks will be counterbalanced across participants so the script will be adjusted accordingly. For the purposes of this script assume the following order of tasks: investment simulation task, horse race betting task, and questionnaire]

“Do you have any questions?”

[The experimenter will then answer participant’s questions, then continue]

The Investment Task

“You see in front of you a simulation of a stock market. Let us pretend that a family member has just willed you \$1,000: \$400 in a bank account, and 20 shares of each of the three different stocks, Azco, Boco, and Cleo at \$10 per share.”

“You may over the next 60 trading days, buy and sell these stocks as you wish. In order to do so you will instruct me to buy or sell stocks on your behalf. When you are satisfied with your sales and purchases, you will instruct me to advance the simulation to the next trading day. At that point you will see the graph on the screen updated with the new values of the stocks, and the information in the top left hand corner of the screen updated to reflect the new values of the

stocks. You will then repeat the process until 60 days of trading are complete. Do you have any questions?”

[The experimenter will then answer participant's questions, and then complete the task]

“Now we will move onto the second task”

The Horse Race Betting Task

“You see in front of you a simulation of a horse race betting situation. Let us pretend that a family member has just willed you \$1,000. You may over the next 5 races use this money to place bets on horses. Once you have placed your bets you will watch the horses race. Should you make a successful bet your bank account will be updated. You may make up to 3 bets per race. As you can see on the computer screen the odds of each horse are listed. If you place a \$1 bet on a horse with odds of 2:1, and the horse wins, you will get your dollar back plus \$2 for a total of \$3. You may also bet that a horse will win, place, or show. A win bet means you bet the horse will be the first one past the finish line, a place bet means you bet a horse will either be the first or second past the finish line, and a show bet means you bet the horse will either be the first second or third to cross the finish line. Win bets pay the most if successful followed by place and show bets.”

“In order to place bets you will instruct me to place bets on your behalf. When you are satisfied with your bets for that race, you will instruct me to continue and you may sit back and watch the race. When the race is complete you will be informed of the results. The process will then repeat itself until 5 races are complete.”

“Do you have any questions?”

[The experimenter will then answer participant's questions, and complete the task]

The Questionnaire

“Please complete the following questionnaire. If you have any questions please let me know”

[Once the final task is complete the participant will be given the debriefing form and asked if they have any final questions]

Appendix D: Horse race mini questionnaire (1)

Field of Horses									
Race 43 2/17/2003 1 1/8 miles					CHURCHILL DOWNS Dirt Track				
3-Year-Olds and Up					Track Fast				
Purse: \$75,000					Allowances From Special Weights				
Point Value: 50									
Field of Horses									
PP	Horse	Odds	Age/ Gender	Wt.	Speed	Stamina	Condition	Running Style	Likes Track?
1	Alydar	8:5	4	119	Very Good	Very Good	Excellent	Flex/Mid Pack	Yes!
2	Cigar	4	5	119	Very Good	Very Good	Excellent	Flex/Near Pace	Yes!
3	Armed	3	5	119	Very Good	Very Good	Excellent	Flex/Mid Pack	Yes!
4	J. O. Tobin	7:2	4	119	Excellent	Good	Excellent	Near Pace	Yes!
5	Alsab	5:2	5	119	Very Good	Very Good	Excellent	Near Pace	Yes!

Display Option
☒ Horse Traits
☐ Betting Pools
☐ Race Records
Recalc Odds
Review PP's
Assign Jockey
Enter Bets
Save Race
Continue **Exit**
Adjust Setup Details
Print Race Setup
Sound Call to the Post

When you placed your bets during the horse race simulation you were presented with the above screen. On this screen there were several pieces of information available to you. Please rate how important each piece of information was in making your betting decisions.

1) PP (Horse Number)

Very Important 1 2 3 4 5 6 7 Not at all Important

2) Horse Name

Very Important 1 2 3 4 5 6 7 Not at all Important

3) Odds

Very Important 1 2 3 4 5 6 7 Not at all Important

4) Age

Very Important 1 2 3 4 5 6 7 Not at all Important

5) Gender

Very Important	1	2	3	4	5	6	7	Not at all Important
----------------	---	---	---	---	---	---	---	----------------------

6) Weight

Very Important	1	2	3	4	5	6	7	Not at all Important
----------------	---	---	---	---	---	---	---	----------------------

7) Speed

Very Important	1	2	3	4	5	6	7	Not at all Important
----------------	---	---	---	---	---	---	---	----------------------

8) Stamina

Very Important	1	2	3	4	5	6	7	Not at all Important
----------------	---	---	---	---	---	---	---	----------------------

9) Condition

Very Important	1	2	3	4	5	6	7	Not at all Important
----------------	---	---	---	---	---	---	---	----------------------

10) Running Style

Very Important	1	2	3	4	5	6	7	Not at all Important
----------------	---	---	---	---	---	---	---	----------------------

11) Likes Track?

Very Important	1	2	3	4	5	6	7	Not at all Important
----------------	---	---	---	---	---	---	---	----------------------

Appendix E: Horse race mini questionnaire (2)

Field of Horses																																																							
Race 59 2/18/2003 3 furlongs				GOLDEN GATE FIELDS Dirt Track																																																			
3-Year-Olds and Up				Track Fast																																																			
Purse: \$75,000				Allowances from Scale Weights																																																			
Point Value: 50																																																							
<div style="float: right;"> Display Option ☐ Horse Traits ☒ Betting Pools ☐ Race Records </div>																																																							
Field of Horses <table border="1"> <thead> <tr> <th>PP</th> <th>Horse</th> <th>Odds</th> <th>Age/ Gender</th> <th>Wt.</th> <th>Win Pool</th> <th>Place Pool</th> <th>Show Pool</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Ruffian</td> <td>9:5</td> <td>3 F</td> <td>102</td> <td>2700</td> <td>903</td> <td>701</td> </tr> <tr> <td>2</td> <td>Bed o' Roses</td> <td>5</td> <td>5 F</td> <td>118</td> <td>1221</td> <td>501</td> <td>332</td> </tr> <tr> <td>3</td> <td>Silver Charm</td> <td>5:2</td> <td>4</td> <td>122</td> <td>2058</td> <td>539</td> <td>571</td> </tr> <tr> <td>4</td> <td>Mom's Command</td> <td>2</td> <td>5 F</td> <td>120</td> <td>2430</td> <td>739</td> <td>552</td> </tr> <tr> <td>5</td> <td>All Along</td> <td>4</td> <td>5 F</td> <td>118</td> <td>1472</td> <td>578</td> <td>422</td> </tr> </tbody> </table>								PP	Horse	Odds	Age/ Gender	Wt.	Win Pool	Place Pool	Show Pool	1	Ruffian	9:5	3 F	102	2700	903	701	2	Bed o' Roses	5	5 F	118	1221	501	332	3	Silver Charm	5:2	4	122	2058	539	571	4	Mom's Command	2	5 F	120	2430	739	552	5	All Along	4	5 F	118	1472	578	422
PP	Horse	Odds	Age/ Gender	Wt.	Win Pool	Place Pool	Show Pool																																																
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2	Bed o' Roses	5	5 F	118	1221	501	332																																																
3	Silver Charm	5:2	4	122	2058	539	571																																																
4	Mom's Command	2	5 F	120	2430	739	552																																																
5	All Along	4	5 F	118	1472	578	422																																																
<div style="float: right;"> Recalc Odds Review PP's Assign Jockey Enter Bets Save Race Continue Exit Adjust Setup Details Print Race Setup Sound Call to the Post </div>																																																							

When you placed your bets during the horse race simulation you were presented with the above screen. On this screen there were several pieces of information available to you. Please rate how important each piece of information was in making your betting decisions.

12) PP (Horse Number)

Very Important 1 2 3 4 5 6 7 Not at all Important

13) Horse Name

Very Important 1 2 3 4 5 6 7 Not at all Important

14) Odds

Very Important 1 2 3 4 5 6 7 Not at all Important

15) Age

Very Important 1 2 3 4 5 6 7 Not at all Important

16) Gender

Very Important	1	2	3	4	5	6	7	Not at all Important
----------------	---	---	---	---	---	---	---	----------------------

17) Weight

Very Important	1	2	3	4	5	6	7	Not at all Important
----------------	---	---	---	---	---	---	---	----------------------

18) Win Pool

Very Important	1	2	3	4	5	6	7	Not at all Important
----------------	---	---	---	---	---	---	---	----------------------

19) Place Pool

Very Important	1	2	3	4	5	6	7	Not at all Important
----------------	---	---	---	---	---	---	---	----------------------

20) Show Pool

Very Important	1	2	3	4	5	6	7	Not at all Important
----------------	---	---	---	---	---	---	---	----------------------