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THE IMPACT OF MOTIVATIONAL SYSTEMS ON DYNAMIC INCONSISTENCY
IN RISK TAKING

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ABSTRACT

Every day we are confronted with risky decisions in which the rewards and the punishments are not always clear. We like to believe that logic is the primary force behind our decisions, but in reality, emotion plays a very important role. This study examines the impact of participants' Behavioral Activation System (BAS) and Behavioral Inhibition System (BIS) on dynamic inconsistencies in a sequential gambling task. Contrary to the hypotheses, neither system predicted deviations following a win or a loss. However, participants high in BAS were more likely to make negative deviations.

TABLE OF CONTENTS

	Page
ABSTRACT.....	iii
LIST OF TABLES.....	vi
LIST OF FIGURES.....	vii
CHAPTER	
I. INTRODUCTION.....	1
II. LITERATURE REVIEW.....	3
2.1 Statement of Problem.....	3
2.2 Defining Types of Risky Decisions.....	3
2.3 Decisions Made Under Uncertainty.....	4
2.3.1 Iowa Gambling Task.....	4
2.3.2 Balloon Analogue Risk Task.....	7
2.4 Decisions Made Under Risk.....	7
2.4.1 Game of Dice Task.....	8
2.5 Theories of Risk Taking.....	8
2.5.1 Expected Value Maximization.....	8
2.5.2 Expected Utility Theory.....	9
2.5.3 Prospect Theory.....	10
2.5.4 Somatic Marker Hypothesis.....	13
2.5.5 Mental Accounting.....	14
2.6 Affective States.....	17
2.7 Impact of Affective States on Risk Taking.....	18

2.7.1 Scope Insensitivity.....	21
2.7.2 Scalar Multiplication.....	22
2.8 Dynamic Consistency.....	22
III. HYPOTHESES.....	26
3.1 Aim of the Present Study.....	26
3.2 Hypotheses.....	26
IV. METHOD.....	28
4.1 Participants.....	28
4.2 Materials.....	28
4.3 Design and Procedure.....	29
V. RESULTS.....	31
5.1 Trial One.....	37
5.2 Trial Two.....	35
5.2.1 Winning.....	35
5.2.2 Losing.....	36
5.4 Simulation Questions.....	38
VI. DISCUSSION.....	41
6.1 Implications.....	44
6.2 Future Directions.....	46
6.3 Limitations.....	46
6.4 Conclusion.....	47
REFERENCES.....	48

LIST OF TABLES

Table	Page
I Mean Amounts Planned to be Risked.....	32
II Mean Amounts Actually Risked.....	32
III Deviations by Trial.....	33
IV Logistic Regression Model of First Trial Deviations.....	34
V Observed and Expected Frequencies for Positive Deviations on Trial 1.....	35
VI Logistic Regression Model of Deviations Following a Win.....	36
VII Logistic Regression Model of Deviations Following a Loss.....	37
VIII Observed and Expected Frequencies for Deviations Following a Loss.....	38
IX Participant's Mean Response Following a Win or Loss.....	39

LIST OF FIGURES

Figure	Page
1. Hypothetical Prospect Theory Value Function.....	12

CHAPTER I

INTRODUCTION

Every day we are faced with the challenge of making risky decisions under uncertain circumstances. From selecting which line to wait in at the grocery store, to investing in the stock market, to choosing an entre at a new restaurant, to gambling in a Las Vegas casino, these decisions carry with them risks and rewards. Of course the weights of the risks and rewards vary by situation; the potential to lose one's life savings in the stock market is riskier than selecting the slow lane at the supermarket and having one's ice cream begin to melt. Selecting a delicious entre at a new restaurant may not be as rewarding as hitting the jackpot on a slot machine.

We like to believe that we use sound, rational strategies when confronted with decisions that contain risk. We choose register four because there are five people in the express lane, each with ten items, and one person in lane two with an overflowing cart. There are only two people in lane four, each with fifteen items, thus lane four it is the rational choice. Stock market analysts have extensive training and complex computer models that predict when to buy and sell stocks. At a restaurant, we make the rational meal choice—"This is an Italian restaurant, the lasagna should be better than the sushi, therefore I will have the lasagna." Playing blackjack in a casino, we may use a specific

strategy, based on what the dealer has compared to the cards one is holding and the cards that are no longer in the deck.

As rational as believe ourselves to be, we often make irrational decisions inspired by emotions. When the person in front of us at the grocery store is arguing that the sign in front of the canned vegetables said 2/\$1 not \$0.65, and we notice that this person will also be paying with a check, do we analyze the length of time for the dispute to be resolved, plus the time for the transaction to be completed, compared to the time it would take to switch lines and stand behind two other people, or do we simply switch lanes because we feel the other line will be faster? Do we sell stocks when they are steadily gaining in value because it is the correct thing to do, or because we are fearful their price will suddenly plummet? Do we order sushi at an Italian restaurant because we are feeling adventurous? At the roulette table, do we put it all on black because the last four spins have been red and we have a lucky feeling? As much as we like to believe we are extremely rational beings, our emotions creep into the decision-making process, drastically altering our choices.

CHAPTER II

LITERATURE REVIEW

2.1 Statement of Problem

Numerous studies have examined an individual's risk taking behavior with regards to money. One area of study is examining how an individual's approach and avoidance motivations influence said risk taking; another area of study examines dynamic inconsistency—the tendency to behave in a way contrary to what one planned. However, no study has examined the influence of approach and avoidance motivations on dynamic inconsistency.

2.2 Defining Types of Risky Decisions

Not all risky decisions are the same. According to Knight (1921), there are two types of risky decisions: decisions made under uncertainty and decisions made under risk. Decisions made under uncertainty are perhaps the most common risky decisions in everyday life. In decisions made under uncertainty, the decision maker has incomplete information regarding risk, reward, or probabilities. The decision of speeding on a highway is a real world example of a decision made under uncertainty. The reward is known- arriving at one's destination sooner; the risk is known- receiving a speeding ticket, yet the probability of actually receiving a ticket is unknown. Decisions made under

risk are fairly straightforward. In these risky decisions, individuals are aware of the risks, rewards, and probabilities. A real world example of a decision made under risk is the lottery. A person wagers a specific amount of money to win a specific amount of money, with explicitly stated probabilities of winning.

2.3 Decisions Made Under Uncertainty

2.3.1 Iowa Gambling Task

One common experimental measure used to test decision-making under uncertain conditions is the Iowa Gambling Task (IGT). Developed by Bechara, Damasio, Damasio, and Anderson (1994), participants in the IGT are given an imaginary loan of \$2,000 and instructed to select one card at a time from a horizontal row of four decks labeled A, B, C, and D. Participants are instructed to continue selecting cards until being told to stop, usually after 100 trials. Participants are told the goal of the task is to maximize profits on the loan. Participants are also instructed that they can change decks at anytime throughout the experiment. Deck A provides a reward of \$100 on every trial, but will also pair the reward with a punishment of \$150, \$200, \$250, \$300, or \$350 on half of the trials, leading to a net loss of \$250 per ten trials. Deck B provides a reward of \$100 every trial, but will also pair the reward with a punishment of \$1250 on one tenth of the trials, leading to a net loss of \$250 per ten trials. Deck C will reward \$50 every trial, but will randomly punish \$25, \$50, or \$75 on half the trials, leading to a net gain of \$250 per ten trials. Deck D rewards \$50 every trial, but punishes \$250 on one tenth of the trials, also leading to a net gain of \$250 per ten trials. Decks A and B provide large rewards and large losses and are considered bad decks because they lead to a negative net gain. Decks C and D provide small rewards and small losses and are considered good

decks because they lead to a positive net gain. Initially, normal participants will sample the four decks and show a preference for the bad decks. Normal participants will then begin to show a preference for the good decks, and will eventually select from them exclusively. Participants will adopt this advantageous strategy before they can verbally report which decks are good and which decks are bad (Bechara et al., 1994; Wager & Dixon, 2006). Prior to adopting the optimal strategy, participants will exhibit high anticipatory Galvanic Skin Response levels, which are associated with high levels of stress and anxiety, when selecting from the bad decks (Bechara et al., 1994).

Several brain regions and systems are linked to IGT performance, such as the amygdala and ventromedial prefrontal cortex (Bechara & Damasio, 2005). The ventral striatum, mesolimbic dopaminergic system, serotonin, and the dorsolateral prefrontal cortex are believed to be important for the selection and retention of the advantageous decks (van den Bos, Houx, & Spruijt, 2006).

Participants with certain clinical and neurological deficits do not perform well on the IGT. Individuals with damage to the ventromedial prefrontal cortex do not perform advantageously on the IGT; they continue to select from the high-risk high-reward decks after they have identified them as the bad decks (Bechara & Damasio, 2005).

Furthermore, these participants do not exhibit anticipatory galvanic skin responses to the negative decks (Bechara et. al., 1994). It is believed these participants are not receiving the negative information needed to associate pain with losing money, causing them to continue to pick disadvantageously (Bechara & Damasio, 2005). Other populations shown to perform poorly on the IGT are problem gamblers, individuals with eating disorders, substance abusers (Suhr & Tsanadis, 2007), adults with attention deficit/

hyperactivity disorder (Malloy-Diniz, Fuentez, Borges Leite, Correa, & Bechara, 2007), and individuals with damage to the amygdala (Bechara & Damasio, 2005).

While most individuals in the normal population perform advantageously on the IGT, some individual differences in performance have been found. De Vries, Holland, and Witteman (2008) found that participants in a happy mood, both natural and induced, selected more beneficial cards during the Second Block, trials 21-40, than unhappy participants. The Second Block is believed to be when participants move out of the exploratory stage of deck selection and begin to use a strategy based off somatic states (Wagar & Dixon, 2006). These results supported the researchers hypothesis that individuals in a positive mood rely more on affective signals than individuals in a negative mood. Another study found that depressed participants outperform control participants, supporting the theory that depressed individuals are more sensitive to negative information (Smoski et al., 2008). Bechara and Damasio (2005) reported that control subjects perform better on the IGT than participants instructed to think of a strong emotional experience. The researchers believe thoughts of a strong emotional experience interfere with the somatic responses generated during card selection.

Education has also been found to impact IGT performance. In one study, participants took the standard IGT and a variant IGT in which a punishment is attached to every card and the rewards are intermittent. In this version of the task selecting from the high punishing decks is the optimal strategy because the high punishments are paired with large gains, leading to a positive net gain, while the low punishing decks are paired with small gains, leading to a negative net gain. Participant's learning rate was calculating by subtracting the number of bad selections from good selections for each 20-

card trial. A correlation was found between participant's education level and their learning rate, as measured by the number of advantageous selections per 20-card block. A correlation was also found between education level and the participant's final score. These correlations were found for both the regular and variant IGT task conditions (Davis et al., 2008).

2.3.2 Balloon Analogue Risk Task

Another task that measures risk taking under uncertainty is the Balloon Analogue Risk Task, known as BART (Lejuez et al., 2002). In this task, participants are presented with the image of a balloon on a computer screen, and are instructed to click on a button to inflate the balloon, with each click corresponding to one degree of inflation in all directions. For each click, the participant is rewarded \$0.05, which goes into a temporary bank. At any point the participant can elect to stop inflating the balloon and be rewarded the amount in the temporary bank. If the participant overinflates the balloon and it pops, the participant loses the money in the temporary bank. The balloon can pop on any click, with the probability of an explosion increasing with each successive click. Performance on the BART has been related to self-reported measures of risk taking, use of cigarettes (Lejuez et al., 2003), and drug use (Bornovalova, Daughters, Hernandez, Richards, & Lejuez, 2005).

2.4 Decisions Made Under Risk

Sample experimental tasks assessing decisions made under risk include providing all of the pertinent information to a participant on a piece of paper and asking how he or she would behave (Kahneman & Tversky, 1979), showing participants a handicapped horse race and assessing gambling behavior in relation to a horse's odds of winning

(McCauley, Stitt, Woods, & Lipton, 1973), or asking participants if a playing card selected from a standard deck is going to be red or black (Felsenthal, 1979).

2.4.1 Game of Dice Task

The Game of Dice Task, or DGT (Brand, Fujiwara et al., 2005) is another experimental task used to assess risk taking under risky circumstances. In this task, participants are given \$1,000 imaginary dollars, and are instructed to maximize profits by predicting what number will appear on the roll of a die. For each trial, participants can select between one and four numbers that will appear, with payoffs and punishments determined by the probability of success. For example, if a participant predicts a 6 will be rolled, the participant will win or lose \$1,000 if a six does or does not appear. The participant can also select that a one, two, four, or six will appear, and win or lose \$100. Choosing one or two numbers is considered disadvantageous because the probability for success is below 50%, while selecting three or four numbers is considered advantageous because the probability for success is 50% or greater. While IQ does not correlate with performance (Brand, Recknor, Grabenhorst, & Bechara, 2007), using a cognitive strategy does (Brand, Heinze, Labudda, & Markowitsch, 2008).

2.5 Theories of Risk Taking

2.5.1 Expected Value Maximization

One of the first models of decision-making is expected value maximization, EV, attributed to Pascal and Fermat in 1654 (Fox and Poldrack, 1998). Using expected value theory, $EV = px$, a decision maker will select the option with the highest expected value—the average payout for a prospect. For example, prospect (\$100, .5) will be preferred to prospect (\$100, .25). The EV of the former prospect is \$50, while the latter

has an EV of \$25. Expected value theory assumes the decision maker has a neutral attitude toward risk. However not all decision makers exhibit this attitude. Some are risk averse, accepting a sure payout in place of the prospect, when the EV of the sure thing is lower than the EV of the prospect. Others are risk seeking, preferring a prospect with a lower EV than the sure thing payout. Expected value maximization cannot explain these risk seeking and risk adverse phenomena.

2.5.2 Expected Utility Theory

In 1738, Daniel Bernoulli theorized that the objective value of a choice is not as important as the subjective value. This theory is known as Expected Utility theory, $EU = \sum p(x)u(x)$, with u representing a decision weight. A prospect of \$100 will carry a great weight for an impoverished individual, leading to risk aversion, while a well off individual may not attach much weight to \$100 and become risk seeking (Bernoulli, 1738/1954).

Von Neumann and Morgenstern (1947) developed four axioms concerning expected utility theory: completeness, transitivity, independence, and continuity. Completeness assumes an individual is able to make a decision between alternatives. Transitivity holds that if $A > B$ and $B > C$ then $A > C$. Independence states that the order prospects are presented should not impact the risk taker's preference. Continuity holds that if $A > B > C$, then there is a combination of A and C that will be equal to B (Schoemaker, 1982).

Expected utility theory is fairly accurate at predicting behavior when the decision maker meets all of the axioms. Unfortunately, individuals do not always conform to the axioms when making a choice. Kahneman and Tversky (1979) describe several phenomena that violate expected utility theory. In what is known as the common ratio

effect, individuals will experience a switch in preference for similar prospects with the same probability ratios. For example, individuals prefer \$3,000 for sure over an 80% chance to win \$4,000. However, if the probabilities are divided by 4, individuals exhibit a preference for a 20% chance to win \$4,000 over a 25% chance of winning \$3,000. People also have a nonlinear preference for probabilities; an increase in probability from 0.01 to 0.02 carries more weight than an increase from 0.45 to 0.46. Illustrating another violation of expected utility theory, decision makers should be indifferent to choices with the same expected value, however, preferences have been shown when framed in terms of losses or gains. For example, if a participant has to decide whether to give a vaccine to 100 people, they will be more likely to do so if told 20 people will survive, than if told 80 people will die. According to expected utility theory, losses and gains should carry the same weight, however it is observed that losses loom much larger than gains. People should accept two wagers with the same probability, regardless of the source, but participants are more willing to accept a risk if it is in their area of expertise. Finally, Kahneman and Tversky observed a fourfold pattern of risk taking. At low probabilities, individuals are risk seeking for gains and risk averse for losses. At high probabilities, individuals risk averse for gains and risk seeking for losses. This pattern of risk taking led Kahneman and Tversky to develop prospect theory (1979), which can explain many irrational phenomena that previous models cannot.

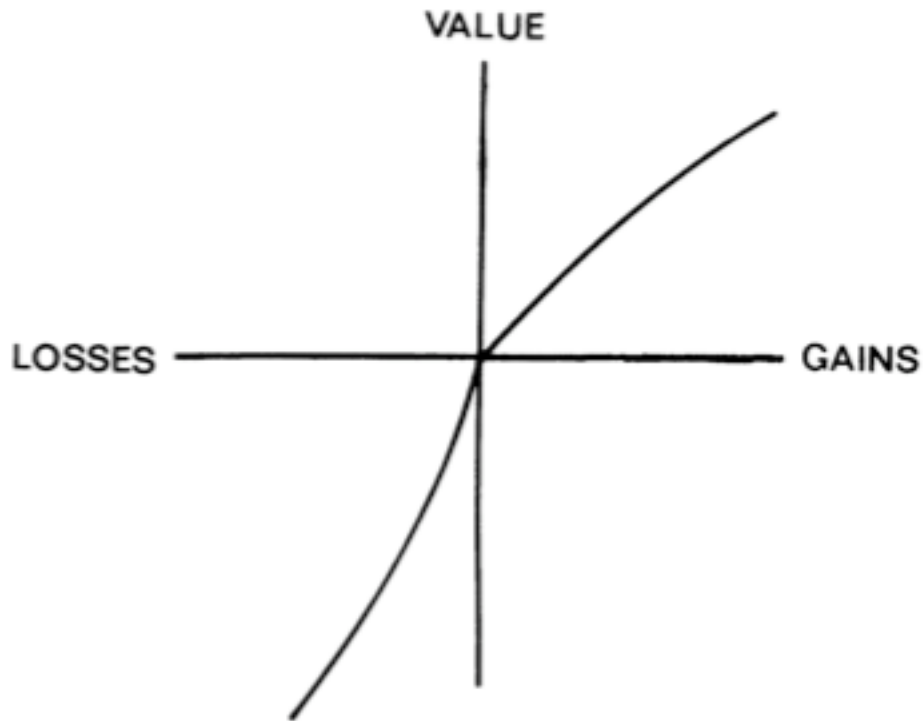
2.5.3 Prospect Theory

According to prospect theory, the value of a prospect x with probability p is: $V(x,p) = w(p) v(x)$ where w is the decision weight of the probability and v is the subjective value of x . The value function of prospect theory is different than the utility

function of utility theory. Instead of focusing on final wealth states, the value function focuses on gains and losses centered on a reference point. The value function exhibits the principle of diminished sensitivity-- changes in value have a diminishing impact on the value function the further from they are from the reference point. For example, losing \$50 is more than half as disvaluable as losing \$100. The value function is concave above the reference point for gains, leading to risk aversion, and convex below the reference point, leading to risk seeking for losses. The value function is also steeper for losses than gains, which illustrates the principle of loss aversion. This means that to risk losing \$50, one must stand to gain more than \$50. Typically this value is twice as much as the amount being risked. Unlike expected utility theory, the weights of a prospect can change based on the way a prospect is framed. Decision makers may also cognitively edit the prospect by combining or cancelling common components, segregating sure things, and simplifying the prospect

In prospect theory, the value of a prospect is multiplied by a decision weight, rather than the probability, representing the subjective probability's impact on the subjective value of the prospect. The weighting function also exhibits diminished sensitivity, using absolute certainty and impossibility as reference points. The inverse S shape of the function is concave near 0 and convex near 1. High probabilities are underweighted—risk aversion for gains, risk seeking for losses, while low probabilities are over weighted—risk seeking for gains, risk aversion for losses. Figure 1 illustrates a prospect theory value function from Kahneman and Tversky's 1979 publication.

Figure 1. Hypothetical prospect theory value function.



For each prospect, c/x is the ratio of the certainty equivalent of the prospect to the nonzero outcome x . A certainty equivalent is the amount one will accept for a risky prospect. For example, to risk \$100 on a coin flip, one may need the opportunity to win \$150. Thus the c/x ratio will be $150/100$, or 1.5. The values of c/x can be plotted as a function of p , with a diagonal line representing a ratio of 1. If subjects are risk averse, all points will lie below the diagonal. Risk neutral participants will have points that lie on the diagonal. Risk seeking participants will have points that lie above the diagonal (Tversky & Kahneman, 1992).

A key component of prospect theory is the reference point used by the individual. During most decision-making, a reference point of zero is used. If a person has not

adapted to their current state by integrating prior outcomes, or expected to be in a different state, a reference point shift will occur, causing an increase in risk taking or risk aversion. For example, a person who has already lost \$2,000 may view the choice between a \$1,000 sure gain and a 50% chance to win \$2,000 as a choice between $(-\$2,000, .50)$ and $(-\$1,000)$, rather than $(\$2,000, .50)$ and $(\$1,000)$ (Kahneman & Tversky, 1979).

2.5.4 Somatic Marker Hypothesis

One theory that takes into account the role of emotions in decision-making is the somatic marker hypothesis (Bechara & Damasio, 2005). The authors argue that reasoning alone may not be sufficient to make advantageous decisions, and that emotion can be beneficial or detrimental to our decisions, depending on the task. They also argue that decision-making tasks made under certainty, where punishment and reward are explicitly known, and uncertain decision-making tasks, where reward and punishment are more ambiguous, elicit different neural circuits.

In the somatic marker hypothesis (Bechara & Damasio, 2005), internal somatic states influence decision-making. These states can be created through primary inducers, an actual event, or secondary inducers, the thought or deliberation of an event. Furthermore, these somatic states can occur in the “body loop” or the “as if body loop.” In the “body loop,” somatic changes take place in the body itself, such as an increase in heart rate and galvanic skin response (GSR). In the “as if body loop” the body itself is bypassed, with the changes occurring in the cortex and the brainstem. These changes in the brain trigger the release of neurotransmitters, which then create the emotional state.

The authors claim that uncertain decision-making tasks trigger the “body loop,” while decision-making tasks with certainty activate the “as if body loop”

According to Bechara and Damasio (2005), the somatic states generated through the two loops can act consciously or unconsciously on the decision-making process. During decision-making the brain activates the different somatic states associated with each choice and selects the option connected to the state that feels the best, or in some situations, the state that hurts the least. Somatic states can be described as a person’s gut feelings, and a person will follow their gut feelings on a conscious or unconscious level. The left side of the prefrontal cortex is traditionally implicated with approach and reward mechanisms, while the right side is implicated with avoidance and punishing mechanisms (Schutter, de Haan, & van Honk, 2004). In the somatic marker hypothesis, the left ventromedial prefrontal cortex is believed to transform positive information, and the right ventromedial prefrontal cortex is believed to transform negative information (Bechara & Damasio, 2005).

2.5.5 Mental Accounting

Thaler (1999) describes mental accounting as “the set of cognitive operations used by individuals and households to organize, evaluate, and keep track of financial activities.” There are three main components to mental accounting: How an event is perceived in terms of gains and losses, which specific mental account activity is occurring, and how often the account is balanced.

Mental accounting has yielded several interesting experimental results. If asked who is happier, someone who won a lottery that pays \$75 or someone who won a lottery that pays \$50 and another lottery that pays \$25, a majority of participants select the

person who won two lotteries (Thaler, 1985). This is in line with the principle of diminished sensitivity further from the reference point in the value function. Similar results have not been found in the case of losses. Participants should wish to combine a series of losses into one big loss, rather than wanting to experience them one by one. When asked who is happier, someone who lost \$30 and \$9 on the same day or weeks apart, a majority of participants responded that the person who lost the money weeks apart is happier. Participants appear to believe that a prior loss makes one more sensitive to a subsequent loss (Thaler & Johnson, 1990).

Another study revealed that participants are willing to pay more for a beer at a resort than at a grocery store. Participants were asked to imagine they were at the beach on a hot day and really wanted a cold bottle of their favorite beer. A friend is getting up to make a phone call and offers to bring back a beer from the only nearby place that sells beer, either a fancy resort or a rundown grocery store. The friend asks what is the maximum amount of money you are willing to pay for the beer? Participants were willing to pay \$2.65 at the resort and \$1.50 at the store for the same bottle of beer. This occurs because the reference point for what a beer should cost is higher at a resort than a grocery store (Thaler, 1985). Retailers use this effect when they advertise the regular price, a reference point, alongside the sales price (Thaler, 1999).

According to mental accounting, people have a reluctance to close out a mental account with a loss. When one buys tickets to an event, the account takes on a negative balance. After one has attended the event, and theoretically received their money's worth, the account is back to zero and the account is closed. If a blizzard occurs that night, and one is unable to go the event, then one is forced to recognize the negative

balance of the account. Rather than closing an account that is in the negative, people will drive through the blizzard to get to the event so the account can be closed with a balance of zero (Thaler, 1980). This desire to close an account with a positive balance, or no balance, explains the observation that investors are more likely to sell winning stocks than losing stocks (Odean, 1998).

In another interesting study, wine collectors were asked to imagine they bought a bottle of wine for \$20 that is now worth \$75. Participants were asked what it costs them to drink this bottle of wine: \$0, \$20, \$20 plus interest, \$75, or -\$55. The percentages of respondents that chose each answer were 30, 18, 7, 20, and 25 respectively. The correct answer is \$75, and a majority of participants that selected this answer were actually economists. The astonishing thing about this study is that over half of the respondents viewed the bottle as costing nothing to drink or actually saving them money (Shafir & Thaler, 2006).

When it comes to risk taking and the influence of previous outcomes, Thaler and Johnson (1990) sampled MBA students and found that after being told to imagine they lost \$30, 60% of participants indicated they would not want to accept a gamble with a 50% chance to win or lose \$9. After being told to imagine a win of \$30, 70% of participants expressed a desire to take a gamble with a 50% chance to win or lose \$9. Thaler describes the tendency to become risk seeking after a win as the house money effect, as many times gamblers at casinos will separate the money they are up from the money they brought with them. Several studies have supported the house money effect. One study found that participants who are given \$75 are willing to pay more for one share of stock than participants who are given \$65, indicating an increase in risk taking

(Ackert, Charupat, Church, & Deaves, 2006). However, other studies have found the opposite of the house money effect. Franken, Georgieva, and Muris (2006) had one group of participants take an IGT that would cause the participants to lose money, regardless of their selections, while another group of participants took an IGT that would lead to gains, regardless of the deck selections. Both groups then took the regular IGT, and it was found that participants in the prior loss group performed worse, indicating more risk taking, than participants in the prior win condition.

According to prospect theory (Kahneman & Tversky, 1979), if one does not integrate prior outcomes, one will become risk averse for gains and risk seeking for losses. This seems at odds with Thaler and Johnson's (1990) house money effect, in which segregation of wins leads to risk seeking and segregation of losses leads to risk aversion.

2.6 Affective States

Another factor that can influence risk taking is a person's sensitivity to reward and punishment, as modeled by Gray's (1994) Behavioral Activation System (BAS) and Behavioral Inhibition System (BIS). The BAS is responsive to signals of reward or non-punishment, and is linked to the approach motivational system. The BIS responds to signals of punishment, non-reward, novel stimuli, and innate fear stimuli, leading to behavioral inhibition, increased arousal, and increased attention. The BIS is linked to the avoidance motivational system. The BAS and the BIS have been implicated to the concept of valuation by feeling, which is evaluating something based on one's emotions (Desmeules, Bechara, & Dube, 2008).

Carver and White (1994) developed a commonly used scale to measure an individual's BAS and BIS. The scale consists of 20 statements, divided into four sections, in which respondents reply strongly disagree, disagree, agree, or strongly agree. The first section consists of seven statements that measure the BIS. A sample statement is, "I worry about making mistakes." The next three sections combine to measure the BAS. The reward responsiveness section measures how a person responds to rewards. A sample from this section is, "When I see an opportunity for something I like, I get excited right away." The next section measures a person's drive and pursuit of goals. A sample statement is, "I go out of my way to get things I want." The final section measures fun seeking, defined as the desire for new rewards and a willingness to approach a rewarding event. A sample fun seeking question is, "I will often do things for no other reason than the fact that they might be fun." While validating of the measures, Carver and White (1994) found that the BIS correlates with negative affect while the BAS correlates with positive affect. The researchers did find a correlation between the BIS and the BAS reward responsiveness scale, however the overall BIS and BAS measures do not correlate, and the three BAS subscales load onto the same factor in a factor analysis.

2.7 Impact of Affective States on Risk Taking

The left side of the prefrontal cortex is traditionally implicated with approach and reward mechanisms, while the right side is implicated with avoidance and punishing mechanisms (Schutter, de Haan, & van Honk, 2004). In the somatic marker hypothesis, the left ventromedial prefrontal cortex is believed to transform positive information, and the right ventromedial prefrontal cortex is believed to transform negative information (Bechara & Damasio, 2005). Schutter et al. (2004) revealed that increases of right

prefrontal cortex activity, implicated with the BIS, are linked with poor IGT performance.

Several studies have examined the impact of an individual's BAS and BIS sensitivity on IGT performance. Desmeules et al. (2008) found that participants high in the BAS and low in the BIS perform better than participants low in the BAS and high in the BIS. The researchers regression equation predicts a difference of 14 good deck selections between those high in the BAS and low in the BIS versus those low in the BAS and high in the BIS. The researchers also had participants take the variant IGT, in which selecting from the high-loss high-reward decks is the optimal strategy. It was observed that in this situation, being low in the BAS and high in the BIS led to more selections from the beneficial decks. Goudriaan, Oosterlaan, de Beurs, and van den Brink (2006) found that participants low in the BIS and low in the BAS perform the best, followed by those low in the BIS and high in the BAS, and those high in the BIS high in the BAS. Scores for those high in the BIS and low in the BAS were not reported. Another study found a positive correlation between the BAS reward responsiveness scale and IGT score, while no correlation was found between IGT score and the BIS scale. This study used a variant IGT in which the magnitude of the rewards and the punishments increased as the task progressed (Franken & Muris, 2005).

Contrary to these results, Peters and Slovic (2000) found a negative correlation between BIS score and selections from the high-risk deck. In this task, however, participants were presented cards one at a time from each deck, and they had to decide whether to accept or reject each card. Instead of a reward being present on each card, rewards were only present on cards not featuring a loss. The researchers also used

different reward and loss amounts than the original IGT. These reward and loss amounts varied throughout the deck. In this study, Deck A rewards between \$50 and \$150, while punishing \$100 to \$200, leading to a net loss of \$250 for every 10 cards selected. Deck B rewards between \$150 and \$250, while punishing \$200 to \$300, leading to a net loss of \$250 for every 10 cards selected. Deck C rewards between \$50 and \$150, while punishing \$200 to \$300, leading to a net loss of \$250 for every 10 cards selected. Deck D rewards between \$150 and \$250 while punishing \$100 to \$200, leading to a net gain of \$250 for every 10 cards selected. The researchers believed this difficult task would reduce participant's reliance on analytical processing, causing them to rely more on affective processing. In another study, using the original IGT amounts, found a correlation between the BAS fun seeking subscale, and impaired performance on the IGT. In this study negative affect was also found to correlate with impaired performance (Suhr & Tsanadis, 2007).

Increases of GSR are associated with the BIS (Brenner, Beauchaine, & Sylvers, 2005). Bechara et al. (1994) found that participants experience an increase in GSR before selecting from a bad deck. This finding is puzzling because it appears like increases of GSR, part of the BIS, contribute to identifying the bad decks, yet those high in the BIS do not perform as well as those low in the BIS.

Research on the impact of motivational forces in other gambling tasks is also unclear. Demaree, DeDanno, Burns, & Everhart (2008) tested the impact of the BAS and the BIS on two different slot machine tasks. In the W-task, participants could change the amount wagered, while the probability remained constant. In the P-task, participants could change the probability, while the amount they could win remained constant. The

researchers found that high levels of the BAS correlated with risk taking on the W-task, while low levels of the BIS correlated with risk taking on the W-task and the P-task. Another study, examining correlates of problem gambling, found that the BAS and the BIS are both positively correlated to gambling severity, as measured by the Problem Gambling Severity Index (Fitzgerald, 2008).

2.7.1 Scope Insensitivity

In an attempt to explain the impact of motivational systems on the IGT, while also taking into account prospect theory, Desmeules et al. (2008) proposed that value functions are modified by motivational systems. To conform to the findings that those high in the BAS perform better on the IGT, it is assumed that they are more sensitive to rewards, but this sensitivity levels off, like a step. Thus a gain of \$50 carries with it the same weight as a \$100 gain, and an attachment is not formed with the \$100 deck. These individuals choose the somatic state that feels the best, in this case it is the one that does not involve a large loss. Those high in the BIS are more sensitive to punishment, but this also levels off, causing a \$50 loss to carry as much weight as a \$1,150 loss, causing the \$100 win to be more appealing than the \$50 win, and the bad decks are selected. This theory is commonly referred to as scope insensitivity. Another example of scope insensitivity is when asked how much money they would donate to save 200, 2,000, or 20,000 birds from drowning in open oil ponds, participants responded \$80, \$78, and \$88 respectively (Desvousges et al., 1992). It is believed that while participants can visualize one bird soaked in oil, which creates emotional arousal, but this arousal is not multiplied by every additional bird. At some point this arousal levels off, as it is nearly impossible to visualize 20,000 dying birds (Kahneman, Ritov, & Schkade, 1999).

2.7.2 Scalar Multiplication

The opposing theory to scope insensitivity is scalar multiplication. According to scalar multiplication, the value function is influenced by sensitivity to reward and punishment. Those high in the BIS place a greater value on losses, and those high in the BAS place a greater value on rewards. According to this theory those high in the BIS should outperform those high in the BAS. In scalar multiplication, individuals high in reward sensitivity prefer winning \$100 to \$50. Thus, those high in the BAS will associate greater positive somatic feelings to the \$100 and select more cards from the bad decks. Participants high in the BIS have stronger somatic states associated with the high punishing decks, and thus avoid those in favor of the less punishing good decks (Desmeules et al., 2008).

2.8 Dynamic Consistency

Much decision making research relies upon the concept of dynamic consistency—the assumption that a participant is required to behave in the same way they plan on behaving in a specific situation (Barkan & Busemeyer, 1999). For example, imagine a person makes a plan to only eat fast food on Mondays, and they can only order a chicken sandwich. A person can always change their mind and order a fish sandwich rather than chicken. In fact, this person could eat fast food everyday, and order a triple cheeseburger each time. This person may not even eat fast food on Monday.

Barkan and Busemeyer (1999) examined dynamic consistency in a sequential gambling task. In their study, participants were presented with four potential prospects: a 50% chance to win 200 or lose 100, a 50% chance to win 80 or lose 40, a 50% chance to win 200 or lose 40, and a 50% chance to win 80 or lose 100. Participants were presented

with 32 trials of two gambles on a computer screen. Participants were asked if they won or lost the first gamble, would they accept the second gamble. Participants then experienced the first gamble and were asked if they wished to revise their original plan. Dynamic inconsistency occurred in 19.13% of the trials. Further analysis indicated that a change to accept the gamble tended to occur after a loss, while the tendency to reject a gamble occurred after a gain. These results cannot be attributed to the random nature of people changing their minds because the inconsistencies followed a significant pattern.

Barkan and Busemeyer (1999, 2003) theorized that these results could be accounted for by a change in the participant's reference point. During the planning phase, participants use a neutral reference point of 0. However, actually experiencing a win or a loss causes a shift in the reference point for some participants. Following a gain, the reference point shifts into the risk-averse portion of the value function, while following a loss the reference point shifts into the risk-taking portion of the value function.

Barkan, Danziger, Ben-Bashat and Busemeyer (2005) replicated the previous study, except this time there were 17 decision problems. Half of the participants had instructions that would cause them to integrate previous outcomes. For example, the participant would be told they have already won \$200. If they accept the \$200 lose \$100 gamble, they will win \$400 or win \$100. In the other condition, segregation, participants were told they have won \$200 and are asked if they want to accept a win \$200, lose \$100 gamble. In line with the researcher's hypothesis, participants in the integration condition planned to bet more after a win and bet less after a loss, while those in the segregation

condition planned to bet less after a win and more after a loss. Dynamic inconsistency was found to occur in the same direction in both conditions.

Andrade and Iyer (2009) examined dynamic inconsistency in sequential gambles in a series of three experiments. In Experiment 1, participants were given \$4 and told they could wager up to \$2 in each of two gambles. For the gamble, 20 red and 20 blue squares appeared on a computer screen. An “X” randomly flashed on the screen every $\frac{1}{2}$ second for 15 seconds. If the X landed on a blue square the participant would win twice the amount risked. If the X landed on a red square the participants would lose the amount risked. Participants reported how much they planned to wager on the first risk and how much they planned to wager on the second risk if they won or lost the first risk. Prior to the first bet, participants were asked if they wanted to change the amount they planned to bet on the first gamble. The gamble was played out and participants were asked if they wanted to change the amount they planned to bet on the second gamble. Compared to the first gamble, participants on average planned to bet less following a loss, and a similar amount following a gain. After experiencing the first gamble, participants bet the planned amount following a gain and a larger than planned amount following a loss. In this study 37% of participants deviated from their plan. No significant difference was found for deviations following a gain. All deviations following a loss were positive, indicating the participant bet more than the plan.

Experiment 2 replicated this method with two distinctions. First, participants could wager up to \$5 on each bet. Second, prior to the first gamble, participants indicated on a scale from 0 to 100, with 0 being very sad, 50 being neutral, and 100 being very happy, how they would feel if they won or lost the first gamble. Participants

performed the first gamble, reported how they actually felt, and then took the second gamble. The results of both gambles were similar to Experiment 1. Looking at predicted emotions, participants accurately predicted how they would feel after a win, and underestimated how they would feel following a loss. Furthermore, 68% of those who made positive deviations following a loss underestimated their emotions. Magnitude of underestimation was not correlated with the magnitude of positive deviations.

Experiment 3 replicated the methods of Experiment 1 with two changes. Once again participants could wager up to \$5 on each bet. In this experiment everyone lost the first gamble. Following this loss, participants saw a 5.5 minute clip of either a negative, neutral, or positive movie. Following the movie, participants were asked if they wanted to change the amount of their bet, and then performed the second gamble. Participants who saw the negative or neutral movie bet significantly more than planned. No difference was found between planned and actual bets for those in the positive movie condition. Examining deviations from the plan, 72% bet more than planned following the positive movie, but this did not differ from chance. 78% and 100% of those in the neutral and negative conditions, respectively, bet more than they had planned. These differences were significantly different from chance.

CHAPTER III

HYPOTHESES

3.1 Aim of the Present Study

This study aims to investigate the impact of the BAS and the BIS on dynamic inconsistency during a multi-stage monetary risk-taking task.

3.2 Hypotheses

Andrade and Iyer (2009) found a relationship between an underestimation of emotional response to a win or loss and the dynamic inconsistency. It seems logical that this emotional response may manifest itself in an individual's approach and avoidance motivations. According to prospect theory, individuals become risk averse following a gain and risk seeking following a loss (Kahneman & Tversky, 1979). The stability favoring nature of the BIS (Gray, 1994) can account for this, as one seeks to maintain current winnings or get back to a predetermined location following a loss. According to the house money effect and mental accounting (Thaler & Johnson, 1990), individuals become risk seeking following a win and risk averse following a loss. The appetitive nature of the BAS (Gray, 1994) can account for the risk seeking following a win, as one is attempting to win as much as possible. Risk aversion following a loss can be accounted for by the BIS, as one seeks to minimize future losses and maintain one's current

financial standing. Even though Kahneman and Tversky's (1979) prospect theory and Thaler and Johnson's (1990) house money effect and mental accounting predict different outcomes, there is no reason both cannot be correct when Gray's (1994) BIS and BAS systems are taken into account.

It is hypothesized that following a win, the BIS and the BAS will predict dynamic inconsistencies. Specifically, high levels of the BIS will predict negative deviations, while high levels of the BAS will predict positive deviations. Following a loss, only the BIS will predict dynamic inconsistency, in such a way that those higher in BIS will either make positive or negative deviations, while those with lower levels of BIS will not make deviations. No hypothesis is made concerning deviations on the first trial, as it is believed these deviations are of a random nature (Andrade & Iyer, 2009).

CHAPTER IV

METHOD

4.1 Participants

Fifty-two students from Cleveland State University participated in the study, with a mean age of 23.13 ($SD = 7.27$). Forty-one participants were female, eleven male.

Participants received course credit for their participation, as well as \$5 compensation for their participation, which they could use for the risk-taking task.

4.2 Materials

Participants completed the BIS and BAS scales developed by Carver and White (1994). Participants also completed a form describing planned risk taking on a computerized task. Participants completed a questionnaire assessing thoughts and reactions during the task, as well as demographic information. Five \$1 bills were used as the compensation and risk-taking medium.

The risk-taking task was presented on a computer. Participants were shown two cards on the screen, and told that one card is the winner and the other is the loser. Clicking on a card showed the outcome on a new screen, indicating “You win!” or “You lose!” If a participant won, he or she was rewarded with the amount wagered. If a participants lost, he or she was punished the amount wagered. Participants clicked on the

word continue to advance to the identical second prospect. The computer program was designed so that regardless of card selection, participants would either win the first and lose the second trial, or lose the first and win the second trial. Participants were randomly assigned to a condition at the beginning of the experiment

4.3 Design and Procedure

Participants began the experiment by signing an informed consent form.

Participants were handed \$5 and instructed to place it in their pocket. It has been found that participants who physically handle the money risk less (Weatherly, McDougall, & Gillis, 2006). This helped create a more realistic risk-taking scenario. Participants then completed a paper version of the BIS and BAS scales (Carver & White, 1994). They were then presented with a form describing the sequential risk-task. Participants were told to imagine they are going to perform the task, and they should indicate how much they planned to risk on the first prospect, between \$0 and \$2.50 in increments of \$0.25, and how much they planned to risk on the second prospect, if they won or lost the first prospect, between \$0 and \$2.50 in increments of \$0.25. Participants were then told they had the opportunity to actually complete the task, using their participation fee. They were reminded that participation was completely voluntarily, and they were free to exit the experiment at any time, keep the \$5, and they would still receive course credit for their participation. If a participant agreed to participate, the participant was asked how much he or she wished to risk on the first trial, and to what degree, on a five point scale, does he or she believe one will win the first trial, and also to what degree does one believe one will lose the first trial. They completed the first trial on the computer, and then completed a questionnaire concerning their feelings to the first trial. Participants were asked how

happy versus unhappy and anxious versus relieved they felt. Participants were also asked to rate how important it was to get back to even following a loss, minimize future losses, maintain winnings, and maximize future winnings. These questions were intended to provide insight into the motivation behind participant's behaviors, and provide a wealth of exploratory data. Responses were on a five-point scale, with 1 representing *strongly disagree* and 5 representing *strongly agree*. The entire process was repeated for the second trial. Finally, all participants, regardless of participation in the simulation, indicated how important \$5 is to them, along with gender and age information.

CHAPTER V

RESULTS

Twenty participants elected to not participate in the risk-taking simulation portion of the study. The mean score of the behavioral approach system was 39.79 ($SD = 4.86$) and the mean of the behavioral inhibition system was 19.29 ($SD = 3.65$). No differences were found in regards to BAS or BIS between those that participated in the simulation and those that did not. Participants were fairly neutral to the five-dollar amount that may be risked ($M = 2.94$, $SD = 1.18$). Once again, no difference was found between those that did not participate.

Table I shows the amounts participants planned on risking in the simulation. Differences between the participators and non-participators were significant for the trial following a loss, and near significant for the other trials, so amounts for both groups are reported. For both non-participators and participators, significantly less was risked following a loss than was risked on the first trial, $t(31) = 4.174$, $p < .000$ and $t(19) = 3.767$, $p = .001$, respectively. Significantly less was also risked by non-participators and participators for a losing trial than a winning trial, $t(31) = 2.874$, $p = .007$; and $t(19) = 3.046$, $p = .007$, respectively.

Table I

Mean Amounts Planned to be Risked

Group	First trial	Trial after win	Trial after loss
Participators	\$2.12	\$2.06	\$1.52
n = 32	<i>SD</i> = \$0.64	<i>SD</i> = \$0.70	<i>SD</i> = \$0.95
Non-Participators	\$1.71	\$1.56	\$0.88
n = 20	<i>SD</i> = \$0.97	<i>SD</i> = \$0.96	<i>SD</i> = \$1.02

Table II illustrates the amount participants actually risked. Those in the winning condition did not differ in amount risked per trial. A significant difference was found between first and second trial amounts in the losing condition, $t(14) = 3.12$, $p = .008$.

Table 2

Mean Amounts Actually Risked

Group	First trial	Second trial
Winning	\$2.01	\$1.72
n = 17	<i>SD</i> = \$0.56	<i>SD</i> = \$0.87
Losing	\$2.08	\$1.43
n = 15	<i>SD</i> = \$0.65	<i>SD</i> = \$0.85

In total, 21 participants, 66%, deviated. Table III breaks down the deviations by type based on condition. The direction of deviations was significant for the first trial, $\chi^2 =$

6 (1), $p = 0.01$. There was no significant difference for type of deviation following a win or a loss.

Table III

Deviations by Trial

Type	First trial	Second after win	Second after loss
Positive	0	2	2
	0.00%	11.76%	13.33%
Negative	6	5	6
	18.75%	29.41%	40.00%
None	26	10	7
	81.25%	58.82%	46.67%
Total	32	17	15
	100%	100%	100%

Participants expected to win ($m = 3.25$, $SD = 0.62$) the first risk significantly more than they expected to lose ($m = 2.66$, $SD = 0.79$), $t(62) = 3.35$, $p = .001$. The difference between winning ($m = 3.19$, $SD = 1.03$) and losing ($m = 2.75$, $SD = 0.98$) expectations for the second risk were not significant. Participant's expectations did not differ significantly based on experimental condition.

5.1 Trial One

No hypothesis was formulated for the first trial. All the deviations in the first trial were negative, and an exploratory logistic regression analysis was conducted, with

whether a participant deviated being the dependent variable. The results of the logistic regression are summarized in Table IV. The change in -2Ll was significant, indicating an improvement over then null model. The Hosmer and Lemeshow statistic was not significant, indicating a goodness-of-fit. On the individual predictor level, amount risked on the first trial was significant, while the constant and second trial deviations were not. However, not including these variables in the model causes a lack of goodness-of-fit. The negative beta weight of amount risked and second trial deviations indicates that participants that risked more or deviated on subsequent trials were more likely to deviate negatively on the first trial. The BIS ($p = .214$) and the BAS ($p = .329$) were not included in the model.

Table IV

Logistic Regression Model of First Trial Deviations (n=32)

Predictor	<i>B</i>	<i>SE</i>	<i>Wald</i>	<i>df</i>	<i>p</i>	<i>Exp(B)</i>
Constant	3.786	2.099	3.254	1	.071	44.092
First Trial Risk Amount	-2.360	1.052	5.030	1	.025	.094
Deviated Second Trial	-2.564	1.450	3.126	1	.077	.077
Test	<i>-2Ll</i>		χ^2	<i>df</i>	<i>p</i>	<i>R</i> ²
Overall model evaluation						
Likelihood ratio test	20.230			1	.005	
Cox & Snell						.281
Nagelkerke						.449
Goodness-of-fit test						
Hosmer & Lemeshow			7.073	4	.132	

Table V

Observed and Expected Frequencies for Positive Deviations on Trial 1

Observed	Predicted		% Correct
	Yes	No	
Yes	2	4	33
No	2	23	92
Overall % Correct			80.6

The contingency table is shown in Table V. The false positive rate was 50.00%. The false negative rate was 14.81%. The overall percentage correct was identical to the rate of chance.

5.2 Trial Two

5.2.1 Winning

Logistic regression was used to test the hypothesis that following a win, the BAS would predict positive deviations and the BIS would predict negative deviations. The direction of deviation was the dependent variable and the BIS and BAS were the independent variables. Table VI summarizes the logistic regression for type of deviation following a win. Contrary to the hypothesis, the BIS and the BAS were not included in the model.

Table VI

Logistic Regression Model of Deviations Following a Win

Predictor	<i>B</i>	<i>S.E.</i>	<i>Wald</i>	<i>df</i>	<i>p</i>	<i>Exp(B)</i>
Constant	-.405	.527	.592	1	.442	.667
Test	-2 <i>Ll</i>	χ^2	<i>df</i>	<i>p</i>	<i>R</i> ²	
Overall model evaluation						
Likelihood ratio test	-	-	-	-		
Cox & Snell						.583
Nagelkerke						.748
Goodness-of-fit test						
Hosmer & Lemeshow			7.073	4	.132	

To further understand any relationships not found by the logistic regression equation, an ANOVA was performed, using positive, negative, and no deviation as levels of the dependent variable. A significant difference was found with the winning expectations for second trial variable, $F(2, 14) = 6.229, p = .012$. Post hoc analysis revealed negative deviators believed they would win significantly less than non-deviators, $p = .013$, and near significantly less than positive deviators, $p = .064$

5.2.2 Losing

To test the hypothesis that following a loss, the tendency to make any deviation would be predicted by high levels of BIS, a t-test was conducted between BIS score of those that deviated and those that did not. The results of the test were not significant,

$t(13) = 0.074$, $p = .9421$. An exploratory logistic regression was performed, with direction of deviation being the dependent variable. The results of the logistic regression are summarized in Table VII. The change in -2LL was significant, indicating an improvement over the null model. The Hosmer and Lemeshow statistic was not significant, indicating a goodness-of-fit. On the individual predictor level, BAS was included in the model. Participants with higher levels of BAS were more likely to make negative deviations following a loss. Specifically, this difference in BAS was driven by the drive level of BAS, with negative deviators having significantly higher levels than positive and non-deviators, $F(2, 14) = 13.408$, $p = .001$.

Table VII

Logistic Regression Model of Deviations Following a Loss

Predictor	<i>B</i>	<i>S.E.</i>	<i>Wald</i>	<i>df</i>	<i>P</i>	<i>Exp(B)</i>
Constant	-27.927	13.886	4.045	1	.044	0
BAS	-.793	.361	4.191	1	.041	2.094
Test	<i>-2Ll</i>		χ^2	<i>df</i>	<i>P</i>	<i>R</i> ²
Overall model evaluation						
Likelihood ratio test	-10.098			1	.001	
Cox & Snell						.281
Nagelkerke						.449
Goodness-of-fit test						
Hosmer & Lemeshow			1.2	4	.676	

Table VIII

Observed and Expected Frequencies Deviations Following a Loss

Observed	Predicted		% Correct
	Yes	No	
Yes	8	1	88.9
No	2	4	66.7
Overall % Correct			80

The contingency table is shown in Table VIII. The false positive rate was 20.00%. The false negative rate was 20.00%. The overall percentage correct was better than the chance rate of 60%.

5.3 Simulation Questions

Table IX details participant's responses to the questions asked following a win or loss. Participants that lost the first trial were more anxious than those that lost the second trial, $t(30) = 2.78, p = .009$. There were no other differences based on condition.

Table IX

Participant's Mean Response Following a Win or Loss

Question	Mean	SD
	(<i>n</i> = 32)	
<i>Winning</i>		
It is important to maintain my earnings.	3.56	1.05
It is important to maximize future earnings	3.50	1.02
I am happy after winning	4.22	0.91
I am relieved after winning	3.66	1.21
<i>Losing</i>		
It is important to get back to even	3.03	1.09
It is important to minimize future losses	3.59	1.19
I am upset after losing	2.50	1.30
I am anxious after losing	2.56	1.34

Participants that made negative deviations on the first trial found it more important to maintain their earnings, $F(2, 31) = 4.464$, $p = .04$, regardless of if they won the first trial, or if they lost the first and won the second trial. Several post-simulation questions had near significant results, and I believe it is prudent to report these results, as this could be an artifact of small sample size. Participants reported being less anxious if they won the first trial and made a negative deviation on the second losing trial, than those who did not make a deviation on the second losing trial, $F(2, 16) = 3.145$, $p = .07$.

For participants that lost the first trial and won the second trial, those making negative deviations before the win found it more important to maintain their earnings than those that did not deviate, $F(2, 14) = 3.130, p = .08$. Furthermore, they wanted to minimize future losses more than non-deviators, $F(2, 14) = 3.197, p = .08$. These negative deviating participants were also happier after winning the second prospect than those that did not deviate $F(2, 14) = 3.503, p = .06$, and cared more about \$5 than those that did not deviate, $F(2, 14) = 5.476, p = .020$.

CHAPTER VI

DISCUSSION

The high rate of nonparticipation was somewhat surprising, as Andrade and Iyer (2009) said that participants are usually happy and willing to participate in experiments like this. The non-significance of how important five dollars is eliminates the possibility that participators cared less about five dollars than non-participators. Perhaps the manipulation of having participants place the money in their pocket to promote ownership worked a little too well. Another likely possibility is that the dynamics of Cleveland State University aided to the high rate of non-participation. Being primarily a commuter college, the five dollars may have represented a day's parking and gas money, or it may have represented a free lunch. This representation of \$5 may not be present at primarily residential colleges, where students live on campus and have meal plans for the cafeteria.

Overall, participants did not risk more following a win, providing support for prospect theory's prediction of risk aversion following a gain (Kahnemen & Tversky, 1979), and conversely, not supporting the house money effect (Thaler & Johnson, 1990). These results may be due to ceiling effects, as many participants opted to risk the

maximum amount. This ceiling effect can also explain why all deviations on the first trial were negative.

Overall, Participants risked significantly less following a loss, which does not support prospect theory's prediction of risk seeking in the realm of losses (Kahneman & Tversky, 1979), but supports Thaler and Johnson's mental accounting prediction (1990).

The lack of differences in winning and losing expectations between winning and losing conditions suggests that participants were not using the gambler's fallacy that a specific result was *due*. The expectation of winning the first trial indicates optimism towards the task (Gibson & Sanbonmatsu, 2004), and can explain why those that lost the first trial reported being more anxious than those that lost the second trial, as stronger emotional responses are elicited when an unexpected result occurs (Shepperd & McNulty, 2002). The anxiety felt after the loss coincides with the belief that losses activate the BIS, even though this relationship was not found to be statistically significant in this study.

All deviations in the first trial were negative; first trial risk amount and if one deviated on the second trial predicted this deviation. Those that planned to risk a higher amount on the first trial were more likely to negatively deviate on the first trial. Those that deviated on the second trial were also more likely to deviate on the first. It is possible these individuals are more indecisive or perhaps they did not take the planning phase as seriously as others. It is also possible that in these participants there may be a disconnect between imagining risking five dollars and actually risking five dollars, or the body loop and as-if body loop in the framework of the somatic marker hypothesis (Bechara & Damasio, 2005). Participants that made negative deviations following a loss reported that

maintaining their earnings was important, more so than non-deviators. Though no significant correlation was found, maintaining the status quo is normally associated with the BIS (Gray, 1994).

The BAS and BIS were not found to influence dynamic inconsistencies following a win as hypothesized. In fact, none of the variables that were measured significantly predicted the type of deviation following a win. It is likely this is a result of small sample size and ceiling effects. However, negative deviators expectations of winning were lower than positive and non-deviators. Negative deviators may be adhering to the gamblers fallacy. Since they won the first trial, they believed they were less likely to win the second, and decided to risk less to attribute for this. These lower expectations can also explain why the negative deviating participants felt less anxious following the loss than those who did not deviate. Weaker emotional responses are elicited to expected outcomes (Shepperd & McNulty, 2002), and in this case, not winning is the expected outcome.

Following a loss, the BIS did not predict deviations, as was hypothesized. However, participants with higher levels of BAS were more likely to make negative deviations following a loss. This seems very counter intuitive, until matched with other significant, and near significant results. These participants also had higher levels of BAS Drive, cared more about five dollars, found it more important to maintain their earnings, and found it important to minimize losses. These results paint the picture of an individual who sets the goal of doing well on the task, and when that initially does not happen, in the form of losing the first trial, they opt for a more conservative approach in hopes of still achieving some form of that goal. Anecdotal examples of this could include: if a sports team is losing, they may adjust their game plan to a more basic strategy, in order to

simplify things and gain momentum. A band, whose goal is to become famous, may realize their style of music is not popular, and switch to a different style in order to attract more fans. An individual that wants to be an astronaut, but has received feedback that result is unlikely, may opt to become part of a different aspect of the space program. An interesting finding is that negative deviating participants were happier following a win than those that did not deviate. Why would one be happier risking less and winning than not changing the risk amount and winning? One explanation is that these individuals are simply more sensitive to the win, but whether these individuals are adhering to scalar multiplication or scope insensitivity is unclear. Another explanation is that the increase in happiness is a form of cognitive dissonance. They wanted to do well on the task, implied by the high BAS Drive score, they would have done better if they made no deviations, so they feel the need to justify to themselves that they are happy with the results of the task.

6.1 Implications

The fairly high level of non-participants highlights the importance of assessing the sample demographics of financial risk taking studies when assessing generalizability. Samples drawn from affluent populations may behave differently than less affluent populations. This study also shows the importance of using real money in risk-taking simulations, as many participants elected to actually risk a different amount than they originally said they would.

When it comes to risk taking in a real world setting, from a casino's perspective, negative deviations are undesirable. In this study, participants high in BAS Drive would make negative deviations following a loss, possibly because of a redefinition of goals. To account for this, casinos could emphasize the goal of gambling is to have fun, regardless

of whether one is winning. This may cause the highly driven to not make the negative deviations, as they are driven to succeed in having fun, not winning money. However, it is also important for the casino to emphasize responsible gaming and setting limits, as industry research has shown that if a person loses too much money, he or she is less likely to return to the casino (Ayres, 2007).

This study may also explain behavior in other forms of risk-taking outside of monetary rewards. Often one is watching sports, such as football, and is confused as to why the coach of a team that is losing elects to punt or kick a field goal when it's fourth down and less than a yard to go. Perhaps this less risky option is the coach's way of readjusting his game plan to set his team up with the best chance of winning. Taking the conservative route may indicate confidence in the team's ability to pull out a win, while the risky move may show desperation and fear that the team is going to lose.

This study highlights the importance of assessing the specific situation for the importance of BIS and BAS. In some tasks, being high in BIS leads to optimal behavior, while in others, BAS leads to the best strategy. Even the same behavior, in the same situation, may be driven by the BAS for one person and the BIS for another. Imagine one is presented with a time-consuming and unpleasant situation in the last 15 minutes of work. One may avoid the situation out of fear of the unpleasantness, the BIS, or one may avoid it because they want to go home, the BAS. Conversely, one may deal with the situation because one is concerned of the consequences, the BIS, or because one strives to do their job to the best of their ability, the BAS. Scientists should carefully examine the situation specific influence of the BIS and BAS when investigating their influence on behavior.

6.2 Future Directions

Future research could examine the impact of the BIS and BAS in more long-term risky settings. Participants could establish a strategy for several series of risks, not just two. Future research could also investigate the possibility that driven people readjust goals. Maybe if a person is competing in an all-or-nothing win or loss situation, such as sports, losing will cause an increase in risk taking to enable the win for those high in BIS. This current research can also be replicated using a task where probabilities of winning are unknown, to investigate the impact of BIS and BAS on dynamic inconsistency in an uncertain risk-taking task. The impact of the BIS and BAS may vary depending on type of task. This study also highlights the need for a theory of multi-stage risk taking, as prospect theory (Kahneman & Tversky, 1979) and the house money effect and mental accounting (Thaler & Johnson, 1990), do not consistently predict behavior. The development of a multi-stage theory is a daunting task, and more research establishing when risk seeking and risk aversion occurs is needed before that theory can begin to take shape.

6.3 Limitations

There are several limitations to this study. First, the student population at Cleveland State University may not generalize to other populations. The sample was also too small to achieve a quality statistical analysis. The amount participants could wager may have been too small, leading to ceiling effects or behavior not similar with larger amounts of money. The probabilities and payouts in this study may not generalize to other studies using different values. Finally, as in all laboratory studies on risk-taking,

there is the issue of if this behavior is accurate and generalizes to the realm of real world risk taking.

6.4 Conclusion

This study sought to examine the impact of the BIS and BAS motivational forces on dynamic inconsistency in financial risk-taking. While being partially successful in this goal, and contrary to the hypotheses, it was found participants high in BAS made negative deviations following a loss. These findings reinforce the notion that significantly more research needs to be conducted examining how individuals behave during multi-stage risks, and to what role emotions play in these risks.

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