

Effects of Acute Stress on Risk Taking in Financial Decisions

by

Peter Gibson Kotvis

A Thesis Submitted in Partial Fulfillment of the
Requirements for the Degree of Bachelor of Arts with
Honors in Brain, Behavior & Cognitive Science
from the University of Michigan

2012

Advisor: Nestor Lopez-Duran
J. Frank Yates

Abstract

The purpose of this study was to examine the association between acute stress and risk taking in financial decisions. The study includes 40 (31 women, 9 men) 18-22 year old university students. Half of the participants were assigned to a Socially-Evaluated Cold-Pressor task to elicit a physiological stress response, while the other half were assigned to the control (no stress) condition. Individuals then completed two computer tasks (risk propensity and risk premium) that assessed risk taking in financial decisions, both in the gain and loss domain. There was a significant increase in risk taking for participants exposed to an acute stressor in the loss domain and overall. Additionally, there was a significant effect of financial domain (gain vs. loss) on risk propensity across stress/non-stress conditions. Participants were more risk prone in the gain domain than in the loss domain. Our data suggests that acute stress may play a role in the way people assess risk in decision making, specifically within the financial decisions. This research will help us understand the interaction between stressful environments, and how individuals make risk related decisions under these conditions.

Keywords: socially-evaluated cold-pressor task, cortisol, acute stress, decision making, risk propensity, risk premium, expected utility theory, prospect theory

Effects of Acute Stress on Risk Taking in Financial Decisions

Every day, humans are faced with innumerable decisions. Individuals must weigh the alternatives, assess the risks, and select the option that will satisfy the interests of the intended beneficiary. Humans make decisions based on a subjective interpretation of information, and consequently, individuals interpret a set of identical information differently (Savage, 1954). The interpretation of information is influenced by motives, previous knowledge, feelings and a myriad of other cognitive, social and emotional influences (Redhead, 2009). Among these factors, behavioral economists have been particularly interested in examining the effect of stress on financial decision making, but there are substantial inconsistencies in this work. That is, stress has been linked to reduced (van Honk, Schutter, Hermans, & Putman, 2003) as well as increased (van den Bos, Harteveld, & Stoop, 2009) risk taking. In light of these inconsistencies, this study aims to gain a more accurate assessment of risk taking by creating two paradigms that specifically test for risk taking based on economic theory. Specifically, we examine the effect of acute stress on risk propensity through financial decision making tasks that determine risk in both financial gains and losses.

Stress and Risk

Emotion plays a pivotal role in our appraisal of information, and can alter the way one perceives an event (Setterlund & Niedenthal, 1994). The physiological response to a stressful event alters an individual's formation of thought (Erickson, Drevets, & Schulkin, 2003). Stress influences cognitive performance in an inverted U-shape, which means that the brain functions best at moderate levels of stress, and declines in both low and high states of stress (Conrad Lupien, & McEwen 1999). As stress increases past optimal levels, cognitive resources are

reduced (Conrad et al., 1999), and consequently, individuals may begin to alter the way in which they come to assess risk in a given decision. Some have found that an increase in stress leads to increased risk taking (van den Bos et al., 2009), while other studies have found a shift toward risk averse behavior (van Honk et al., 2003). These inconsistencies may be due to the context in which risk is taken. Specifically, how does domain (gain or loss) effect an individual's assessment of a financial decision in the presence of stress?

Assessing Risk Propensity

Risk propensity can be assessed by exposing individuals to decisions with uncertain outcomes. In finance, the principal model of decision making under uncertainty is Expected Utility Theory (Sullivan, 1993). This theory states that individuals choose between risky prospects by multiplying the utility of each choice's outcome by their respective probability (e.g. a 25% chance of winning \$4 is calculated as $.25(\$4) = \1) (Davis, Hands & Mäki, 1998). One can determine an individual's risk propensity by making someone decide between a certain value and a gamble, each with equal expected value (Menezes & Hanson, 1970). An individual is defined as a risk averse if he/she prefers the certain amount equal to the expected value of the gamble (Menezes & Hanson, 1970). For example, if given the choice between a 25% chance of winning \$4 versus a certain gain of \$1, the individual who selects taking the dollar preferred the certain win, even though the value of each option is equal over the long run.

Risk propensity can be further examined by looking at an individual's risk premium. Risk premium is defined as the amount of money an individual is willing to pay to guarantee a sure gain or prevent a sure loss in relation to the risky choice (Menezes & Hanson, 1970). Determining the certainty equivalent, the amount of money needed to make an individual indifferent between the risk and a certain value, can assess an individual's risk premium

(Menezes & Hanson, 1970). For example, present an individual with a 25% chance of winning \$4, and ask them to indicate the value of a certain gain that would make them indifferent between the two choices. If someone responds '\$0.75,' then his/her risk premium is \$0.25 because the expected value of that gamble (\$1) subtracted by the individual's certainty equivalent value (\$0.75) is the amount of money that person is willing to pay to obtain the sure gain.

Gain/Loss Domain within Risk

Economists have researched tenets within Expected Utility and have uncovered a number of violations within the theory. Kahneman & Tversky (1979) developed Prospect Theory as a supplement to Expected Utility Theory. Prospect Theory aims to illuminate the observed departure from the tenants posed in Expected Utility. Their work found that individuals tend to dislike losses more than gains, a phenomenon known as loss aversion (Kahneman & Tversky, 1979). For example, people rarely accept a gamble with a 50-50 chance of winning or losing \$100. Under the axioms of expected utility, an individual would be indifferent to this gamble because the expected value of the gamble is \$0, but people are more afraid to lose \$100 compared to gaining the same amount. Kahneman & Tversky (1979) also observed a phenomenon called reflection effect, whereby changing the domain (i.e. from gain to loss) often reverses a person's risk taking tendencies. Subjects are generally risk averse in the gain domain, and risk prone in the loss domain. For example, individuals will usually select a sure gain (win \$2) when the alternative is a possible gain (50% chance of winning \$4), thus risk averse. However, when the domain is reversed (lose \$2 versus 50% chance of losing \$4), individuals prefer to select the gamble and thus are risk prone. This study will therefore test the effects of acute stress on risk aversion in both the gain and loss domains.

Specific Aims

This study aims to expand our understanding of stress induced decision making by creating two decision tasks that specifically look at risk taking in both the gain and loss domain. By looking at risk behavior within a gain or loss, we can gain a more insightful understanding of how people make real-life financial decisions. Subjects in the study will undergo a procedure that elicits a cortisol response followed by a decision task that measures risk propensity and a task that measures risk premium. Thereby examining how an acute stress may influence the rationality displayed in financial decisions.

First, we hypothesize that individuals in the acute stress condition will display an altered subjective appraisal of financial decisions, resulting in increased loss aversion. We further predict that this effect will be moderated by the gain/loss domain condition. Specifically, the increased loss aversion will result in more risk taking in the loss domain in comparison to the gain domain, in an attempt to mitigate immediate and certain financial losses. In addition, we predict that individuals in the acute stress condition will show an overall decreased risk premium, indicative of risk taking behavior. Finally, we predict that risk premium will be moderated by gain/loss domain. Specifically, we expect to see an exaggerated effect of decreased risk premium in the loss domain. This research will help us understand the interaction between stressful environments, and how individuals make risk related decisions under these conditions.

Method

Participants

All participants were undergraduate students from the University of Michigan (31 women, 9 men, $M_{age} = 18.7$ years, range 18-22 years) who were recruited through the Psychology Department Human Subjects Pool as part of the research participation requirement

for Introductory Psychology. After completion of the study, subjects were compensated with 1.5 hours of credit towards their research participation requirement.

Procedure

Experiments were conducted between 13:00 and 18:00 to ensure consistent cortisol collection between subjects. All subjects signed an informed consent indicating they were participating in the experiment out of free will and were free at all times to quit the experiment. Upon entering the experimental room, subjects were told to sit and relax for 30 minutes to accommodate any potential stress of participating in an experiment or entering a psychology laboratory. After the baseline period, the first saliva sample was taken. Subsequently, participants were split randomly into two conditions. One half of participants completed the experimental condition, called the Socially-Evaluated Pressor task, while the others sat for an additional 5 minutes. All participants then completed, in counterbalanced order, the two financial decision tasks lasting approximately 20 minutes. After completion of the decision tasks, participants returned to the waiting room for approximately 25 minutes and subsequent cortisol saliva samples were taken 25 and 45 minutes after the initial sample. All subjects were debriefed with appropriate materials concerning the aims of the study and given the opportunity to address any questions or concerns.

Socially-Evaluated Cold-Pressor Task

To induce stress, half of the participants underwent a Socially-Evaluated Cold-Pressor task, which has been previously validated to elicit an acute cortisol response (Schwabe, Haddad, & Schachinger, 2008). Participants were asked to place their hand in a bucket filled with a mixture of clean tap water and ice (approximately 4 °C) for as long as possible or until they

experienced significant discomfort. If their hand was still submerged after two minutes, they were asked to remove their hand.

Financial Decision Making Task

Risk Propensity Task. Participants completed two E-Prime computer tasks, adapted from Kahneman and Tversky (1979), to assess individual risk-taking. The first task, risk propensity task, consisted of 64 trials in which participants viewed and selected between a gamble (a monetary value with a percentage chance of win/loss) and a certain value, each with equal expected value (see Figure 1). The 64 trials within this condition were split evenly between the gain and loss domain (32 trials each). Each trial was displayed for five seconds, or the time it took the individual to make a decision, followed by a half second fixation period. Participants who selected the guaranteed outcome for loss/gain trials are defined as risk averse, whereas individuals who selected the gamble option are defined as risk prone. The overall proportion of risky choices selected in the task measured risk propensity.

Risk Premium Task. In the second task, adapted from Pratt (1964), participants were shown a gamble and asked to select a value that would make the individual indifferent between the two options (see Figure 2). Each trial was displayed for ten seconds, or the time it took the individual to make a decision, followed by a half second fixation period. As in the first condition, the 64 trials were split between gain and loss domain (32 trials each). Individuals were given a gamble, and asked to state the outright value such that he/she was indifferent between that gift and the opportunity to play the gamble. An individual's risk premium was measured by the mean risk premium (expected value minus certainty equivalent). Trials in both tasks were randomized, and options distributed equally on the left and right hemifield.

Analytic Approach

The direct and interactive effects of stress and domain (gain vs. loss) on our outcomes (risk propensity or risk premium) were examined using a General Linear Model. Specifically, we predicted risk propensity from stress as a between-subject effect, and domain as a within subject effect, and the interaction between stress and domain. A similar model was conducted to predict risk premium.

Results

Descriptive Statistics

Risk Propensity. The financial domain (gain vs. loss) had a significant effect on risk propensity across stress/non-stress conditions $t(39) = 2.92, p < .01$ (see Figure 3). Participants selected the risky option more often for gains ($M = .55$) compared to losses ($M = .38$). There was no observed difference between males and females in the risk propensity test in the gain domain $t(38) = 0.64, p = .529$, loss domain $t(38) = 0.75, p = .457$ or overall risk $t(38) = 0.14, p = .891$ (see Figure 4). There was no significant difference between stress and control conditions for risk propensity in the gain domain $t(38) = 1.02, p = .315$, but the difference in the loss domain approached significance $t(38) = 1.81, p = .078$, and there was an observed difference in overall risk propensity $t(38) = 2.76, p < .01$. Individuals in the acute stress condition displayed an increase in risk taking in the loss domain ($M = .44$) and overall ($M = .51$) compared to the control group in loss domain ($M = .31$) and overall ($M = .41$) (see Figure 5, see Table 1 for descriptive statistics).

Risk Premium. Number of respondents in this task ($N = 39$) was reduced due to a corrupted file. There were no significant differences in risk premium between the gain and loss domain across stress/non-stress conditions $t(38) = 1.36, p = .183$ (see Figure 6). There were no

observed difference between males and females in the risk premium test for the gain domain $t(37) = 0.75, p = .457$, loss domain $t(37) = 0.70, p = .488$ or overall $t(37) = 0.81, p = .421$ (see Figure 7). There was no significant difference between stress and control condition for risk premium in the gain $t(37) = 1.43, p = .162$, loss domain $t(37) = 1.15, p = .256$ or overall $t(37) = 1.41, p = .168$ (see Figure 8, see Table 1 for descriptive findings).

Multivariate Analysis

Effects of stress on Risk Propensity. A general linear model was used to test the effect of acute stress and domain (gain vs. loss) on the proportion of risky decisions. There was a significant effect of domain on risk propensity, $F(1, 38) = 8.34, p < .01, \eta^2 = .18$. Participants selected risky options more often in the gain condition ($M = .55$) than in the loss domain ($M = .38$). The effect of stress on risk propensity was also significant, $F(1, 38) = 7.62, p < .01, \eta^2 = .167$. Specifically, participants in the stress condition were more risk prone ($M = .51$) compared to participants in the non-stress condition ($M = .42$). Finally, the interaction between stress and domain was not significant, $F(1, 38) = 0.27, p = .61, \eta^2 = .007$ (see Table 2 for multivariate findings).

Effects of stress on Risk Premium. A general linear model was used to test the effect of the acute stress and domain (gain vs. loss) on risk premium. The financial domain did not affect an individual's risk premium, $F(1, 37) = 1.87, p = .179, \eta^2 = .048$. Acute stress also had no effect on risk premium, $F(1, 37) = 1.98, p = .168, \eta^2 = .051$. Finally, the interaction between stress and domain was not significant $F(1, 37) = 0.55, p = .461, \eta^2 = .015$ (see Table 2 for multivariate findings).

Discussion

In this study, we examined a possible relationship between stress, domain, and their effects on risk propensity. The results from the risk propensity task are relatively consistent with the proposed hypothesis. Although not all of the data held statistical significance, there was an observed trend towards increased risk taking under the cold-pressor condition, especially in overall and loss domain risk propensity. Conversely, the data from the risk premium task did not support the proposed hypothesis. Participants in the stress condition increased the amount of money they would be willing to sacrifice in order to receive the certain value, but few inferences can be derived from these findings because none of the risk premium data held statistical significance. This is the first study to create two distinct risk propensity tasks to examine the effect of acute stress on financial domain in decision making.

Regarding risk propensity, we found a main effect of gain/loss domain. Specifically, we found that participants across stress/non-stress conditions were more risk prone in the gain domain, compared to the loss domain. These findings are inconsistent with reflection effect in Prospect Theory, which posits that risk taking is increased in the loss domain (Kahneman & Tversky, 1979). However, the findings from their study were obtained from across-subject testing, as opposed to within-subject (Hershey & Schoemaker, 1980). Therefore, it is possible that their findings reflect differences between the groups assigned to the conditions as opposed to differences in the effect of their domain. Our protocol examined risk propensity in the gain and loss condition within subjects in random order, increasing the likelihood that our findings truly reflect differences in the effect of the financial domain.

In addition, we found a main effect of stress on risk propensity. Specifically, we found that in the risk propensity task, participants in the acute stress condition were more risk prone in

the loss domain (approaching significance) and overall (all trials including gain and loss domain). The outcome from the risk propensity task is consistent with findings made by van den Bos, Harteveld, & Stoop (2009). We propose that the observed increase in risk taking is due in part to the physiological effects of stress, which alter an individual's subjective perception of risk (Setterlund & Niedenthal, 1994). In order to learn more about stress in decision making, one must understand the physiology behind the stress.

Cortisol is a glucocorticoid hormone secreted by the adrenal gland in response to activation in the hippocampus. Once released into the bloodstream, cortisol elicits a wide range of physiological, behavioral and cognitive effects including changes in appetite, emotional and social behaviors like attachment, temperament and mood (Erickson et al., 2003). Elevated cortisol levels result in increased subjective arousal in humans (Erickson et al., 2003), and have been shown to increase attention toward negative emotional stimuli (Suslow, Arolt, & Junghanns, 2000). Furthermore, neuroeconomic research has speculated that cortisol may significantly influence financial decision making through its interaction with the nucleus accumbens, which plays a central role in the mesolimbic dopaminergic system (Coates, Gurnell, & Sarnyai, 2010). Acutely elevated levels of cortisol increase extracellular dopamine levels, associated with euphoria and reward-like properties related to sensation-seeking behavior (Cabib & Puglisi-Allegra, 1996). This physiological arousal may influence the way individuals assess risk in a financial decision making task. Specifically, the increase in cortisol and its subsequent effects may lead to increased risk taking.

Contrary to our expectations, we did not find an interaction between gain/loss domain and stress in predicting risk propensity. Our multivariate interaction analysis of domain and stress condition resulted in no significant findings in the risk propensity task or the risk premium

task. The absence of an interaction suggests an analogous relationship between stress and financial domain. Our findings are inconsistent with Porcelli & Delgado (2009), which found that acute stress exaggerates the reflection effect by increasing risk propensity in the loss domain and decreasing risk propensity in the gain domain. As mentioned previously, our results may have been due to the physiological arousal from increased cortisol, causing a unidirectional preference for risk.

Limitations

The first limitation to this study is the small sample size ($N = 40$). Although there were some interesting trends observed from both financial decision tasks, it was difficult to achieve statistical significance with such a small pool of participants. The small sample size and disproportionate number of females also led to a lack of external validity. The disproportionate gender ratio is likely due to the proportion of females enrolled in Introductory Psychology, from which subjects were recruited. The population is also likely misrepresentative because all subjects were undergraduate students in an Introductory Psychology course, which limits the variety of age, intelligence, racial and socioeconomic status of participants.

The results from the risk premium task indicate that there might have been some limitations in the construct validity of the test. According to Pratt (1964), individuals are expected to respond with a certainty equivalent value that is less than the expected value of the alternative option. The results show that on average, individuals entered a certainty equivalent greater than the expected value. In the task, the instructions stated to determine a value for the certain win or loss that would make an individual 'indifferent' with the gamble presented. In the study, many participants asked for clarification, and some did not seem to understand the concept of indifference. Possible misunderstanding of the task led to large variability in responses. Some

participants understood the implications of selecting an actual value, while others entered seemingly illogical responses. Future studies could possibly improve on this task by rejecting responses with a value greater than the expected value within each trial. Additionally, many of the responses lacked specificity. For example, many participants rounded their responses by entering values like '\$1.00' or '\$2.00,' which can affect the accuracy of a test when expected values of a the trials were rarely a rounded financial value.

Furthermore, there are many factors that contribute to an individual's risk propensity, so it is difficult to determine what actually caused the observed change in risk taking between individuals in the stress condition compared to the control. One way future studies might mitigate this discrepancy would be to change the study to a repeated measures design in which individuals complete the risk propensity and premium tasks under the control and acute stress condition. This way, the differences between the stress and control may provide a better understanding of how stress individually affects risk propensity.

Another limitation of the study is the effectiveness of the cold-pressor intervention. Due to necessary ethical concerns, stress induction must be minimally invasive. This study defined acute stress as an individual exposed to a Socially-Evaluated Cold-Pressor task. Outside the laboratory, individuals in stressful situations perceive their stress as emotional, while this study looks solely at physiological arousal resulting from stress induction in a controlled laboratory setting. Participants in the stress condition were oftentimes unaware of their stress, which makes it difficult to determine if the experiment is testing the impact of stress in the real world, or exposure to elevated cortisol.

Summary and Implications

Overall, we found that both domain and acute stress affect risk propensity in financial decision making. Although there are some inconsistencies, data from the risk propensity task showed that individuals under acute stress display increased risk taking compared to individuals in the control. The results from this study have some important implications on decision making for individuals in careers that involve risk assessment. Coates & Herbert (2008) studied financial traders to examine the effects of endogenous steroids like cortisol and testosterone under real working conditions. Their work found that cortisol increases in response to variance of trading results, and volatility of the market (Coates & Herbert, 2008). Consequently, an increase in cortisol may shift an individual's risk preferences and ability to form rational decisions. If certain conditions within financial trading elicit an acute stress response, financial traders may be prone to selecting the more risk seeking choice, which may result in detrimental outcomes over the long run.

Although this study specifically looks at acute stress, it is also important to consider the effects of prolonged exposure to stress on risk taking in the financial domain. While acute exposure to stress can result in increased motivation and focus (Erickson et al., 2003), chronic exposure to stress hormones can affect neurological pathways through the stimulation of the stimulate corticotrophin-releasing hormone (CRH) gene (Korte, 2001). This gene activation results in anxiety and can produce irrational pessimism by finding threat and risk where none exist (McEwen, 1998).

There are many factors that contribute to risk assessment, and subsequent financial decisions, but examining the effect of stress is fundamental in understanding how emotions regulate our ability to make rational decisions. Future research must focus on how this stress is

actually manifested in a person's decision by looking at how stress affects the way we predict uncertain outcomes. It is important to understand how stress alters the way we subjectively interpret risk within a financial decision, and what appraisal methods result in decisions that produce the best results for the intended beneficiaries.

References

- Cabib, S., & Puglisi-Allegra, S. (1996). Different effects of repeated stressful experiences on mesocortical and mesolimbic dopamine metabolism. *Neuroscience* 73, 375–380. doi:10.1016/0306-4522(96)00750-6
- Coates, J. M., Gurnell, M., & Sarnyai, Z. (2010). From molecule to market: Steroid hormones and financial risk-taking. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, 365(1538), 331-343. doi:10.1098/rstb.2009.0193
- Coates, J. M., & Herbert, J. (2008). Endogenous steroids and financial risk taking on a london trading floor. *Proceedings of the National Academy of Sciences of the United States of America*, 105(16), 6167-6172. doi:10.1073/pnas.0704025105
- Conrad, C. D., Lupien, S. J., & McEwen, B. S. (1999). Support for a bimodal role for type II adrenal steroid receptors in spatial memory. *Neurobiology of Learning and Memory*, 72(1), 39-46. doi:10.1006/nlme.1998.3898
- Davis, J. B., Hands, D. W., & Mäki, U. (1998). *The handbook of economic methodology*. Retrieved from <http://books.google.com/books?id=rOy6AAAAIAAJ>
- Erickson, K., Drevets, W., & Schulkin, J. (2003). Glucocorticoid regulation of diverse cognitive functions in normal and pathological emotional states. *Neuroscience and Biobehavioral Reviews*, 27(3), 233-246. doi:10.1016/S0149-7634(03)00033-2
- Hershey, J. C., & Shoemaker P. J. H. (1980). Prospect theory's reflection hypothesis: a critical examination. *Organizational Behavioral and Human Performance*, 25, 395-418. doi: 0030-5073, 10.1016/0030-5073(80)90037-9.
- Kahneman, D., & Tversky, A. (1979). Prospect theory: an analysis of decision under risk. *Econometrica*, 47, 263-292.

- Korte, S. M. (2001). Corticosteroids in relation to fear, anxiety and psychopathology. *Neuroscience and Biobehavioral Reviews* 25(2), 117-142. doi: 10.1016/S0149-7634(01)00002-1
- Kudielka, B.M., Kirschbaum, C. (2005). Sex differences in HPA axis responses to stress: a review. *Biological Psychology*, 69, 113-132. doi: 10.1016/j.biopsycho.2004.11.009
- McEwen, B. S. (1993). Stress, adaptation, and disease: allostasis and allostatic load. *Annals of the New York Academy of Sciences* 840, 33-44.
- Menezes, C. F., & Hanson, H. L. (1970). On theory of risk aversion. *International Economic Review*, 11(3), 481-487.
- Porcelli, A. J., & Delgado, M. R. (2009). Acute stress modulates risk taking in financial decision making. *Psychological Science*, 20(3), 278-283. doi:10.1111/j.1467-9280.2009.02288.x
- Pratt, J. W. (1964). Risk aversion in the small and in the large. *Econometrica*, 32(1/2), 122-136.
- Pruessner, J. C., Hellhammer, D. H., & Kirschbaum, C. (1999). Burnout, perceived stress, and cortisol responses to awakening. *Psychosomatic Medicine*, 61(2), 197-204.
- Redhead, K. (2009). A behavioral view of how people make financial decisions. *Journal of Financial Planning. Between the issues*. Retrieved from: <http://www.fpanet.org/journal/BetweentheIssues/LastMonth/Articles/ABehavioralViewofHowPeopleMakeFinancialDecisions/>
- Savage, L. J. (1954). *The Foundations of Statistics*. Wiley, New York.
- Schulkin, J., Gold, P. W., & McEwen, B. S. (1998). Induction of corticotropin-releasing hormone gene expression by glucocorticoids: Implication for understanding the states of fear and anxiety and allostatic load. *Psychoneuroendocrinology*, 23(3), 219-243.

- Schwabe, L., Haddad, L., & Schachinger, H. (2008). HPA axis activation by a socially evaluated cold-pressor test. *Psychoneuroendocrinology*, *33*(6), 890-895.
doi:10.1016/j.psyneuen.2008.03.001
- Setterlund, M. B., & Niedenthal, P. M. (1994). Emotion congruence in perception. *Personality and Social Psychology Bulletin*, *20*(4), 401-411. doi:10.1177/0146167294204007
- Sullivan, Kathryn. T. (1993). *An investigation of risk behavior in financial decision-making* (Doctoral Dissertation, UMass Amherst). Retrieved from <http://scholarworks.umass.edu/dissertations/AAI9316719>
- Suslow, T., Arolt, V., & Junghanns, K. (2000). Detection of facial expression of emotions in depression. *Perceptual and motor skills*, *92*(3), 857-868.
- van den Bos, R., Hartevelde, M., & Stoop, H. (2009). Stress and decision-making in humans: Performance is related to cortisol reactivity, albeit differently in men and women. *Psychoneuroendocrinology*, *34*(10), 1449-1458. doi: 10.1016/j.psyneuen.2009.04.016
- van Honk, J., Schutter, D.J.L.G., Hermans, E.J., Putman, P. (2003). Low cortisol levels and the balance between punishment sensitivity and reward dependency. *NeuroReport*, *14* (15), 1993-1996. doi: 10.1097/01.wnr.0000091690.72892.ec

Author Note

Peter Kotvis, Department of Psychology, University of Michigan, Ann Arbor

I would like to thank everyone in the Michigan Psychoneuroendocrinology Affective Laboratory for their accommodation and support throughout the past year. Special thanks to Nestor Lopez-Duran, J. Frank Yates, and Kate Kuhlman for their insight and dedication. I would also like to thank my friends and family, who have nurtured my curiosity and encouraged me to challenge established notions.

Table 1

Summary of Descriptive Statistics

Risk Propensity						
	Cold-Press ($N = 20$)		Control ($N = 20$)		t	p
	M	SD	M	SD		
Gain	.58	.13	.51	.26	1.01	.315
Loss	.44	.20	.32	.24	1.81	.078
Overall	.51	.09	.42	.12	2.76	.009
Risk Premium						
	Cold-Press ($N = 20$)		Control ($N = 19$)		t	p
	M	SD	M	SD		
Gain	-.37	.68	-.78	1.1	1.42	.162
Loss	-.31	.57	-.56	.81	1.15	.256
Overall	-.34	.59	-.67	.86	1.40	.168

Table 2

Summary of Multivariate Statistics

Estimating Risk Propensity			
	<i>F</i>	<i>p</i>	η^2
Within Subjects Factor: Domain	8.34	.006	.180
Between Subjects Factor: Cold press	7.62	.009	.167
Interaction: Cold press x Domain	.267	.608	.007
Estimating Risk Premium			
	<i>F</i>	<i>p</i>	η^2
Within Subjects Factor: Domain	1.87	.179	.048
Between Subjects Factor: Cold press	1.98	.168	.051
Interaction: Cold press x Domain	.554	.461	.015

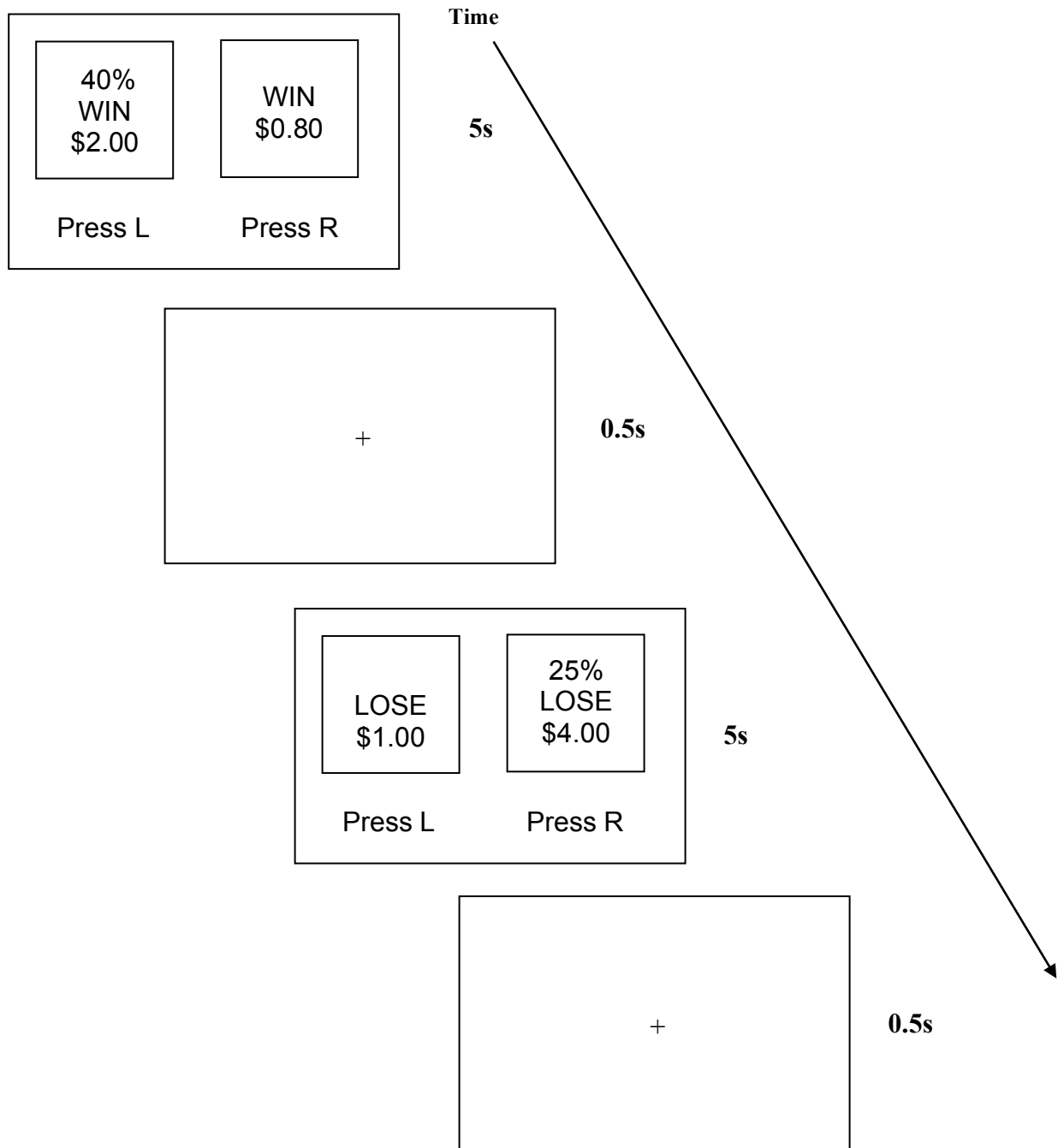


Figure 1 Illustration of two trials of the risk propensity task. In the first trial (top left), the participant must choose between a 40% chance of winning \$2.00 and a certain winning of \$0.80. In the second trial the participant must choose between a 25% chance of losing \$4.00 and a certain loss of \$1.00. Trials vary in percent chance of winning/losing, but all have equal expected value. Consequently, a risk prone choice is defined as selecting the option with uncertainty. Participants have 5 seconds to select between the two options followed by a half second fixation period.

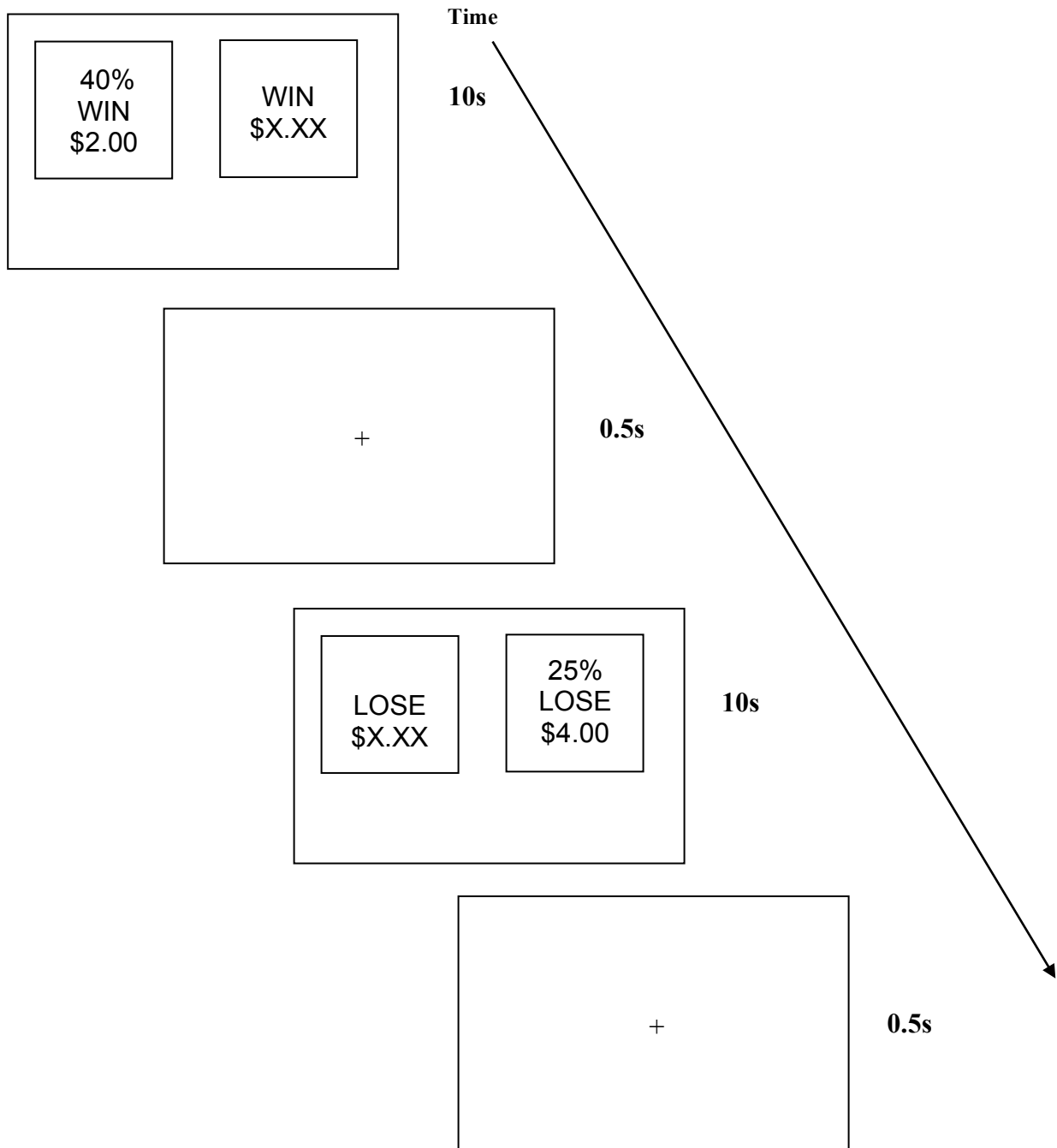


Figure 2 Illustration of two trials of the risk premium task. In the first trial (top left), the participant must enter a value for a certain gain that makes him/her indifferent between a 40% chance of winning \$2.00 and the value that they select. In the second trial, the participant must enter a value for a certain loss that makes him/her indifferent between a 25% chance of losing \$4.00 and the value they select. Trials vary in percent chance of winning/losing. Participants have 5 seconds to select between the two options followed by a half second fixation period.

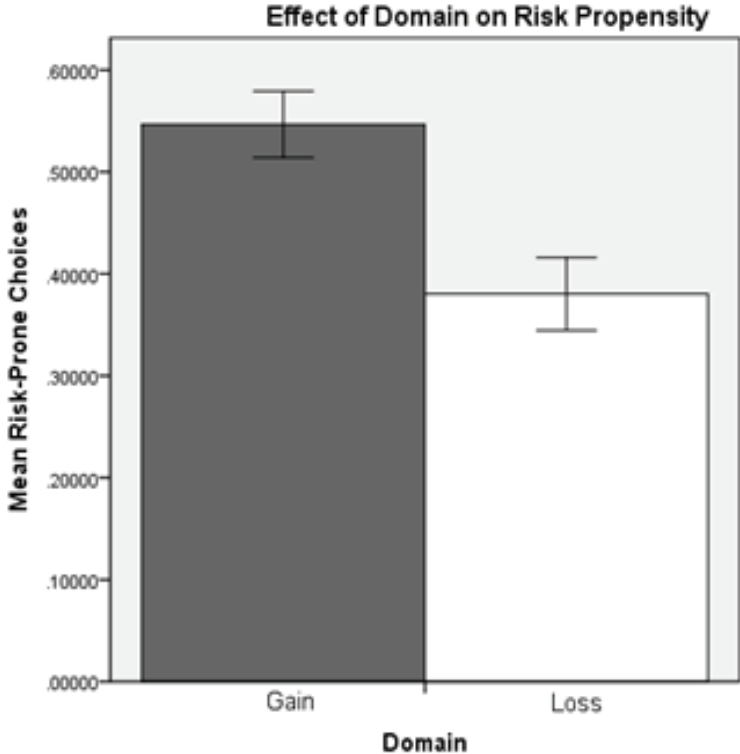


Figure 3 Proportion of participants' risky choices as a function of domain (gain or loss domain). Error bars show 1 SE

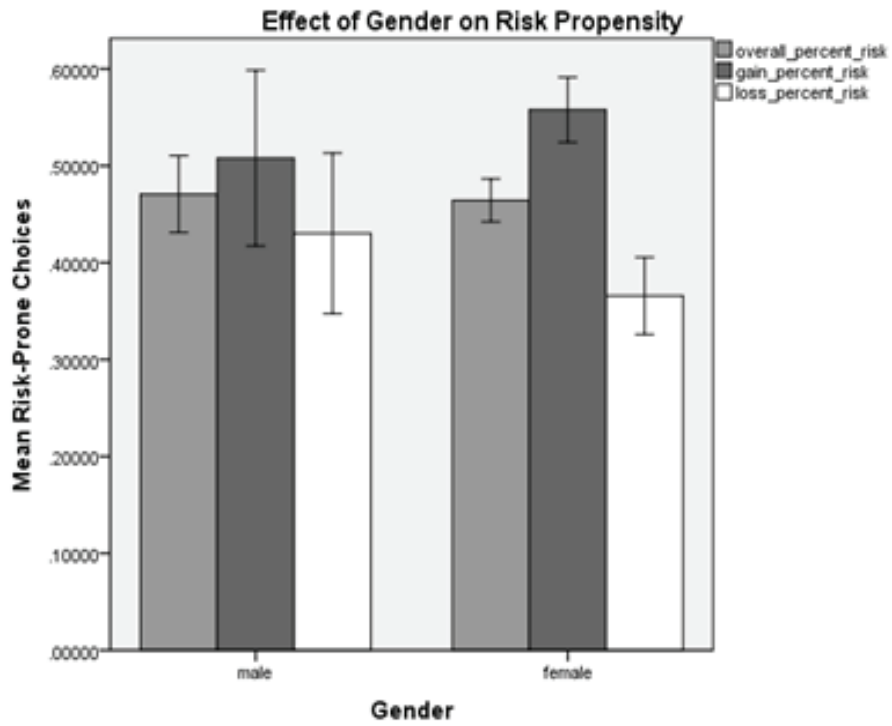


Figure 4 Proportion of participants' risky choices as a function of domain (loss or gain domain) and gender. Error bars show 1 *SE*

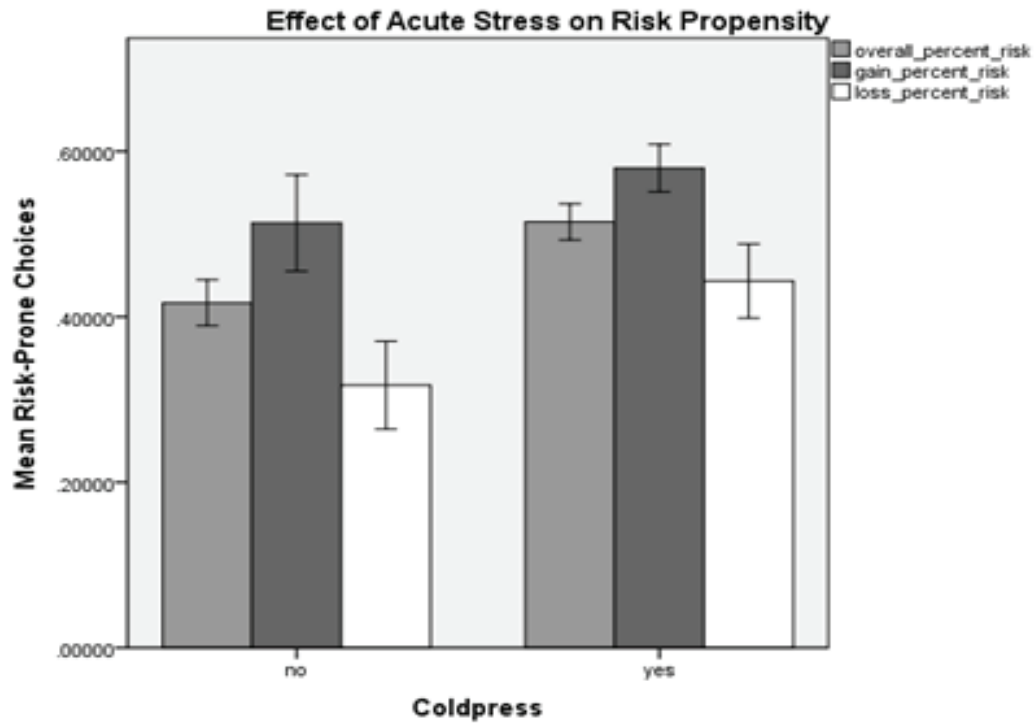


Figure 5 Proportion of participants' risky choices as a function of domain (loss or gain domain) and condition (coldpress or control). Error bars show 1 *SE*

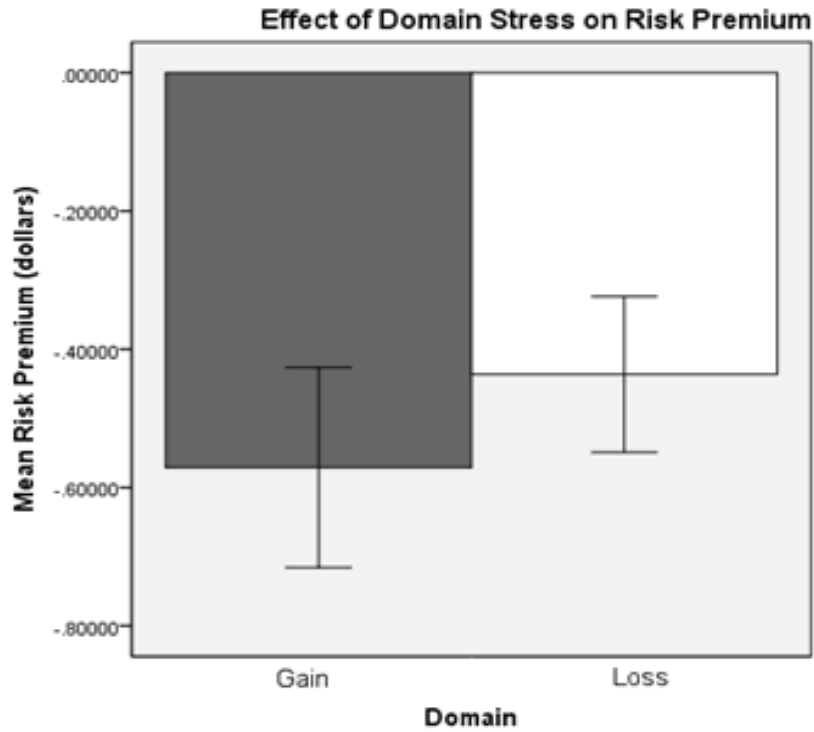


Figure 6 Participants' mean risk premium (the expected value of a gamble minus the certain equivalent value declared in the task) as a function of domain (gain or loss domain). Error bars show 1 *SE*

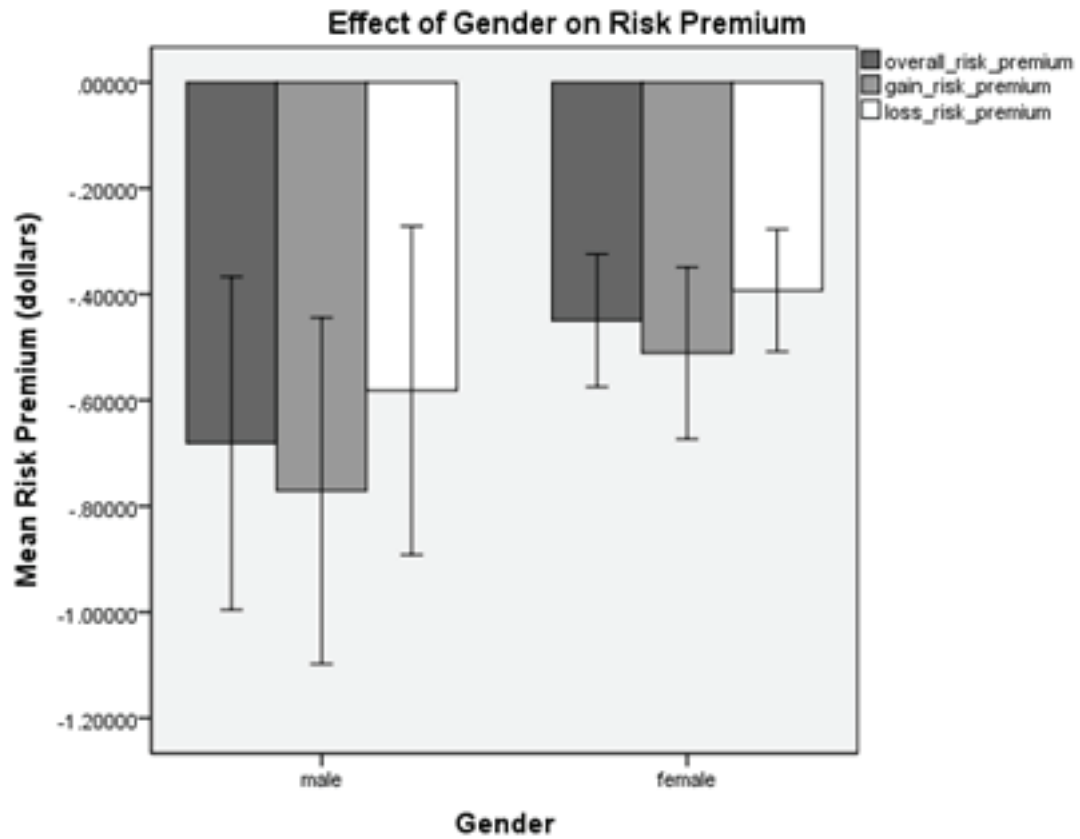


Figure 7 Participants' mean risk premium (the expected value of a gamble minus the certain equivalent value declared in the task) as a function of domain (gain or loss domain) and gender. Error bars show 1 *SE*

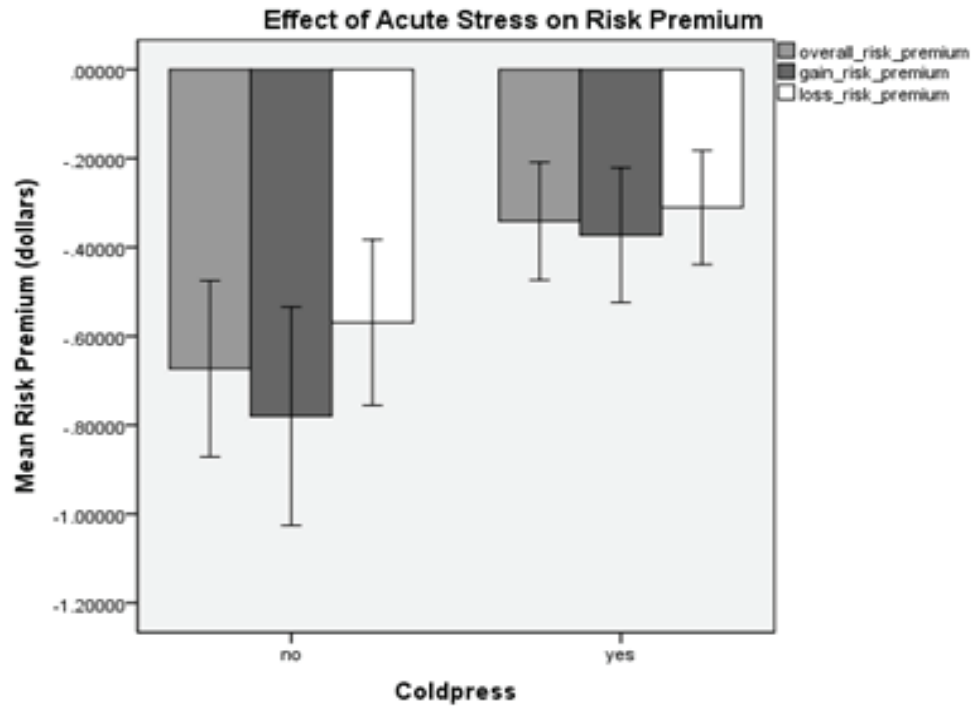


Figure 8 Participants' mean risk premium (the expected value of a gamble minus the certain equivalent value declared in the task) as a function of domain (gain or loss domain) and condition (coldpress or control). Error bars show 1 SE