Risky Intertemporal Choice in the Loss Domain

by

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AUTHOR'S DECLARATION

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

Risky intertemporal choice is a fairly new topic in the realm of behavioral economics that involves examining the interactions between individuals' time and risk preferences. Previous research has looked at the gains and mixed domain, but little to no research has been done in the loss domain. This study aims to fill this gap by examining how people respond to risky gambles in the loss domain given real world time delays. The thesis focuses on changes in attitudes towards risk caused by temporal distance rather than how people discount risky prospects. Based on Construal Level Theory we predict that there will be a greater focus on outcomes over probabilities in delayed gambles compared to immediate ones, and hence, individuals will become more *risk-averse* for delayed gambles that are in the loss domain. We conducted two experiments to test this prediction. Results revealed that while subjects in the immediate resolution group were significantly more *risk-seeking* than future resolution groups in both experiments, the difference in risk attitudes between two delayed resolutions depend on how big the difference between two delays is.

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I would like to thank my supervisor, Professor Selçuk Onay, for his guidance and support throughout the thesis. I would also like to thank my two readers, Professor Vanessa Bohns and Professor Bonwoo Koo, for their inputs in improving the quality of the thesis.

Dedication

I dedicate this thesis to my family who have always stood by me and supported me in all my endeavours. Thank you for always being there.

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Chapter 1

Introduction

Risk is an unavoidable dimension of many everyday decisions. Examples of risky decisions span all parts of life ranging from simple decisions such as purchasing a lottery ticket or to relatively more important, potentially life-changing decisions such as whether to undertake a newly developed medical treatment or investing one's entire savings in the stock market etc. Regardless, risky decision making is something that everyone personally deals with on a day-to-day basis.

What defines people's choices in risky situations however? One important factor is personal preferences or attitudes. Many of us would not bet our life saving's on a spin at the roulette table while a select few may be inclined to do so. In this case, the attitude towards risk is what defines how such decisions are arrived at. In the above example, the select few who would play such a gamble would display *risk-seeking* behavior while the majority of people would comparably display *risk-averse* behavior.

Empirical research on decision making under risk has uncovered many other perceptual and contextual factors that might influence attitudes towards risk (Ahlbrecht & Weber, 1997; Allais, 1953; Anderhub, Güth, Gneezy, & Sonsino, 2001; Chateauneuf & Wakker, 1999; Ellsberg, 1961; Glockner & Betsch, 2008; Kahneman & Tversky, 1979; Levy, 1992; March & Shapira, 1992; Nguyen & Leung, 2009; Onay & Öncüler, 2007; Öncüler, 2000; Prelec & Loewenstein, 1991; Savage, 1954; P. Wakker & Tversky, 1993; P. P. Wakker, 2010; Wu, Zhang, & Gonzalez, 2008). One important factor that influences attitudes towards risk is temporal distance to the resolution of the risk. This is not to be confused with how someone's risk attitude changes over time (e.g., with age), but rather how it changes based on delay until realization of outcomes.

Naturally many of the risky decisions we face have delayed outcomes. This subset of risky decisions is known as *risky intertemporal* decisions. For example, insurance is not bought to protect oneself against an immediate loss but rather the potential of loss that can be incurred in the future. In other words, individuals buy car insurance for an accident that may happen a year or two in the future. Similarly, most investments are long term and you make them with delayed outcomes in mind. People don't usually buy stocks with the intention of selling them in a day and likewise a company doesn't invest in R&D with the expectation that profits will double in a week.

Although previous research has acknowledged that time does indeed influence risk preferences and that individuals may prefer different options when the gamble is delayed versus immediate (Abdellaoui, Diecidue, & Öncüler, 2011; Ahlbrecht & Weber, 1997; Anderson & Stafford, 2009; Baucells & Heukamp, 2011; Keren & Roelofsma, 1995; Noussair & Wu, 2006; Onay & Öncüler, 2007; Sagristano, Trope, & Liberman, 2002; Shelley, 1994; Weber & Chapman, 2005), they have mainly focused on risky intertemporal choice in the gains domain. However, risky decisions in the loss domain are as common as the ones in the gains domain. For instance, an insurance problem is entirely in the loss domain. In one case, one incurs a small fixed loss (i.e., the insurance premium) to cover a chance of a larger loss, and in the other case, one takes a chance of incurring a large variable loss. Thus, in order to close this gap in the risky intertemporal choice literature, we will focus on risky intertemporal choice in the loss domain. We expect to find different results than what has been found in the gains domain as individual have been shown to treat losses psychologically different than gains (Kahneman, Knetsch, & Thaler, 1991).

Based on Construal Level Theory (Trope & Liberman, 2003) we conjecture that there will be a greater focus on outcomes over probabilities in delayed gambles, and hence individuals would become more *risk-averse* for delayed risky losses. We conducted two experiments to test our hypothesis. In our experiments we compared gambles of immediate versus delayed resolution time with both real and hypothetical incentives. In experiment 1, we conducted a series of choice tasks with real incentives and found that individual in the immediate resolution group were significantly more *risk-seeking* than those in the future resolution groups. In experiment 2, we conducted a series of pricing tasks in hypothetical scenarios and also found that individual became more *risk-averse* as the resolution time of the outcome was increased contrary to the decrease in *risk aversion* with increased delay observed in the gains domain (Noussair & Wu, 2006).

The thesis will start off by summarizing the literature on risky choice starting with Expected Utility Theory (Von Neumann & Morgenstern, 1944) and Prospect Theory (Kahneman & Tversky, 1979), then we will review theories of intertemporal decision making such as Discounted Utility Theory (Samuelson, 1937) and Construal Level Theory (Trope & Liberman, 2010). There will then be a detailed review of risky intertemporal choice literature in the gains domain and mixed domain. I will also discuss the implications of Construal Level Theory on risky intertemporal decisions in this section. The thesis will proceed a presentation of experimental procedures and design, analysis of data and discussion of the results. It will conclude by looking at an overview of the experiments, the limitations, and potential future research topics.

Chapter 2

Literature Review

2.1 Risky Choice

Many real world decisions involve risky choice as it covers a wide spectrum of everyday decisions people make. Examples of such decisions include gambling, many if not all areas of investment, medical treatments, R&D projects, and insurance decisions to name a few. In many cases (as is evident from the list above) the exact chance or probabilities involved in the risky choice themselves are uncertain or unknown. Decisions in which the probabilities are certain and objectively known (such as in many gambling scenarios like playing poker or blackjack) are known as decision under *risk*. Decisions in which the probabilities are unknown (such as whether or not it will rain on a particular day) are known as decision under uncertainty (Savage, 1954). The focus of this thesis will be on the former as the results can often be generalized to include the latter.

2.1.1 Expected Utility Theory

Risky choice refers to choices in which a decision maker chooses among lotteries defined as $\mathcal{L}$ $(p_1, x_1;\ldots; p_n, x_n)$ giving outcome x_i at probability p_i such that $\sum p_i = 1$. Expected value of a lottery is defined as $EV(\mathcal{L}) = \sum p_i x_i$ and expected utility is defined as $EU(\mathcal{L}) = \sum p_i u(x_i)$, where in this case $u(x_i)$ measures the utility of receiving outcome x_i (Wu et al., 2008).

Expected Utility Theory developed by von Neumann and Morgenstern (1944) showed that if a decision maker's choice obeys the four axioms of choice, namely the completeness, transitivity, continuity, and independence, then decision maker's choices over lotteries can be represented by a utility function unique up to an affine transformation. Completeness axiom states that a decision maker has well defined preferences. That is, for any lotteries L, M, exactly one of the following holds: $L \succ M$, $M \succ L$, or $L = M$. In other words either L is preferred, M is preferred, or there is no preference between the two. Transitivity posits that preference must be consistent across any three options. Thus if $M \succeq L$ and $N \succeq M$, then $N \succeq L$. Continuity is the idea that if $N \succeq M \succeq L$, then there exists a probability $p \in [0, 1]$ such that $pN + (1\text{-}p)L \backsim M$. Finally, the independence axiom is if $A \succeq B$ then $pA + (1\text{-}p)C \succeq pB + (1\text{-}p)C$.

We need more definitions in order to quantify risk attitudes. A *certainty equivalent* (*CE*) of a lottery $\mathcal{L}$ $(p_1, x_1;\ldots; p_n, x_n)$ is defined as the sure amount of money $CE_{\mathcal{L}}$ that makes the decision maker indifferent between receiving $CE_{\mathcal{L}}$ or playing the lottery $\mathcal{L}$. That is equivalent to saying the utility of the *certainty equivalent* of lottery $\mathcal{L}$ is equal to the expected utility of $\mathcal{L}$ or $u(CE_{\mathcal{L}}) = EU(\mathcal{L})$. *Risk-averse* behavior is exhibited if and only if $CE(\mathcal{L}) < \mathrm{EV}(\mathcal{L})$. *Risk-neutral* behavior is exhibited if and only if $CE(\mathcal{L}) = \mathrm{EV}(\mathcal{L})$. Lastly, *risk-seeking* behavior is exhibited if and only if $CE(\mathcal{L}) > \mathrm{EV}(\mathcal{L})$. In general the classical model of decision under risk assumes that individuals are generally *risk-averse*. This is because, in general, (marginal) utility obtained from winning an extra dollar declines as additional dollars are won. This is equivalent to saying that the decision maker has a concave utility function which is the same as saying he/she is *risk-averse*.

Expected Utility Theory explains risk attitudes completely through the shape of the utility function. If a utility function is convex, *risk-seeking* behavior such as buying lottery tickets is observed. This is because under convex utility functions the expected value of a gamble is less than the certainty equivalent of a gamble. On the other hand, if the utility function is concave, *risk-averse* behavior such as purchasing insurance is exhibited. This is because under concave utility, the certainty equivalent of a gamble is less than the expected value of a gamble. If the function is linear then *risk-neutral* behavior is exhibited where the *certainty equivalent* is equal to the expected value (Pratt, 1964).

To better understand this, consider the following example. Suppose a decision maker is faced with a gamble with 0.5 chance at winning \$400 and 0.5 chance at winning \$100 assuming a concave utility function of $u(x) = \sqrt{x}$. The expected value is 0.5(400) + 0.5(100) = $250. The expected utility is 0.5*u*(400) + 0.5*u*(100) = 0.5*20 + 0.5*10 = 15. Using the original utility function we can find the certainty equivalent corresponding to this amount or 15 = $\sqrt{CE}$ implying *CE* = $225. In this case we find that *certainty equivalent* of the gamble is less than the expected value of the gamble as $225 < $250. The difference of these two numbers is also known as the *risk premium*. As the individual values this gamble at less than its expected value, it is transparent that he/she is *risk-averse*. Figure 1 below gives a visual representation of this problem. In the case for *risk-seeking*, the *certainty equivalent* of the gamble would be more than the expected value of the gamble as the function is convex. The case for *risk-neutral* corresponds to a utility function that is the same as the expected value function as can be seen as the linear line in Figure 1.

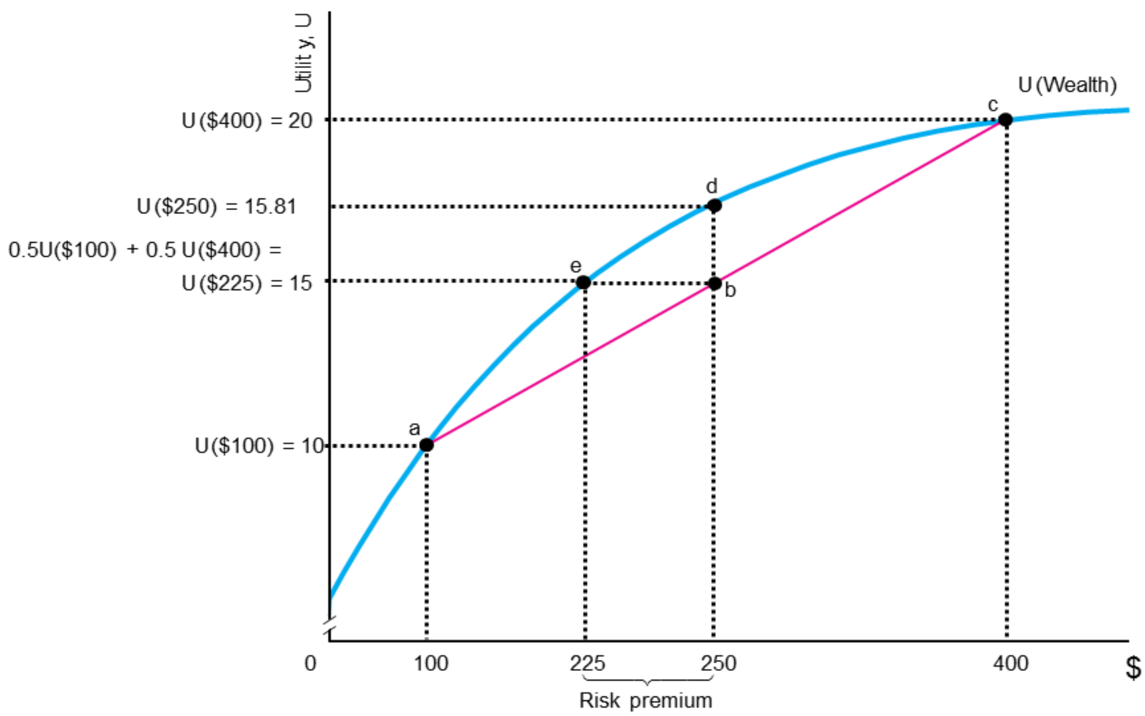


Figure 1: Diminishing Marginal Utility and Risk Aversion.

An extension of EUT was produced by Lucas (1978) when he created a Discounted Expected Utility Model (DEU) to evaluate risky outcomes over time. This model is very similar to the EUT model except in addition to a probability weighting function, there is a discount function to weight the value of each outcome. The general form is: $\sum p_i \delta^t u(x_{it})$ where the only aspects that have changed from EUT are that there is a summation over time and a discount function represented as δ^t. Although there is the inclusion of the time parameter in DEU, it tells nothing about how risk attitudes should change with time much like EUT. Rather, the model assumes independent time and risk preferences and therefore cannot predict how an individual's risk attitude will be affected by a temporal delay.

2.1.2 Prospect Theory

Even though EUT is a normative theory of risky decision making (i.e., how people should make risky decisions), there has been research that has shown it is not valid from the descriptive point of view (i.e., how people actually make risky decisions) (Wu et al., 2008). On the other hand, Prospect Theory is a descriptive theory or in other words it tells us how people actually make decisions rather than only looking at optimal decisions.

Prospect Theory (PT) is introduced by Kahneman and Tversky's influential paper "Prospect Theory: An analysis of decision under risk" (1979). The major components of their theory were a probability weighting function and a value function. Thus, the general form is: $\sum w(p_i)u(x_i)$ where $u(x_i)$ represents the value function and $w(p_i)$ represents the weighting function.

In EUT the utility function is defined over final wealth states whereas the value function is defined over changes in wealth (defined in terms of gains and losses) rather than absolute wealth levels. Also, although utility may be linear in the probabilities in EUT, value is not. This value function is concave for gains and convex for losses. The function is steeper for losses than gains as it exhibits loss aversion, which addresses one of the major pitfalls of EUT in that there is an observed gains/loss symmetry that EUT cannot capture. The probability function on the other hand identifies how varying probability levels contribute to an evaluation of a gamble (Wu et al., 2008).

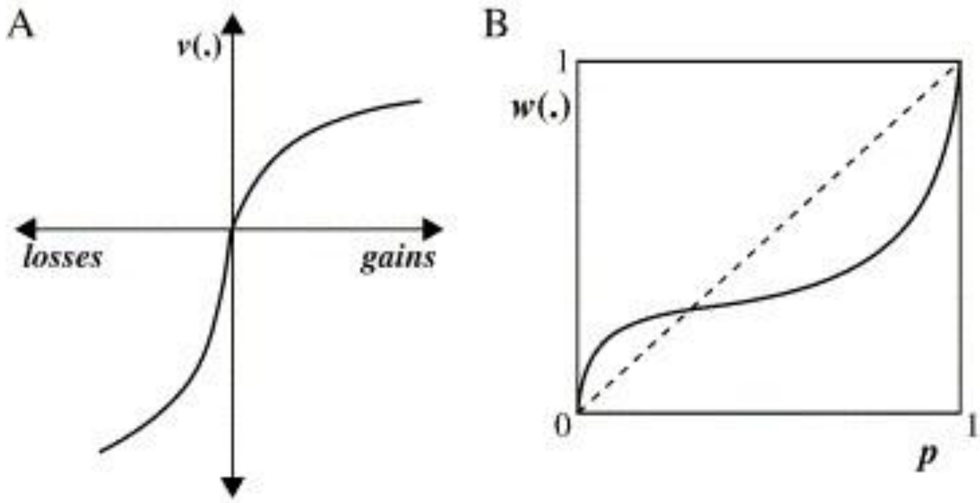


Figure 2: (A) Value function *v* as a function of gains and losses. (B) Probability weighting function *w* as a function of the probability *p* of a chance event. Source: (Trepel, Fox, & Poldrack, 2005).

In figure 2 we can examine a qualitative representation of the value and probability functions in Prospect Theory as discussed above. Key characteristics from the value function are that it is defined in terms of losses and gains from a reference point, it has diminishing sensitivity, and its steeper for losses than for gains (loss aversion). In terms of the probability weighting function, the schematic weighting of the function presented by Tversky and Kahneman underweighted medium and large probabilities, and overweighed small probabilities. Hence, we see that probabilities lower than approximately 0.3 are overweighed whereas probabilities greater are underweighted.

Kahneman and Tversky (1974) also found that people are not always *risk-averse*. In particular they found that in the gains domain although 84% of participants preferred $500 for sure over $1000 with 0.5 chance and hence exhibited *risk-averse* behavior, 72% of the participants also preferred a 0.001 chance of $5000 to $5 for sure exhibiting *risk-seeking* behavior. On the other hand, in the case of losses, 69% of subjects chose a 0.5 chance at losing $1000 to losing $500 for sure (i.e., exhibited *risk-seeking* behavior), while 83% chose losing $5 for sure over losing $500 with 0.001 chance (i.e., exhibited *risk-averse* behavior). That is, in the gains domain people are *risk-averse* for moderate probabilities and *risk-seeking* for small probabilities. However in the loss domain, they exhibit the exact opposite or *risk-seeking* for moderate probabilities and *risk-averse* for small probabilities.

These findings lead to the four-fold pattern of risk attitudes that explained preferences for gambles in the gains and loss domain for small and medium/large probabilities (Tversky & Kahneman, 1992).

	Small Probabilities	Medium/Large Probabilities
Gains	*Risk-seeking*	*Risk-averse*
Losses	*Risk-averse*	*Risk-seeking*

Table 1: Four-fold Pattern of Risk Attitudes.

In attempting to introduce the effects of time, we can introduce a discount function into Prospect Theory similar to what was done for EUT. The new form would be: $\sum w(p_i)\delta^t u(x_{it})$ for a discounted Prospect Theory model (DPT). In this case much like the shift from EUT to DEU, the functional form is identical except that there is a summation over time and a discount function represented as δ^t.

Although Prospect Theory and DPT are improvements over EUT in describing how individuals assess risky gambles, both theories do not address time dependencies of risk attitudes. In the next section, there will be a greater examination of the discount function and its shortcomings in addition to its inability to address why risk attitudes should change with time.

2.2 Intertemporal Choice

Time is a fundamental factor in how people make decisions. Many choices require individuals to trade-off costs and benefits at different points of time. Decisions with consequences in multiple time periods are known as intertemporal choices. Do you buy a fancy dinner today and eat cheap for the rest of the week? Do you skip purchasing the latest music player in favour of accruing more interest in your savings account? Decisions in the realm of education, savings, work effort, nutrition, exercise, and healthcare are all intertemporal choices (Chabris, Laibson, & Schultdt, 2008). Discounted utility theory is the most widely used framework for analyzing intertemporal choices.

2.2.1 Discounted Utility Theory

The Discounted Utility (DU) Model arose from Paul Samuelson's "A Note on Measurement of Utility" (1937). The paper outlined a utility function representing intertemporal preferences with the normative property that such individual are consistent with their preferences. In other words, the relative consumption in two periods t and $t+k$ will remain constant through time (i.e., if \$100 in 2015 is equivalent to \$150 in 2018 for an individual then \$100 in 2020 should be equivalent to \$150 in 2023 and so on). The model is essentially a preference on bundles of consumption ($c_t, \ldots, c_T$) where c_t is the consumption in the first period and c_T represents the consumption in the last period. The general model is given as:

$$U^t(c_t \ldots, c_T) = \sum_{k=0}^{T-t} D(k)\, u(c_{t+k}) \text{ where: } D(k) = \left(\frac{1}{1+r}\right)^k.$$

$U^t(c_t \ldots, c_T)$ is defined over the consumption bundle $(c_t \ldots, c_T)$ which represent the utility of that bundle. Furthermore, in this representation, $u(c_{t+k})$ is the individual's cardinal instantaneous utility function or the utility gained from consuming a specific amount in a particular period. $D(k)$ is the discount function and r is a parameter of the model that represents the individual's pure rate of time preference or the individual's discount rate (Frederick, Loewenstein, & O'Donoghue, 2002).

The DU model is named such because it discounts consumption in each successive period at a rate of r. The variable factor from individual to individual is how much value is placed on the utility of consumption in a period $t+k$ relative to the utility of consumption in a period t. This is all captured in the parameter r (or the discount rate) which can be positive, negative, or zero given on if the individual weights the present more highly than the future (normally the case), the future more highly than the present, or both equally respectively.

The other part of the DU model is the *u*(.) which represents the utility gained from consumption defined over a single period. The utility of a consumption bundle is defined as the sum of the utilities of consumption discounted at a rate of *r* in each period. A major point in this model is that individuals are dynamically consistent where their decisions will not change over time which equates to not being able to use a varying discount rate through time (causing conflicting views of what the best course of action is according to this model) (Strotz, 1953).

One of the major flaws of this model arises from the dynamic inconsistency in the form of hyperbolic discounting. Hyperbolic discounting or a time-inconsistent form of discounting is often used to signify that a person has a declining rate of time preference (Frederick et al., 2002). A typical experiment used to reveal hyperbolic discounting tendencies involve comparing short-term preferences against long-term preferences. Using pairs of hypothetical amounts of money available after different delays, when smaller immediate amounts were chosen over larger delayed amounts an introduction of a constant delay in both conditions resulted in a reversal of preferences (Green, Fristoe, & Myerson, 1994). For example, someone may prefer $50 today over $100 available in 2-months, but also prefer $100 in 6 months opposed to $50 in 4 months. This pattern of preference directly contradicts the standard DU model as the discount rate is not constant.

Another anomaly of the DU model is that small outcomes are discounted more than large ones. For example, subjects in Thaler's (1981) study exhibited varying discount rates based on the amount. Thaler identified subjects on average were indifferent between $15 now and $60 in a year, $250 now and $350 in a year, and $3000 now and $4000 in a year which corresponds to a 139, 34, and 29 percent discount rate respectively. Again, the DU model fails to address this phenomenon and cannot reliably be used to model intertemporal decision making.

In addition to these shortcomings, DU much like all the previous models (EUT, DEU, PT, DPT) does not examine how risk attitudes should change with time. In order to better understand why risk attitudes do indeed change over time and the basis of our hypothesis it is important to examine a theory of psychological distance (temporal in our case) that addresses why and how time delay can influence individuals' attitudes towards risk.

2.2.2 Construal Level Theory

Construal Level Theory (CLT) posits that psychological distances (e.g., spatial, social, probabilistic, and temporal) affect how people mentally represent events in their mind. Whether an event is classified as more abstract or concrete in one's mental representation is based upon the magnitude of the psychological distance. Individuals mentally represent near-future events with low-level construals and far-future events with high-level construals. High-level construals are seen as abstract and superordinate representations of events while low-level construals are more concrete and subordinate representations (Trope & Liberman, 2010).

The idea behind this subordinate versus superordinate is that the former is always contained in the latter whereas the reverse is not the case. In this sense superordinate events are always one step or rank ahead in that they encompass a more abstract concept. For instance a high-level construal could be representing an event as "having fun" while a low level-construal would be moving to representing it as "playing tennis". Playing tennis is subordinate to having fun. It is also more specific in that it gives more incidental details such as information about the activity that "having fun" does not contain. However, this is not to say that higher level construals are vaguer than lower level construals in every sense. A great deal of the time additional higher order information may be extracted from the higher level construals (Trope & Liberman, 2010). In this case "having fun" could entail many other activities or concepts that "playing tennis" does not imply.

A key distinction between high-level and low-level construals is the emphasis on desirability compared to feasibility of outcomes respectively (Trope & Liberman, 2003). Desirability looks at an action's end state in contrast to feasibility that is more concerned with the difficulty in reaching such an end state. Feasibility examines the subordinate nature of an action (i.e., how) whereas desirability looks at the superordinate nature of an action (i.e., why) (Vallacher & Wegner, 1987). As a result desirability is considered a high-level construal in contrast to feasibility which is considered a low-level construal. Placing this in the context of CLT, far-future preferences are more likely to be affected by desirability considerations while near-future preferences are more likely to be affected by feasibility considerations. Such near or far-future preferences are dependent however on the psychological distance.

The major component of CLT is psychological distance. Psychological distance is the driving force behind what shifts representations in our minds from low-level construals to high-level construals. This is because high-level construals remain more unchanged compared to low-level construals as one become more distant to it (Trope & Liberman, 2003). As a result, it is much easier to look at an event in terms of high-level construals when the psychological distance is large because it can be tough to grasp any sort of low-level construal representations of the event (Trope & Liberman, 2010).

In this thesis, there will be a focus on the temporal distance as we are most interested in the effects of time in risky decision making. CLT predicts that as temporal distance increases preferences are more likely to reflect the value associated with high-level construal of options opposed to that of low-level construal of options. This means that the value linked with low-level construals is diminished or discounted with temporal distance while the corresponding value of high-level construals is magnified with temporal distance (Trope & Liberman, 2003). But how is this linked to risky intertemporal decisions? What part of a gamble can be represented as a high-level construal or superordinate feature and what part can be represented as low-level construal or subordinate feature?

A typical lottery has a probability and outcome associated with winning. When comparing outcome to probability, according to CLT outcome is seen as a superordinate feature as it determines the desirability of the end state of the gamble; probability on the other hand is a subordinate feature as it determines the feasibility of winning. Another way of saying this is that an individual will only care about the probability if the outcome is high whereas the outcome will be important regardless of whether the probability is high or low.

Connecting this to risky decision making, Sagristano, Trope, and Liberman (2002) found that temporal distance did indeed increase participants' focus on desirability (outcomes) while decreasing their focus on feasibility (probability). They showed that desirability was superordinate to feasibility and subsequently that people are more *risk-seeking* in the case of the gains domain (and by extension more *risk-averse* in the loss domain) as there is a greater focus on outcome in the far-future. More details on this study can be found in section 3.5.

Chapter 3

Risky Intertemporal Choice

3.1 Risky Intertemporal Choice

Risky intertemporal choice combines elements from risky decision making with individuals' temporal preferences. Time preference or discounting is how much more a decision maker values a good now over later. Risk preference is whether an individual exhibits *risk-seeking, risk-averse,* or *risk-neutral* behavior. In this section we will summarize empirical research on showing whether and how a decision makers risk preferences change when outcomes are delayed. Furthermore, this section will examine how changes on the amount of the outcome, the associated probabilities, and whether the gamble is in the loss, gains, or mixed domain affects risky intertemporal choice.

3.2 Gains Domain

The majority of the research in risky intertemporal choice has been carried out in the gains domain as it is much easier to supply real incentives. Although a large amount of research has been done relative to the mixed and loss domain, it is still an area that has much to be explored. In this section we will closely examine a few of the key studies and the subsequent conclusions we can arrive at from the results of these studies.

In a recent study, Abdellaoui, Diecidue, and Öncüler (2011) looked at risky intertemporal decision making in the gains domain through a series of choice tasks with real incentives. The focus of their experiment was to look at risky intertemporal choice by establishing individual preferences at different points of time. 52 subjects had a choice between a lottery and a sure amount of money. This was done to get the *certainty equivalent*s for 10 different lotteries. Also, four different independent sessions were carried out that consisted of immediate, 6-month delay, 12-month delay, and an ambiguous delay between 0 and 12 months. A bisection method was used to find the *certainty* *equivalent*s (*CE*). For instance one choice may be between the gamble: (200, 0.33; 0) and $66 for sure. Choosing the latter would indicate that the *CE* is in (0, 66) interval, choosing the former indicates that *CE* is in the (66, 200) interval. This was continued on with different sure options until a *CE* could be found for the gamble (200, 0.33; 0).

They found that on average the subjects' *certainty equivalent*s went up as the evaluation period increased. For the ambiguous delay between 0 and 12 months the values lied between those for 0 and 6 months delay. Then, the *certainty equivalent*s were used to elicit the utility functions and the probability weighting functions. Power estimates for utility revealed that delay had no significant impact on utility while having an impact on the probability weighting function. Their results revealed that there was higher *risk-seeking* for lotteries played out in the future in the gains domain. According to the authors, people are more "optimistic" about lotteries played out in the future due to a temporal change in probability weighting as the utility functions stays the same for future lotteries.

In another recent paper, Anderson and Stafford (2009) examined risky intertemporal choice in the gains domain with real decisions and time delays. In their experiment, subjects choose between a certain and a risky payoff or two risky payoffs in the future (with some temporal delay between them). Also, resolution of the gamble happened on the actual payment date. Their experiment involved 25 choice tasks. The choice task involved choosing between two payment options for a set of 25 scenarios. Option A was paid in 2 weeks from the date of the experiment and Option B was paid in 2 weeks plus *n* days. The 2-week delay was included to control for the immediacy effect which occurs if outcomes later in time are perceived as less certain and thus the imminent future receives a disproportionate weight in the evaluation process (Keren & Roelofsma, 1995). The only constant was that Option A always had an expected value of $20, while Option B's value was from $22 to $30 dollars. Varying for each scenario was the level of risk associated with the options (i.e., certain vs. risky, risky vs. risky, risky vs. certain for Option A and Option B respectively). They utilized Ellsberg's urn design where the options represented multiple colors that could be drawn to get certain payments (Ellsberg, 1961). For example, Option A could be receive $20 for sure on November 19 and Option B could be receive $20 on December 3 if a red ball is drawn (75 out of 100) or receive $28 if a yellow ball is drawn (25 out of 100). They also used three temporal extensions (+*n* days) of 14, 28, and 56 days with 6 sessions each. Within each session, the first five scenarios were choice tasks between a certain payment of $20 in 2 weeks and certain payment of $X in 2 weeks plus n days where n was 14.1, 14.2, 28.1, 28.2, and 56 to elicit *certainty equivalent*s.

They discovered the percentage of subjects choosing Option B increased as the value of Option B increased and the percentage of subjects choosing Option B became smaller for a given value the longer the delay between both options was. Few subjects made the same choice for a pair of expected values regardless of the presence of risk. They also found that very few subjects were consistently *risk-averse* and that risk in intertemporal decision made subjects less patient (take the earlier payment option regardless of whether risk occurs in the early or latter payoff).

The results here are inconclusive in determining whether an intertemporal delay will make someone more *risk-seeking* in the gains domain. A downfall of the experimental design that could be attributed to the ambiguous results is the difference in the payouts was of too low magnitude causing participants to exhibit a lack of "patience". Öncüler (2000) found this lack of patience in hypothetical matching tasks for gambles opposed to certain outcomes as well. Öncüler also observed that the introduction of risk has less effect on decisions made in the future opposed to those made in the present.

In a similar study, Noussair and Wu (2006) looked at how risk preferences differ towards lotteries in the gains domain that were resolved and paid in the future versus the present with real cash incentives. The general framework behind their experiment was to give the participants a choice between two lotteries: one risky and one less risky. Each subject was then required to make ten choices between the two lotteries in two separate rounds. The 10 choices differed with probabilities assigned to winning the higher and lower amounts within the lottery. Subjects would then use two rolls of a 10 sided dice to determine which gamble they would actually play and the corresponding high or low payoff they would receive. A comparison was done within subject on whether they were more risk averse, seeking, or neutral over time whether they chose the risky lottery in the future less, more, or the same amount respectively compared to the present. It was found that 38.6% of subjects were more *risk-seeing* while 9.1% were more *risk-averse* for future gambles.

They believe that their estimate was conservative in the sense that with smaller probability increments a larger percentage of the participants would become more *risk-seeking* for future gambles (i.e., the 10% shift between the questions was too crude and a smaller grain would have given significantly better results). Furthermore, they found an increased time horizon to also create more *risk-seeking* in the domain of positive payoffs. In other words, people are less *risk-averse* when the risk is in the far-future opposed to immediate risks.

On the other hand, Onay and Öncüler (2009) looked at path dependency in risky intertemporal choice in three hypothetical experiments in the gains domain. In each experiment subjects were asked to give the present value of a lottery to be resolved and paid in the future at a known time in three different ways. The first way involved subjects directly eliciting the present *certainty equivalent* in a single evaluation (direct path). In the second way subjects first indicated their future *certainty equivalent* for the future lottery and then the present value of the future certainty equivalent (risk-time path). Lastly, subjects were asked to give the present value of the risky prospect and then the *certainty equivalent* for this current lottery (time-risk path).

Their results suggest that time and risk preferences are not independent for a decision maker in the case of risky future prospects. They find that the evaluation of future gambles is path-dependent as the present values elicited from the direct and time-risk methods are higher on average than those observed from the risk-time path. Furthermore, they found evidence of a two-stage evaluation for risky future prospects. Individuals first assess the present value of the gamble (time discounting) and then determine a certainty equivalent (probability discounting) when evaluating a gamble in the future. The implications are relevant to the loss domain as well since the method in which the gamble is assessed will affect the risk attitude of the decision maker.

Overall, previous literature supports that people become relatively more *risk-seeking* in the gains domain as the temporal delay of a risky gamble increases. Although in some case the results were ambiguous, it was usually due to fault in experimental design where either the probabilities were not fine enough or the difference in amounts was not perceived as significant. Furthermore, the type of elicitation procedure used is significant as an individual's *certainty equivalent* will be affected as a result.

3.3 Mixed Domain

The mixed domain involves gambles with both positive and negative outcomes. In that sense, it is similar to the loss domain as it is hard to give real incentives in the case of mixed domain gambles. Overall, little research has been done in the mixed domain. In this section we will examine one of the most famous studies in the mixed domain for risky intertemporal choice.

Shelley (1994) examined risky intertemporal choice in the mixed domain. She found that delayed losses are seen as more attractive than immediate ones while delayed gains are seen as less attractive than immediate ones in the case of risky choices. The study examined this by having participants evaluate the desirability of gambles to be played in the present as well as in the future. Risky gambles were evaluated more positively in the distant future as a result of the asymmetry between gains and losses. The study found that both time discounting as well as implicit risk for the lottery evaluation task act as factors in gains/loss asymmetries.

In terms of time discounting even though both losses and gains showed similar patterns of decline over time it was found that there was a noticeable difference in magnitude. The loss rate was found to still be higher than the gains rate even with implicit rate being taken into consideration. In other words, the expected severity of losses went down much faster with time than the supposed benefit of gains. This points to people in general believing losses are more likely to not occur or they have greater control over lowering losses when they are in the future in comparison to gains which are seen as more concrete. An increase in *risk-seeking* can therefore be linked to a gains/loss asymmetry connected to implicit risk as the perceived uncertainty involving loss is greater than gains. This leads to the conclusion that decision makers will gravitate towards more risky alternatives in the far-future.

In terms of implicit risk discounting it comes down to decision makers viewing gains as more credible than losses in the future. A few theories are proposed by March and Shapira (1992) that have to do with the connection between self-confidence and risk taking. Previous risky situations that turned successful for a decision maker become attributed to their skills and not of good fortune which translates to discounting loss more heavily because they do not imagine suffering a loss in the future or the loss will not be as bad as imagined. Since losses are discounted more steeply over delay than gains are, it makes sense that losses are weighted more heavily in the present. The results indicated that most decision makers are *risk-averse* in the short run while becoming more and more *risk-seeking* in the long run for mixed gambles.

From the results, it appears that the mixed domain is similar to the gains domain in that individuals become more *risk-seeking* as the temporal delay increases. Although these findings are important, it is hard to take any results from the mixed domain and apply them to the loss domain as the exact interaction can be hard to pinpoint.

3.4 Gains and Loss Domain

A few studies have examined the effects of time in risky intertemporal choice in both the gains and loss domain. As far as we know, the majority of these studies have been hypothetical in nature. Two of the major studies will be examined in this section.

In one study, Albrecht and Weber (1997) examined risky and certain intertemporal decision making through hypothetical experiments involving lotteries in both the gains and loss domain. They predicted that the influence of delay would be sensitive to the type of elicitation procedure used (in this case matching versus choice). A sample matching task involved the subject stating the amount in Deutsche Marks (DM) that they would receive today that would make them indifferent to a lottery of receiving DM 250 with 0.5 chance or DM 0 otherwise. A sample equivalent choice task would be the subject deciding on whether they prefer a sure amount today, a lottery of receiving DM 250 with 0.5 chance or DM 0 otherwise, or are indifferent to the two. The finding of most interest was whether any short-long term asymmetry was found (an example of such an asymmetry would be a preference of $10 today over $12 tomorrow implying a preference of $10 in 10 days over $12 in 11 days). In the case of the choice task, no short-long term asymmetry was found whereas for the matching task it was. The authors justify this as for the choice tasks, participants disregard the common delay (i.e., certain reward in 6 months vs. a risky reward in 12 months is seen as the same as certain reward now vs. a risky reward in 12 months) while for matching this is not possible as all the alternatives are considered individually.

This is important as it explains why there may be discrepancies in a choice versus matching experiment. However, gains and losses were not found to be discounted at different rates. The results showed no significant relationship between risk aversion and individual discount rates in both the gains and loss domain. Rather, they found that the discount rate was sensitive to the type of elicitation procedure used and risky options were discounted less than certain ones in the case of matching (certain outcomes were found to be discounted more than risky ones).

Similarly, Weber and Chapman (2005) closely examined the “peanuts effect” (Prelec & Loewenstein, 1991) which was the effect of decreasing *risk aversion* with decreasing monetary amounts that was first discovered by Markowitz (1952). In other words, decision makers will become less *risk-averse* when playing for “peanuts” (very small gains). Markowitz also extended the peanuts effect into the loss domain in that decision makers are more *risk-seeking* for small losses compared to large losses. Weber and Chapman broke their study into two experiments. The first being a choice experiment (participants would choose between two gambles) while the second was a choice and ratings experiment (participants would rate the attractiveness of a gamble from 1-100). They found that the peanuts effect only occurs when probabilities are high as this makes disappointment possible. They also found that the peanuts effect was slightly larger in the case of rating response in comparison to choice response in the loss domain.

Although the peanuts effect does not look at risk attitudes in the context of time it still has interesting applications. It can be used to explain why individuals may remain *risk-seeking* in the loss domain for the far-future. If amounts may be seen as too small or "peanuts" then the peanuts effects may overpower any influence from a greater focus on outcomes over probabilities.

3.5 Implications of Construal Level Theory

As we mentioned in section 2.2, according to CLT, psychological distance influences perceptions and mental representations of objects and events. In the case of this thesis, the temporal distance is of most concern. In this section, we will examine two relevant studies of CLT in the context of risky intertemporal choice.

Sagristano, Trope, and Liberman (2002) investigated the hypothesis that far-future events are represented in a more abstract, high-level manner than near-future events and subsequently a greater focus on outcome (desirability) over probability (feasibility) would be observed in risky choice when lotteries are delayed. In general, CLT predicts that temporal distance affects peoples' responses to events in the future by changing the way they mentally represent such events. As a result high-level construals are likely to include superordinate rather than subordinate goals.

Their first study found that desirability is superordinate to feasibility through asking subjects a series of rating questions with controllable and uncontrollable outcomes. People were likely to focus on desirability more when the temporal distance was great and feasibility more when the temporal distance was small. The subjective importance of the feasibility in getting an outcome depended on how desirable the outcome was, whereas the importance of the desirability of an outcome was independent of its feasibility. Translating this into the gambling domain, their second study found that probabilities were subordinate to payoffs using the same methods as the previous study. As a result they were able to have probabilities match feasibility criteria while payoffs were able to match desirability criteria. The subjective importance of the probability involved in winning depended on the payoff whereas the importance of the payoff was independent of the probability in winning. Hence, in terms of hierarchical preference it is more important to seek information regarding the payoff or desirability of an outcome over the probability or feasibility of an outcome.

Relating this to CLT, the probability involved in the payoff should play a larger role in deciding on a near-future or temporally close gamble while the payoff itself should play a more influential role in deciding on a distant future or temporally distant gamble. Sagristano (2002) confirmed this as near-future participants preferred to sacrifice payoff for better odds while far-future participants were more willing to gamble with worse odds in return for higher payoffs. Hence, temporal distance acted to increase the weight placed on payoffs in comparison to probability in the gambling domain.

The results imply that individuals become more *risk-seeking* in the gains domain as the temporal distance increases for the gamble as they put more weight on the outcome and less on the probability as compared to a temporally close gamble. Conversely, in this thesis we hypothesize that individuals should become more *risk-averse* in the loss domain as the temporal distance increases because of the increased weight of payoffs in decisions.

On a similar note, Maglio, Trope, and Liberman (2011) found that an initial instantiation of psychological distance caused a generalized reduction in sensitivity to subsequent instantiations of distance. For example a within-dimension sensitivity to temporal distance would be that a given span of time (one day delay) exerts less influence on choice when it follows an initial instantiation (occurring 365 days in the future) than when it does not (occurring immediately). Furthermore, since different psychological distances are conceptualized as sharing similar meaning, they found that an initial instantiation of any distance produces a similar reduction in sensitivity to a second instantiation of any dimension of distance (example: a wait of one month would seem shorter when it pertains to a spatially more distant event).

This is relevant as representing a target as far away makes it so extra psychological distances are made less influential than when they exist nearby. In line with risky intertemporal choice, this predicts that an instantiation of the psychological distance of time will cause a reduction in sensitivity to the psychological distance of probability in the case of risky gambles. In other words, only looking at the effects of probability, a person should be more *risk-seeking* for a risky gamble in the far-future than in the near-future for the gains domain because they will be less sensitive to the probability. For the loss domain, only looking at the effects of probability, this would also indicate they should be more *risk-seeking* as there is a reduction in sensitivity to probability.

After examining the results from both these studies, we can reach some conclusion about the influence of temporal delay on risky gambles. In both domains one side of the gamble is closer to zero. In the loss domain this is the outcome that is sought after, whereas in the gains domain it is not the outcome that is sought after. If an instantiation of temporal distance acts to increase the sensitivity to outcome, then for the gains domain both the reduction in sensitivity to probability and increase in sensitivity to outcome contribute to the outcome that is sought after. However in the loss domain, a decrease in sensitivity to the probability and an increase in sensitivity in outcome act in a conflicting manner as one pushes towards *risk-seeking* behavior (reduction in sensitivity to probability) while the other pushes towards *risk-averse* behavior (increased sensitivity to outcome). The superordinate nature of outcome over probability will result in outcome having a greater effect as the temporal distance (or any other psychological distance for that matter) increases.

3.6 Overview

Analysis of the previous literature has revealed that to our knowledge no research has been done exclusively in the loss domain. Furthermore, any of the studies that did deal in the loss domain were completely hypothetical in nature. From Table 2 below it is evident that the overall consensus in the gains domain is that an increase in temporal delay will cause individuals to become more *risk-seeking* in the case of risky gambles.

Domain	Experimental Task	Context	Attitude	Rewards	Referee
Gains	Choice	Gambles	Seeking	Real	(Abdellaoui et al., 2011)
Gains	Choice	Gambles with real time delay	Inconclusive	Real	(Anderson & Stafford, 2009)
Gains	Choice	Gambles	Seeking	Real	(Noussair & Wu, 2006)
Gains	Matching & Choice	Gambles	Inconclusive	Hypothetical	(Ahlbrecht & Weber, 1997)
Gains	Choice & Rating	Gambles	Seeking	Hypothetical	(Weber & Chapman, 2005)
Gains	Rating	Gambles	Seeking	Hypothetical	(Sagristano et al., 2002)
Gains	Rating	Real World Scenarios	Seeking	Hypothetical	(Maglio et al., 2011)
Mixed	Rating	Gambles	Seeking	Hypothetical	(Shelley, 1994)

Table 2: Previous Findings of Risk Attitudes in Related Literature.

Chapter 4

Hypothesis and Experimental Design

4.1 Hypothesis

An introduction of time delay will make people less sensitive to probabilities and more sensitive to outcomes in risky choice (Sagristano et al., 2002). We hypothesize that this will result in greater *risk aversion* in the loss domain as the resolution time of the gamble is increased. We tested this hypothesis in two experiment using various preference elicitation methods and both real and hypothetical rewards. Next, we will present these studies.

4.2 Overview of the Studies

We conducted two studies of risky intertemporal choice in the loss domain. The primary goal of both studies was to test the effects of a temporal delay on risk attitudes. In order to do this, we elicited participants' *certainty equivalents* for both real and hypothetical risky choices using paper-and-pencil as well as oral-based surveys. The major similarity between the two studies we conducted was that for both we carried out between-group analysis on three temporal extensions of immediate, future, and far-future resolution of the risky choices. In the first experiment, subjects went through a series of choice questions in order to elicit *certainty equivalents* for 4 sets of risky gambles with varying outcome levels and probabilities. In the second experiment, subjects went through six pricing questions involving various car insurance scenarios also with varying outcome level risk and probabilities. The goal in varying probabilities and outcome level was to produce a larger data set as well as gauge any direct effects on risk attitudes or in conjunction with temporal delay. Additionally, the first experiment gave monetary reward based on the choices made as well as class participation credit while the second experiment was completely voluntary. This was done to balance the effects of hypothetical versus real rewards and hedge against flaws in experimental design.

4.3 Experiment 1

4.3.1 Design and Procedure

Experiment 1 was conducted at the University of Waterloo and consisted of a paper-and-pencil based survey of 176 undergraduate students. Participants received extra course credit for participating in this study. In addition to the course credit, subjects also participated in a drawing and were given a chance to play out one of their choices for real and gain monetary reward based on their decisions in the survey.

We manipulated the delay (i.e., resolution and payment time) in a between-subject fashion. There were three conditions: no-delay, 2-week delay, and 2-month delay. In each condition subjects faced a series of risky choices and rating questions in the loss domain. Subjects were asked to imagine which of two losses they would rather undergo; one being a risky loss and the other being a sure loss. Overall, there were 60 choice questions in a total of 4 sets. Each set looked to find the subject's *certainty equivalent* by comparing a gamble against an incrementing sure loss for a certain delay. For instance, in the choice set taken from the no-delay condition and shown in Table 3, if a subject chose the sure loss (Option B) up to question 4 and the risky loss (Option A) thereafter we assumed his *certainty equivalent* for the lottery presented as the Option A lied between -\$45 and -\$50. As \$5 is a relatively wide range we asked the subjects in a follow-up question what his exact *certainty equivalent* was. Subjects were also asked follow-up rating questions from a 0 to 9 scale (0 being not important to 9 being very important) on the importance of the probability and amount of loss. A question was also asked about the attractiveness of the gamble as well but the results were not used due to a typographical error in the question. The delay signified when the subject was expected to play the lottery. In order to make the time dimension more salient we added a picture of a calendar showing the exact date of resolution and payment time.

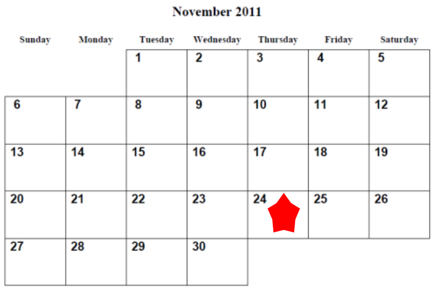
<table>
<tr><th></th><th>Option A (risky loss)</th><th>Option B (sure loss)</th><th>Decision
A or B</th></tr>
<tr><td>1</td><td rowspan="9">Lose $70 with 80% chance or lose $30 with 20% chance TODAY

</td><td>Lose $30 for sure TODAY</td><td>◯ ◯</td></tr>
<tr><td>2</td><td>Lose $35 for sure TODAY</td><td>◯ ◯</td></tr>
<tr><td>3</td><td>Lose $40 for sure TODAY</td><td>◯ ◯</td></tr>
<tr><td>4</td><td>Lose $45 for sure TODAY</td><td>◯ ◯</td></tr>
<tr><td>5</td><td>Lose $50 for sure TODAY</td><td>◯ ◯</td></tr>
<tr><td>6</td><td>Lose $55 for sure TODAY</td><td>◯ ◯</td></tr>
<tr><td>7</td><td>Lose $60 for sure TODAY</td><td>◯ ◯</td></tr>
<tr><td>8</td><td>Lose $65 for sure TODAY</td><td>◯ ◯</td></tr>
<tr><td>9</td><td>Lose $70 for sure TODAY</td><td>◯ ◯</td></tr>
</table>

Table 3: A Sample Set of Questions from Survey - Experiment 1.

As mentioned in total there were 4 sets of questions. More specifically there was a high and medium risk outcome level (100, 0; 70, 30) crossed with a probability level (80, 20) and its converse. This was done to examine any effects probability and outcome level may have on risk attitudes as well as strengthen our assertion that changes in time delay plays the primary role in forming risk attitudes.

To provide real incentives we notified the participants that we would randomly select a few subjects to actually play out one of their 60 decisions (determined randomly) at the given time by giving them a base of 100 Canadian dollars and taking away however much they lost (the max loss was 100 Canadian dollars so there was no negative to being chosen). Then, a series of follow-up rating questions were asked such as importance of the probability/amount of loss. The experiment lasted approximately 30 minutes. The participants were told at the beginning that were no right or wrong answers and that the experimenters were only interested in their true preferences. Refer to Appendix B-D for more details on the survey.

4.4 Results

4.4.1 Overview Results – Experiment 1

We did not use responses from 56 of the 176 participants as they answered illogically or they chose not to complete the entire survey. Hence, the following analysis is based upon the response of the remaining 120 participants. The primary focus was to examine how risk attitudes alter when the temporal delay changes. In this case, from an initial observation there seems to be some notable differences in risk attitudes between the no-delay and 2-week/2-month delay conditions but little difference between the latter two. The following table shows percentages of risk attitudes observed in each choice set and in each condition. These were obtained by looking at the *certainty equivalent* for all subjects in each choice set and comparing it to the expected value of the respective choice set. For instance, choice set 1 had an expected value of -$80. If the subjects would pay less than $80 for this gamble they would be coded as *risk-seeking*, if they would pay more than $80 they would be coded as *risk-averse*, and if they would pay exactly $80 they would be coded as *risk-neutral*.

Choice Set	Risk Attitude	No-delay, n = 31	2-week Delay, n = 44	2-month Delay, n = 45
1 (EV = -80)	Seeking	80.6	75	80
	Neutral	16.1	22.7	20
	Averse	3.2	2.3	0
2 (EV = -20)	Seeking	22.6	23	33.3
	Neutral	54.8	29	22.3
	Averse	22.6	48	44.4
3 (EV = -62)	Seeking	93.5	91	95.6
	Neutral	6.5	4.5	2.2
	Averse	0	4.5	2.2
4 (EV = -38)	Seeking	61.3	34.1	46.7
	Neutral	6.5	4.5	0
	Averse	32.3	61.4	53.3

Table 4: Risk Attitude Percentages for Subjects in each Choice Set – Experiment 1.

In Table 4 above it is observed that for choice sets 2, 3, and 4 subjects become more *risk-averse* when comparing the no-delay group to the 2-week delay group and the 2-month delay group respectively. In choice sets 1, 2, and 3 *risk-seeking* is relatively constant between groups whereas in choice set 4 it increases when comparing no-delay to 2-week and 2-month delay respectively. It is also relevant that there appears to be little overall difference between the 2-week delay and 2-month delay group for all risk attitudes in all choice sets.

Additionally, it is interesting to note that the choice sets with lower magnitude expected values (2 and 4) have a significantly larger percentage of *risk-averse* individuals while the choice sets with higher magnitude expected values (1 and 3) have a significantly larger percentage of *risk-seeking* individuals contradicting the peanuts effect (Prelec & Loewenstein, 1991).

In the next table, there is an examination of the average *certainty equivalents* in losses for each choice set and condition. Here, a comparison of the points verifies that the *certainty equivalents* have gone up with the delay which equates to subjects becoming more *risk-averse*.

Choice Set	No-delay, n = 31 (std. deviation)	2-week Delay, n = 44 (std. deviation)	2-month Delay, n= 45 (std. deviation)
1 (EV = -80)	-57.9029 (21.32156)	-65.5682 (16.39682)	-64.6222 (15.38194)
2 (EV = -20)	-21.4513 (10.26273)	-27.3864 (16.04821)	-24.8444 (14.25890)
3 (EV = -62)	-49.9674 (7.55594)	-52.0227 (7.44433)	-50.7556 (7.24618)
4 (EV = -38)	-37.0642 (6.50603)	-40.1364 (7.78666)	-38.8222 (6.20589)
Average	-41.5965 (8.30748)	-46.2784 (9.03195)	-44.7611 (7.03541)

Table 5: Descriptive Statistics for Certainty Equivalents – Experiment 1.

It is evident from Table 5 above that the *certainty equivalents* are going up when comparing the no delay group to the 2-week and 2-month delay group. Although in all choice sets there is an increase in the *CE* from the no-delay group to the 2-week and 2-month respectively, the *certainty equivalent* for the 2-week compared to the 2-month group appears to be slightly decreasing in all choice sets which is contradictory to the hypothesis.

The following graph shows a visual representation of the overall risk attitude percentages across all the choice sets. Essentially, it is the average of Table 4 in graphical format. In this case, we want to confirm the results from Table 5 and get a better understanding of the overall risk attitude behavior across the conditions.

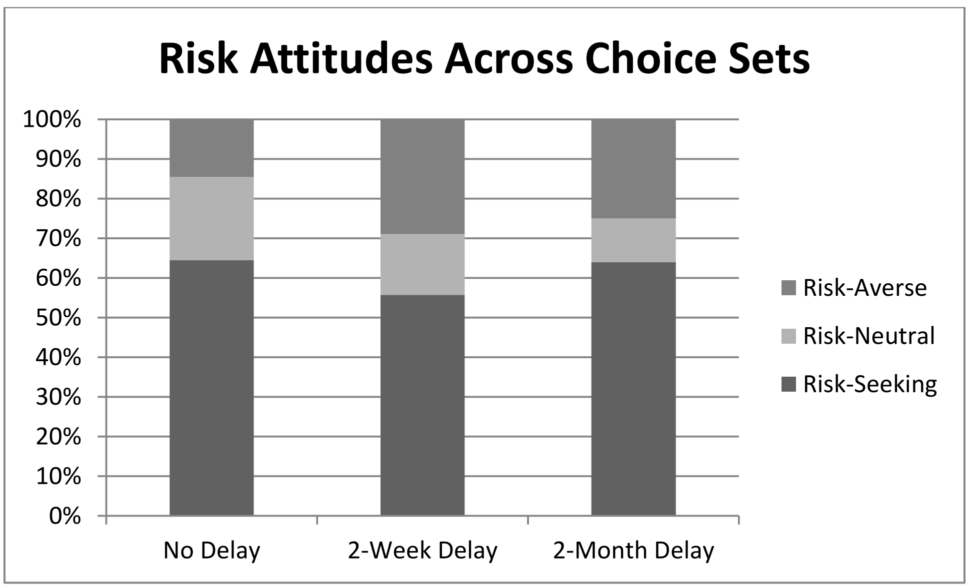


Figure 3: Overall Risk Attitude Visual Representation – Experiment 1.

After examining the visual representation of overall risk attitudes for the 4 sets in Figure 3 above, it is verified that subjects become slightly more *risk-averse* when moving from the no-delay group to the 2-week and 2-month delay group. However, *risk-aversion* appears to remain constant between the 2-week and 2-month delay group. Also, *risk-seeking* becomes slightly more prevalent in the 2-week and 2-month delay group compared to the no-delay group.

4.4.2 Choice Question Results – Experiment 1

A 3 (time) by 2 (probability) by 2 (outcome) mixed-model ANOVA was conducted for the certainty equivalents. Time was a between-subject variable while probability and outcome which were within-subject variables. The following table shows the main effects of time, outcome, and probability interactions.

Effect	df	Mean Square	F	p
Time	2	807.154	3.044	> 0.05
Outcome	1	158.349	1.230	> 0.05
Outcome x Time	2	186.886	1.452	> 0.05
Probability	1	73961.429	519.019	< 0.001
Probability x Time	2	14.358	0.101	> 0.05
Outcome x Probability	1	19543.001	285.524	< 0.001
Outcome x Time x Probability	2	42.490	0.621	> 0.05
Error	117	265.165		

Table 6: Repeated Measures Analysis of Variance – Experiment 1.

The main effect of time approached significance as $F\ (2, 117) = 3.044$, $p = 0.052$. Results indicate that this was in the direction of the hypothesis as there was an overall increase in *certainty equivalent* from the no-delay condition ($M = 41.5965$, $SD = 8.30748$) to the 2-week ($M = 46.2784$, $SD = 9.03195$) and 2-month condition ($M = 44.7611$, $SD = 7.03541$) respectively. However as the 2-week and 2-month condition exhibited similar overall *certainty equivalents*, the effect only approached significance rather than actually being significant. The main effect of probability was also significant as $F\ (1, 117) = 73961.43$, $p < 0.001$. Only the interaction effect of outcome and probability was significant, $F\ (1, 117) = 19543.001$, $p < 0.001$.

Further contrast tests were used to break down the effect of time and look at the interaction between each respective pair of delay groups. A contrast is a weighted sum of means that allows the examination of differences between the conditions. It is possible to see not only if the results are significant, but to test the research hypothesis and see if an increased time delay resulted in an increase in *risk aversion*. The contrasts comparisons were as follows in Table 7 below: Contrast 1 was the comparison between condition 1 (no-delay) and condition 2 (2-week delay). Contrast 2 was the comparison between condition 1 (no-delay) and condition 3 (2-month delay). Contrast 3 was the comparison between condition 2 (2-week delay) and condition 3 (2-month delay).

	Contrast	Value of Contrast	Std. Error	t	df	Sig. (2-tailed)
Assume equal variances	1	-4.6820	1.90920	-2.452	117	.016
	2	-3.1647	1.90041	-1.665	117	.099
	3	1.5173	1.72620	.879	117	.381
Does not assume equal variances	1	-4.6820	2.01997	-2.318	67.913	.023
	2	-3.1647	1.82379	-1.735	57.412	.088
	3	1.5173	1.71870	.883	81.219	.380

Table 7: Contrast Tests between all combinations of no-delay, 2-week delay, and 2-month delay groups – Experiment 1.

Since Levene's test of homogeneity of variances was not significant ($p > 0.05$), the part labeled *assume equal variances* in Table 7 was used. This gave the weighted sum of the group means or the value of the contrast itself. This was acquired by multiplying each group mean by the weight for the specific contrast and then taking the summation of all the products. In this case it appears that only contrast 1 or the no-delay with 2-week comparison was significant as $t\,(117) = -2.452$, $p = 0.016$ in the direction stated by the hypothesis as there is an increase in the *certainty equivalent* from the no-delay condition ($M = 41.5965$, $SD = 8.30748$) to the 2-week ($M = 46.2784$, $SD = 9.03195$) indicating greater *risk aversion*.

4.4.3 Rating Question Results – Experiment 1

We also conducted a 3 (time) by 2 (probability) by 2 (outcome) mixed-model ANOVA for the follow-up rating questions. Again, time was a between-subject variable while probability and outcome which were within-subject variables. The rating questions were asked in order identify the influence of probability and outcome in the decision making process for the 3 delay conditions. The other rating question regarding the attractiveness of the gamble was worded incorrectly and thus the results for that case have been omitted. The subsequent table shows the average response for the Probability Rating Question observed in each choice set and each condition.

Choice Set	No-delay, n = 31 (std. deviation)	2-week Delay, n = 44 (std. deviation)	2-month Delay, n= 45 (std. deviation)
1 (EV = -80)	7.2581 (1.87914)	8.0227 (1.33797)	7.5333 (1.42382)
2 (EV = -20)	8.0000 (1.36626)	7.5227 (1.87379)	7.2667 (2.20948)
3 (EV = -62)	7.2903 (1.77376)	7.8636 (1.39085)	6.7333 (1.75032)
4 (EV = -38)	7.5806 (1.80322)	7.6818 (1.81432)	7.1778 (1.93401)
Overall	7.5323 (1.33657)	7.7727 (1.12299)	7.1778 (1.44071)

Table 8: Descriptive Statistics for Probability Rating Question – Experiment 1.

From Table 8 above it is observed that there are little to no patterns within the choice sets as well as between the choice sets for the Probability Rating Question. Thus, it is expected the results will not be significant. From a mixed-model ANOVA it is verified as the main effect of time is not significant as $F\ (2, 117) = 2.338$, $p > 0.05$. Furthermore none of the other effects are significant as $p > 0.05$ for the other main effects of probability and outcome as well as all the interactions.

The next table shows the average response for the Outcome Rating Question observed in each choice set and each condition.

Choice Set	No-delay, n = 31 (std. deviation)	2-week Delay, n = 44 (std. deviation)	2-month Delay, n= 45 (std. deviation)
1 (EV = -80)	7.5806 (2.09403)	7.7273 (1.49982)	7.0889 (1.97510)
2 (EV = -20)	7.5161 (1.87743)	7.2955 (1.77292)	6.7778 (2.39212)
3 (EV = -62)	7.5161 (1.38735)	7.2273 (1.47638)	7.3111 (1.74281)

4 (EV = -38)	7.2903 (1.93552)	6.7727 (1.89078)	6.8222 (2.03703)
Overall	7.4758 (1.44677)	7.2557 (1.33326)	7.0000 (1.75405)

Table 9: Descriptive Statistics for Outcome Rating Question – Experiment 1.

From Table 9 above it is observed that there is a very slight overall decrease within the choice sets as the time delay goes up for Outcome Rating Question. However the change is subtle and it is still expected the results will not be significant. From a mixed-model ANOVA it is verified as the main effect of time is not significant as F (2, 117) = 0.908, $p > 0.05$. The main effect of probability is significant as F (2, 117) = 7.690, $p < 0.01$ but none of the interactions are as well as the other main effect of outcome and any of its interactions.

4.5 Discussion – Experiment 1

The rationale behind the choice questions was to elicit the subject's *certainty equivalent* for specific sets of gambles (set 1, 2, 3, and 4). In order to combat anchoring or any other adjustment bias (Tversky & Kahneman, 1974) the subjects were first asked to indicate their switching point by going through a table where the sure amount of loss incremented by $5 and the risky gamble remained the same. A follow-up question was then asked directly to verify the *certainty equivalent*. These two were cross-checked to ensure rational thinking. Results that did not match were thrown out as illogical data as the participant either did not understand the task or chose to not complete the survey in a logical manner. 56 of a total of 176 participants either did not complete the entire survey or had illogical answers and thus their responses were not used. For example, if a subject's response in set 1 showed that he/she preferred Option B up to question number 10 and then Option A from question 11 to 21, their *certainty equivalent* would have to be between the bounds of the certain amount in those two questions. In this case, that would correspond to answering that their *certainty* *equivalent* to be between -\$45 and -\$50. Then based on their *certainty equivalent*, there would be a between subject analysis of the 3 conditions of no-delay, 2-week delay, and 2-month delay.

The results indicate that there was a significant difference between the no-delay and 2-week group; however, not for the no-delay and 2-month group as well as the 2-week and 2-month delay group. It is important to note that this is not a test of a general hypothesis that one group will differ from the other, which would be two-tailed and likewise correspond to the given significant levels. Rather, the hypothesis predicts that the introduction of time delay will make people less sensitive to probabilities and more sensitive to outcomes, and as a result make them more *risk-averse* (which corresponds to a higher *certainty equivalent*). This corresponds to a one-tailed hypothesis and thus we can divide the corresponding significant levels by 2. Thus for contrast 1: $p = 0.016/2=0.008$, for contrast 2: $p = 0.099/2 = 0.05$, and for contrast 3: $p = 0.381/2 = 0.1905$ indicating significance in actually both contrast 1 and 2 but not in 3.

The hypothesis predicts that all the contrasts will be significant. It is unexpected that the 2-week delay condition has a greater overall mean than the 2-month delay condition because that implies that the *certainty equivalent* for the 2-month delay group was less than 2-week delay group or in other words the 2-week delay group was more *risk-averse* than the 2-month delay group. It is also unexpected that contrast 3 is not significant implying that the temporal difference of 2 weeks and 2 months had no effect on subjects' *risk aversion*. Both of these could be attributed to the possibility that the participants did not distinguish between 2 weeks and 2 months and just grouped the two as in the future versus the no-delay group of being in the present. In summary, the contrasts reveal that there is significant difference between the no-delay group with the 2-week delay group as well as the no-delay with 2-month delay group corresponding in the direction the hypothesis predicts (more *risk-averse* in the far-future), but no significant difference between the 2-week delay group and the 2-month delay group.

The rating questions were designed with the notion of examining the superordinate versus subordinate nature of amount versus probability respectively (Sagristano et al., 2002). It was expected that as the temporal delay increased, there would be a larger concern with the amount of loss in comparison to the probability involved. For Question (1-4)C ["How important was the probability of loss in your decisions on a scale of 0 to 9 (0 being not important at all and 9 being very important)?] it was hypothesized that the no-delay group would show the most concern and put the highest rating followed by the 2-week delay group and finally the 2-month delay group. Likewise, for Question (1-4)D ["How important was the amount of loss in your decisions on a scale of 0 to 9 (0 being not important at all and 9 being very important)?] it was expected that the 2-month delay group would put the highest rating followed by the 2-week delay group and finally the no-delay group. However, both rating question C and D were not significant. This could be attributed to many factors such as the subjects not having much incentive to give real answers to them not accurately being able to quantify how attractive the probabilities or outcomes were.

For Question (1-4)B ["How unattractive was Option B in this decision on a scale of 0 to 9 (0 being not unattractive at all and 9 being very unattractive)?] Option B was meant to be Option A. Due to a last minute change to the table the two got mixed up. Had it said Option A, it was anticipated that a higher temporal delay would result in greater *risk aversion* compared to a lower temporal delay due to the preoccupation on outcome over probability in the long run.

4.6 Experiment 2

4.6.1 Design and Procedure

Experiment 2 was conducted at the University of Waterloo and consisted of an oral-based survey of various undergraduate and graduate students conducted at the campus student life center. Unlike experiment 1, experiment 2 was completely hypothetical offering no incentives for completion. The major reasoning behind this was to combat framing the problem in the gains domain that maybe have occurred in experiment 1 as a result of endowing them with monetary incentives (Kahneman et al., 1991). Subjects were asked to imagine hypothetical losses in car rental for a one day trip. Like experiment 1, experiment 2 was broken up into 3 conditions. The first condition imagined they would be renting the car for today, the second condition for a day in 2 months, and the third condition for a day in 1 year. Each condition consisted of 25 participants for a total of 75 participants. Subjects were asked to decide on the maximum amount of money they would be willing to spend purchase different types of insurances (or in other words identify their *certainty equivalents*). The insurance scenarios were generalized into 3 probability sets: low (0.1), medium (0.5), and high (0.9). The potential loss was kept constant at $200 and then $2000 across all probability sets for a total of 6 questions. Figure 4 below shows an example of the low probability set questions for the 1-year delay condition. Refer to Appendix E-G for more details on the survey.

Scenario 1a: You are renting a car **in 1-year** and are offered a breakdown insurance that will cover an auto repair service man coming out to fix your car in the case of an engine malfunction. Suppose you know from the National Motorists Association that there is a 10% chance that the car will breakdown. If you do not buy the insurance and the car breaks down it will cost you $200.

What is the maximum amount you will pay for this insurance: _______________

Scenario 1b: Now suppose instead of $200, it costs $2000 if the car breaks down (the probability remains the same).

What is the maximum amount you will pay for this insurance: _______________

Figure 4: A Sample Set of Questions from Survey - Experiment 2.

4.7 Results

4.7.1 Overview Results – Experiment 2

Like experiment 1, the primary focus was to examine how risk attitudes alter when the temporal delay changes. In this case, from a preliminary observation there seems to be some notable differences in risk attitudes between all three delay groups. The following table shows percentages of risk attitudes observed over all questions in each condition. These were obtained by looking at the *certainty equivalents* for all subjects in each question and then comparing it to the expected value of the respective question. For instance, the first question had an expected value of -$20. If the subjects would pay less than $20 for the insurance they would be identified as *risk-seeking*, if they would pay more than $20 they would be identified as *risk-averse*, and if they would pay exactly $20 they would be identified as *risk-neutral*. The participants would then be coded as *risk-seeking, neutral*, or *averse* based on the attitude they displayed for the majority of the questions (ties were broken by using a comparison of the overall *certainty equivalent* with the overall expected value of all six questions).

	Risk Attitude	No-delay	2-month Delay	1-year Delay
Overall Mean	Seeking	84	72	51.3
	Neutral	11.3	22.7	29.3
	Averse	4.67	5.33	19.3

Table 10: Risk Attitude Percentages for Subjects over all 6 Questions – Experiment 2.

In Table 10 above it is observed that as the temporal delay increases, the subjects are becoming more and more *risk-averse*. The trend looks to be significant as across temporal conditions there is a decrease in the number of *risk-seeking* responses and an increase in both *risk-neutral* and *risk-averse* responses.

In the next table, there is an examination of the average *certainty equivalents* for all 6 questions. Here, a comparison of the points verifies that the *certainty equivalents* have gone up with the delay which equates to subjects becoming more *risk-averse*.

Question	No-delay, n = 25 (std. deviation)	2-month Delay, n = 25 (std. deviation)	1-year Delay, n= 25 (std. deviation)
1A (EV = -20)	15.3200 (5.42924)	18.6000 (2.79881)	21.0000 (7.50000)
1B (EV = -200)	147.4000 (46.14560)	166.8000 (27.57112)	205.2000 (60.88719)
2A (EV = -100)	75.1600 (25.61360)	86.4800 (16.61856)	100.2000 (26.11992)
2B (EV = -1000)	666.2000 (219.01903)	769.9600 (193.22816)	914.6000 (253.17945)
3A (EV = -180)	133.5600 (44.55996)	153.0000 (19.84313)	169.4000 (13.48765)
3B (EV = -1800)	1227.9200 (404.60453)	1465.5600 (229.96632)	1622.0000 (201.59778)
Overall	377.5933 (111.63378)	443.4000 (70.49306)	505.4000 (76.56701)

Table 11: Descriptive Statistics for Certainty Equivalents – Experiment 2.

It is evident from Table 11 above that the *certainty equivalents* are going up as the temporal delay increases for all the questions. This trend is prevalent across all the questions which points to the results being significant in the direction of the hypothesis.

The following graph shows a visual representation of the risk attitude percentages for all 6 questions across all conditions. Essentially, it is Table 10 in graphical format. In this case, the graph should represent a distinct trend of subjects becoming more *risk-averse* and less *risk-seeking* as the delay goes up across the 3 groups. It will also help in identifying in other trends that may not have been obvious from Table 10 or 11.

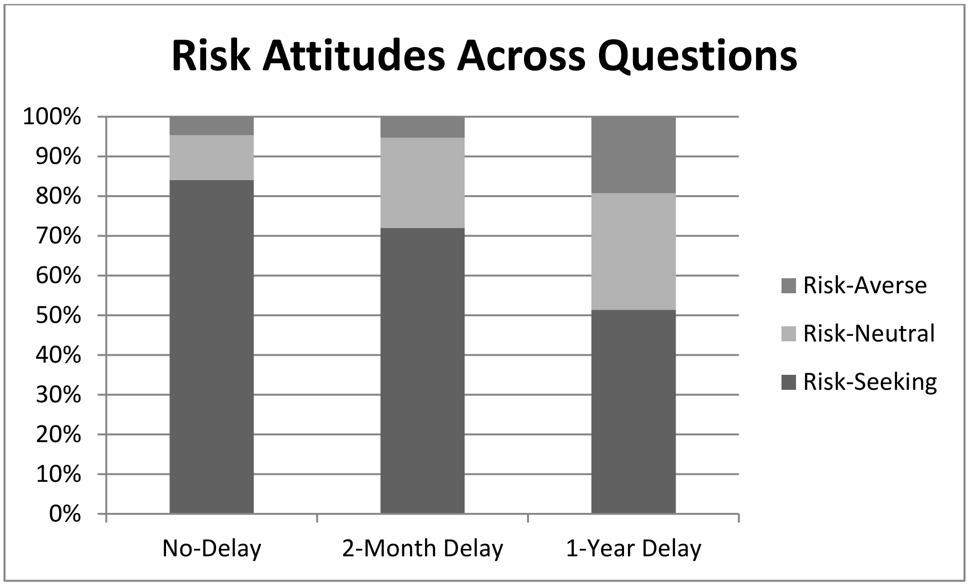


Figure 5: Overall Risk Attitude Visual Representation – Experiment 2.

After examining the visual representation of the subjects' risk attitudes across all 6 questions, it is evident that subjects are becoming more *risk-averse* as the delay increases. Unlike experiment 1, the *risk aversion* is not constant between the two future delay groups (in this case 2-month and 1-year delay respectively), but rather is increasing as a function of time. This is in accord with the hypothesis and is expected to be highly significant from the preliminary observation.

4.8 Certainty Equivalent Results – Experiment 2

A 3 (time) by 3 (probability) by 2 (outcome level) mixed-model ANOVA was conducted for the *certainty equivalents*. Time was a between-subject variable while probability and outcome which were within-subject variables. The subsequent table shows the main effects of time, outcome, and probability interactions.

Effect	df	Mean Square	F	p
Time	2	612726.536	13.152	< 0.001
Outcome	1	57118809.620	1699.083	< 0.001
Outcome x Time	2	418470.540	12.448	< 0.001
Probability	1	36699617.280	1679.352	< 0.001
Probability x Time	2	215266.870	9.850	< 0.001
Outcome x Probability	1	24013117.920	1445.132	< 0.001
Outcome x Time x Probability	2	151427.190	9.113	< 0.001
Error	72	46587.755		

Table 12: Repeated Measures Analysis of Variance – Experiment 2.

The main effect of time was highly significant as F (2, 72) = 13.152, p < 0.001. Results indicate that this was in the direction of the hypothesis as there was an overall increase in *certainty equivalent* from the no-delay condition (M = 377.5933, SD = 111.63378) to the 2-month (M = 443.4000, SD = 70.49306) and subsequently to the 1-year condition (M = 505.4000, SD = 76.56701). Also, the main effect of probability and outcome were highly significant as F (1, 72) = 1679.352, p < 0.001 and F (1, 72) = 1699.083, p < 0.001 respectively. In this case higher probabilities led to higher *certainty equivalents* (low prob: M = 95.720, SD = 2.986, med. prob: M = 435.433, SD = 13.850, high prob: M = 795.240, SD =18.179) and higher outcomes led to higher *certainty equivalents* (low outcome: M = 85.858, SD = 1.905, high outcome: M = 798.404, SD = 18.784). All the interaction effects were also statistically significant at the 0.001 significance level and thus it was necessary to carry out post hoc procedure to further examine the effect of time upon risk attitudes.

Additional contrast tests were used to break down the effect of time and look at the interaction between each respective pair of temporal delay groups. The contrasts comparisons were as follows in Table 13 below: Contrast 1 was the comparison between condition 1 (no-delay) and condition 2 (2-month delay). Contrast 2 was the comparison between condition 1 (no-delay) and condition 3 (1-year delay). Contrast 3 was the comparison between condition 2 (2-month delay) and condition 3 (1-year delay).

	Contrast	Value of Contrast	Std. Error	t	df	Sig. (2-tailed)
Assume equal variances	1	-65.8067	24.92328	-2.640	72	.010
	2	-127.8067	24.92328	-5.128	72	.000
	3	-62.0000	24.92328	-2.488	72	.015
Does not assume equal variances	1	-65.8067	26.40558	-2.492	40.514	.017
	2	-127.8067	27.07368	-4.721	42.489	.000
	3	-62.0000	20.81517	-2.979	47.676	.005

Table 13: Contrast Tests between all combinations of no-delay, 2-month delay, and 1-year delay groups – Experiment 2.

Since Levene's test of homogeneity of variances was not significant ($p > 0.05$), the part labeled *assume equal variances* in Table 13 was used. It his case all of the contrasts were significant, contrast 1: t (72) = -2.640, $p < 0.05$, contrast 2: t (72) = -5.128, $p < 0.001$, contrast 3: t (72) = -2.488, $p < 0.05$. Furthermore this was in the direction of the hypothesis as there was an increase in *certainty equivalent* from the no-delay condition (M = 377.5933, SD = 111.63378) to the 2-month (M = 443.4000, SD = 70.49306) and subsequently to the 1-year condition (M = 505.4000, SD = 76.56701) indicating increased *risk aversion* over time. It also makes sense that contrast 3 was highly significant whereas the other contrasts were only significant as it was comparing the largest temporal distance of no-delay versus 1-year delay.

4.9 Discussion – Experiment 2

The rationale behind experiment 2 was similar to experiment 1 in that it was to elicit the subject's *certainty equivalent* for specific gambles (Q1A, Q1B, Q2A, Q2B, Q3A, Q3C). One of the major motivations was to increase the temporal distance in order for subjects to be able to distinguish between far-future distances. In experiment 1, the temporal distance of 2 weeks compared with 2 months did not provide significant results. Thus, in order to test the hypothesis, it was necessary to re-examine the temporal distance and increase the time to test if there was indeed any difference.

Also, another motivation was to make the study hypothetical to combat any sort of framing in the gains domain as a result of providing a monetary reward based on the decision made. The subjects may have just framed the entire study in experiment 1 and acted similar to how they might act in the gains domain rather than the loss domain exclusively.

The results indicate that all the contrasts were significant in the direction the hypothesis predicts (more *risk-averse* as the temporal delay increases). Unlike experiment 1, in experiment 2, contrast 3 or the contrast which compared the two far-future conditions (2 weeks vs. 2 months for experiment 1 and 2 months vs. 1 year for experiment 2) was significant. Furthermore, the overall *certainty equivalent* increased as the temporal distance increased for the 3 conditions which is in line with what the hypothesis predicts.

Chapter 5

Conclusions

5.1 General

This study has found that there is a significant relationship between the time of resolution for a risky gamble in the loss domain and the level of *risk aversion*. Previous literature has found that people are generally *risk-seeking* in the loss domain (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992). The results of this study have shown that as the delay to outcome increases, the degree of *risk-seeking* diminishes. This result is in accord with previous literature that looked at risk attitudes in the gains domain. While people are generally *risk-averse* in the gains domain, the degree of *risk aversion* diminishes with delay (Noussair & Wu, 2006; Sagristano et al., 2002). While risk attitudes differed distinguishably between immediate and future gambles, the change between two future delays depended on the difference between two future delays. Although in experiment 1 attitude towards risk did not change between two delay conditions- probably due to the proximity of the delay in the future conditions-, experiment 2 verified our conjecture by increasing the delay difference between two future conditions. Thus, the general finding is in line with our hypothesis that as the temporal distance increases for the resolution of risky gamble in the loss domain, decision makers will become more *risk-averse*. In regards to the influence of delay on the importance or weight of probabilities and outcomes, we were not able to find that the increase in *risk aversion* was due to subjects focusing more on outcomes and less on probabilities as the temporal delay increased. I tried to provide evidence for the underlying mechanism by directly asking subjects how important probability and outcome dimensions were in their decisions. However, even if temporal distance might have influenced how the subjects treat these two dimensions, they may not have been consciously aware of this effect. Hence, on the subconscious level it could still be the correct mechanism, but this conjecture still requires further research.

5.2 Limitations

The major limitation of this study is conceptual. Inherently, it is difficult to mimic loss in experimental settings as subjects cannot face real losses. In experiment 1, real world incentives were given to try to make subjects answer more truthfully. However in order to do this, it was necessary to give everyone a base of money that we would take away from (see Appendix B-D for more details) to mimic loss. In doing so, this could have shifted the thought process into the gains domain. For instance in Option A for choice set 1, rather than losing $100 with 80% chance or losing nothing with 20% chance, it could have been interpreted as getting $0 (100-100) with 80% chance or $100 (100-0) with 20% chance. In addition, subjects may have been prone to the *endowment effect* (Kahneman et al., 1991) which would make them overvalue the $100 and subsequently treat it differently had the loss just been a part of their normal assets. Unfortunately, it is difficult to create a study where the premise depends on the subjects paying the experimenters, which is a major contributing factor to why the literature on risky intertemporal choice is much less comprehensive in the loss domain than the gains.

5.3 Future Research

Future research is necessary to verify the effects of temporal delay on gamble resolution time to accurately gauge the level of *risk aversion*. The inconsistencies between contrast 3 in experiment 1 and 2 makes it somewhat unclear how long the delays should be in order to alter risk attitudes. It would be ideal if the experiment could be recreated in a real life context where subjects would be using their own assets so as to combat various problems such as framing in the gains domain or any sort of *endowment effects*. It would also be ideal to look at many more temporal delays and probability levels to accurately see how much participants were discounting and subsequently risk attitudes between the various groups.

Additionally, it would be interesting to broaden the spectrum of participants outside of strictly university students. Trends may emerge based on age, gender, and/or socioeconomic factors.

Little research has been done in the realm of risky intertemporal choice in this regard in both the loss and gains domains and it may be worth pursuing.

The limited pool of participants also acted as somewhat of a hindrance to the overall findings. The study was relatively small in that for experiment 1 approximately only 40 subjects made up each of 3 groups, while in experiment 2 only 25 subjects made up each of 3 groups. An increase in the number of participants would increase the power of the study and cement the overall findings.

Lastly, the lack of significant results from the rating questions in experiment 1 is worth revisiting. Whether it is the question wording or the overall design of the survey, there must be a way to obtain significant answers in order to verify that outcome is focused on more than probability as the temporal delay increases.

Appendix A
Experiment 1: Information & Consent Form

Date: November 23, 2011

Title of Project: Risky Intertemporal Choice in the Loss Domain

Faculty Supervisors: Selcuk Onay, selcuk.onay@uwaterloo.ca

Student Investigators: Kimiyoshi Oshikoji, k2oshiko@uwaterloo.ca

Study Overview

I am a Master's student in the Department of Management Sciences at the University of Waterloo conducting research under the supervision of Professor Selcuk Onay.

You are invited to participate in a study assessing the effects of time on risky decision making in the loss domain.

What You Will Be Asked to Do

You will be asked a series of choice questions about your preference between a sure and risky loss. Please note that there are no right or wrong answers. We are only interested in your preferences. There are 60 questions regarding a choice between two losses. You will also be asked a few questions about your feeling regarding the choices you have made. The whole survey should take about 15-30 minutes.

A few of you will also be asked for permission to contact you for a second session. If you are selected for consideration in this second session you will be asked to play out one of the 60 questions from the first session (all of which have equal chance of being randomly chosen). You will be provided with a base of 100 dollars and receive money based on the choice you have made and how it plays out.

For example if the question we chose to use is a choice between:

Lose $50 for sure (Option A) vs.
Lose $40 with 70% chance or $70 with 30% chance (Option B)

and you chose Option A, then you will get $50. Likewise if you chose Option B we will play out the choice in front of you and you will have a 70% chance of getting $60 ($100-$40) or a 30% chance of getting $30 ($100-$70).
The amount received is taxable. It is your responsibility to report this amount for income tax purposes.

Participation and Remuneration

Participation in this study is voluntary, and will take approximately 30 minutes of your time. You will receive 0.5 bonus points for MSCI 211.

You may decline to answer any questions presented during the study if you so wish. A decision to participate or not will not impact your grade in MSCI 211. If you choose not to participate in the study and wish to obtain a 0.5 bonus mark you will perform a task assigned by the TA. You may also withdraw from the study at any time by not completing the survey and you will still receive the 0.5 bonus mark.

Personal Benefits of the Study

The benefits of participation in this study include learning about research in risky decision making in the loss domain. You will receive additional background information about the study once the results have been gathered. There are no other personal benefits to participation.

Risks to Participation in the Study

We want you to be aware of the possible risks/side effects associated with participation in this research. You will be asked to imagine having to lose money for sure or with a certain probability. In the event that you develop any negative reactions, or are concerned that you may, please contact the researcher, Kimiyoshi Oshikoji at ***k2oshiko@uwaterloo.ca***. You may also contact Professor Selcuk Onay at ***selcuk.onay@uwaterloo.ca*** or the University of Waterloo Counselling Services at 519-888-4567 x32655.

Confidentiality

All information you provide is considered completely confidential; indeed, your name will not be included or in any other way associated, with the data collected in the study. Furthermore, because the interest of this study is in the average responses of the entire group of participants, you will not be identified individually in any written reports of this research. Data obtained from the surveys will promptly be entered into Excel and participants will be identified as numerical entries. The hard copies of the surveys will be securely stored in CPH 3626 and promptly shredded after no more than 2-months. The electronic data may be kept indefinitely as they will no longer contain any personal identifiers.

Questions and Research Ethics Clearance

If you have any questions about this study, or would like additional information to assist you in reaching a decision about participation, please feel free to ask the student investigator listed at the top of the sheet.

I would like to assure you that this study has been reviewed and received ethics clearance through the Office of Research Ethics at the University of Waterloo. However, the final decision about participation is yours. If you have any comments or concerns resulting from your participation in this study, please contact Dr. Susan Sykes at this office at 519-888-4567 Ext. 36005 or ssykes@uwaterloo.ca.

Thank you for your interest in our research and for your assistance with this project.

Consent of Participant

I have read the information presented in the information letter about a study being conducted by Kimiyoshi Oshikoji under the supervision of Professor Selcuk Onay of the Department of Management Sciences at the University of Waterloo. I have had the opportunity to ask any questions related to this study, to receive satisfactory answers to my questions, and any additional details I wanted. I am aware that I may withdraw from the study without loss of participation credit at any time by advising the researchers of this decision.

This project has been reviewed by, and received ethics clearance through, the Office of Research Ethics at the University of Waterloo. I was informed that if I have any comments or concerns resulting from my participation in this study, I may contact Susan Sykes, the Director of the Office of Research Ethics at 519-888-4567 ext. 36005 or ssykes@uwaterloo.ca.

With full knowledge of all foregoing, I agree, of my own free will, to participate in this study.

____

Print Name

____

Signature of Participant

____

Dated at Waterloo, Ontario

____

Witnessed

Appendix B
Experiment 1: Zero Delay Questionnaire

Instructions:

This is a study in risky decision making. You will be answering a series of choice questions about your preference between a sure and risky loss. Please note that there are no right or wrong answers. We are only interested in your preferences. You will be asked 60 questions regarding a choice between two losses. You will also be asked a few questions about your feeling regarding the choices you have made. The whole survey should take from 15-30 minutes.

In the questions you'll be answering Option A will always represent a risky loss while Option B will represent a sure loss.
For example one of your choices could be:

Option A: Lose $90 with 80% chance or $10 with 20% chance vs.
Option B: Lose $50 for sure

As an incentive to make realistic decisions, we will choose a few of you *randomly* out of the entire pool of participants to receive a monetary reward by actually playing out one of the 60 questions you have answered. We will do this by providing you with a base of $100 dollars and then taking away however much is decided by your choice. Then we will pick one of the 60 questions you have answered randomly and proceed to play out the choice in front of you. If your choice is the sure loss in that question you'll simply be paid the difference between $100 and the amount you decided to lose for sure. If, on the other hand, you've chosen the risky option in that question, we will resolve that uncertainty using a random number generator to determine your gains.

For instance, in the example above, say you were chosen to play out one choice and we randomly selected that choice question to play out. Then you would get $50 if you chose Option B. If in this particular question if you've chosen Option A, we will actually play this choice out using a random number generator and depending on the outcome you will either lose $90 or $10 and be paid $10 or $90 respectively.

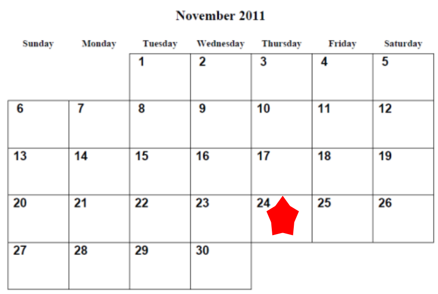
We will contact you if you are one of the few that will actually play out one of your choices and gains a monetary reward to come see us **today (November 24, 2011)**. Hence, make your choices as if you were losing the money **today (November 24, 2011)**. If you do not want to be contacted please just provide us with your name so you can receive your 0.5 bonus marks. However, if you are interested in having a chance at receiving monetary reward please provide us with your email/phone in addition to your name. Any questions?

Name:___________________________________

Email:___________________________________

Phone:___________________________________

Choice Set 1. Please fill in your preferred option between A or B in each of 21 questions. Note that Option A (the risky option) is the same in all questions in this set.

	Option A (risky loss)	Option B (sure loss)	Decision A or B
1		Lose $0 for sure TODAY	◯ ◯
2		Lose $5 for sure TODAY	◯ ◯
3	Lose <u>$100</u> with 80% chance or lose <u>nothing</u> with 20% chance TODAY	Lose $10 for sure TODAY	◯ ◯
4		Lose $15 for sure TODAY	◯ ◯
5		Lose $20 for sure TODAY	◯ ◯
6		Lose $25 for sure TODAY	◯ ◯
7		Lose $30 for sure TODAY	◯ ◯
8		Lose $35 for sure TODAY	◯ ◯
9		Lose $40 for sure TODAY	◯ ◯
10		Lose $45 for sure TODAY	◯ ◯
11		Lose $50 for sure TODAY	◯ ◯
12		Lose $55 for sure TODAY	◯ ◯
13		Lose $60 for sure TODAY	◯ ◯
14		Lose $65 for sure TODAY	◯ ◯
15		Lose $70 for sure TODAY	◯ ◯
16		Lose $75 for sure TODAY	◯ ◯
17		Lose $80 for sure TODAY	◯ ◯
18		Lose $85 for sure TODAY	◯ ◯
19		Lose $90 for sure TODAY	◯ ◯
20		Lose $95 for sure TODAY	◯ ◯
21		Lose $100 for sure TODAY	◯ ◯

Question 1A.
What is the **<u>maximum</u>** amount you would accept to lose **<u>for sure</u>** instead of playing out the gamble of losing $100 with 80% chance or $0 with 20% chance?

Answer: I would accept to lose maximum $_______ for sure rather than lose $100 with 80% chance.

Question 1B.
How **<u>unattractive</u>** was Option B in this decision on a scale of 0 to 9 (0 being not unattractive at all and 9 being very unattractive)?

Answer: _______

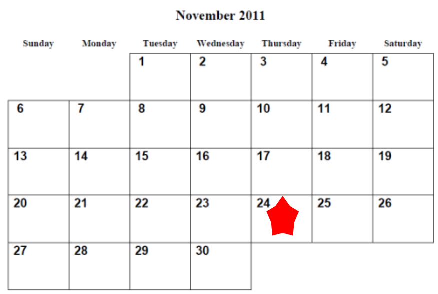
Question 1C.
How important was **<u>the probability of loss</u>** in your decisions on a scale of 0 to 9 (0 being not important at all and 9 being very important)?

Answer: ________

Question 1D.
How important was **<u>the amount of loss</u>** in your decisions on a scale of 0 to 9 (0 not being important at all and 9 being very important)?

Answer: ________

Choice Set 2. Please fill in your preferred option between A or B in each of 21 questions. Note that Option A (the risky option) is the same in all questions in this set.

	Option A (risky loss)	Option B (sure loss)	Decision A or B
1		Lose $0 for sure TODAY	◯ ◯
2		Lose $5 for sure TODAY	◯ ◯
3	Lose <u>$100</u> with 20% chance or lose <u>nothing</u> with 80% chance TODAY	Lose $10 for sure TODAY	◯ ◯
4		Lose $15 for sure TODAY	◯ ◯
5		Lose $20 for sure TODAY	◯ ◯
6		Lose $25 for sure TODAY	◯ ◯
7		Lose $30 for sure TODAY	◯ ◯
8		Lose $35 for sure TODAY	◯ ◯
9		Lose $40 for sure TODAY	◯ ◯
10		Lose $45 for sure TODAY	◯ ◯
11		Lose $50 for sure TODAY	◯ ◯
12		Lose $55 for sure TODAY	◯ ◯
13		Lose $60 for sure TODAY	◯ ◯
14		Lose $65 for sure TODAY	◯ ◯
15		Lose $70 for sure TODAY	◯ ◯
16		Lose $75 for sure TODAY	◯ ◯
17		Lose $80 for sure TODAY	◯ ◯
18		Lose $85 for sure TODAY	◯ ◯
19		Lose $90 for sure TODAY	◯ ◯
20		Lose $95 for sure TODAY	◯ ◯
21		Lose $100 for sure TODAY	◯ ◯

Question 2A.
What is the **<u>maximum</u>** amount you would accept to lose **<u>for sure</u>** instead of playing out the gamble of losing $100 with 20% chance or $0 with 80% chance?

Answer: I would accept to lose maximum $_______ for sure rather than lose $100 with 20% chance.

Question 2B.
How **<u>unattractive</u>** was Option B in this decision on a scale of 0 to 9 (0 being not unattractive at all and 9 being very unattractive)?

Answer: _______

Question 2C.
How important was the **<u>probability of loss</u>** in your decisions on a scale of 0 to 9 (0 being not important at all and 9 being very important)?

Answer: ________

Question 2D.
How important was the **<u>amount of loss</u>** in your decisions on a scale of 0 to 9 (0 not being important at all and 9 being very important)?

Answer: ________

Choice Set 3. Please fill in your preferred option between A or B n in each of 9 questions. Note that Option A (the risky option) is the same in all questions in this set.

	Option A (risky loss)	Option B (sure loss)	Decision A or B
1	Lose $70 with 80% chance or lose $30 with 20% chance TODAY 	Lose $30 for sure TODAY	◯ ◯
2		Lose $35 for sure TODAY	◯ ◯
3		Lose $40 for sure TODAY	◯ ◯
4		Lose $45 for sure TODAY	◯ ◯
5		Lose $50 for sure TODAY	◯ ◯
6		Lose $55 for sure TODAY	◯ ◯
7		Lose $60 for sure TODAY	◯ ◯
8		Lose $65 for sure TODAY	◯ ◯
9		Lose $70 for sure TODAY	◯ ◯

Question 3A.
What is the **maximum** amount you would accept to lose **for sure** instead of playing out the gamble of losing $70 with 80% chance or $30 with 20% chance?

Answer: I would accept to lose maximum $_______ for sure rather than lose $70 with 80% chance or lose $30 with 20% chance.

Question 3B.
How **unattractive** was Option B in this decision on a scale of 0 to 9 (0 being not unattractive at all and 9 being very unattractive)?

Answer: _______

Question 3C.
How important was the **probability of loss** in your decisions on a scale of 0 to 9 (0 being not important at all and 9 being very important)?

Answer: ________

Question 3D.
How important was the **amount of loss** in your decisions on a scale of 0 to 9 (0 not being important at all and 9 being very important)?

Answer: ________

Choice Set 4. Please fill in your preferred option between A or B in each of 9 questions. Note that Option A (the risky option) is the same in all questions in this set.

	Option A (risky loss)	Option B (sure loss)	Decision A or B
1	Lose $70 with 20% chance or lose $30 with 80% chance TODAY 	Lose $30 for sure TODAY	◯ ◯
2		Lose $35 for sure TODAY	◯ ◯
3		Lose $40 for sure TODAY	◯ ◯
4		Lose $45 for sure TODAY	◯ ◯
5		Lose $50 for sure TODAY	◯ ◯
6		Lose $55 for sure TODAY	◯ ◯
7		Lose $60 for sure TODAY	◯ ◯
8		Lose $65 for sure TODAY	◯ ◯
9		Lose $70 for sure TODAY	◯ ◯

Question 4A.
What is the **maximum** amount you would accept to lose **for sure** instead of playing out the gamble of losing $70 with 20% chance or $30 with 80% chance?

Answer: I would accept to lose maximum $_______ for sure rather than lose $70 with 20% chance or lose $30 with 80% chance.

Question 4B.
How **unattractive** was Option B in this decision on a scale of 0 to 9 (0 being not unattractive at all and 9 being very unattractive)?

Answer: _______

Question 4C.
How important was the **probability of loss** in your decisions on a scale of 0 to 9 (0 being not important at all and 9 being very important)?

Answer: ________

Question 4D.
How important was the **amount of loss** in your decisions on a scale of 0 to 9 (0 not being important at all and 9 being very important)?

Answer: ________

Appendix C
Experiment 1: 2-week Delay Questionnaire

Instructions:

This is a study in risky decision making. You will be answering a series of choice questions about your preference between a sure and risky loss. Please note that there are no right or wrong answers. We are only interested in your preferences. You will be asked 60 questions regarding a choice between two losses. You will also be asked a few questions about your feeling regarding the choices you have made. The whole survey should take from 15-30 minutes.

In the questions you'll be answering Option A will always represent a risky loss while Option B will represent a sure loss.
For example one of your choices could be:

Option A: Lose $90 with 80% chance or $10 with 20% chance vs.
Option B: Lose $50 for sure

As an incentive to make realistic decisions, we will choose a few of you *randomly* out of the entire pool of participants to receive a monetary reward by actually playing out one of the 60 questions you have answered. We will do this by providing you with a base of $100 dollars and then taking away however much is decided by your choice. Then we will pick one of the 60 questions you have answered randomly and proceed to play out the choice in front of you. If your choice is the sure loss in that question you'll simply be paid the difference between $100 and the amount you decided to lose for sure. If, on the other hand, you've chosen the risky option in that question, we will resolve that uncertainty using a random number generator to determine your gains.

For instance, in the example above, say you were chosen to play out one choice and we randomly selected that choice question to play out. Then you would get $50 if you chose Option B. If in this particular question if you've chosen Option A, we will actually play this choice out using a random number generator and depending on the outcome you will either lose $90 or $10 and be paid $10 or $90 respectively.

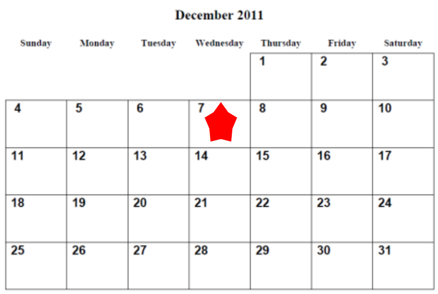
We will contact you if you are one of the few that will actually play out one of your choices and gains a monetary reward to come see us **in two weeks (December 7, 2011)**. Hence, make your choices as if you were losing the money **in two weeks (December 7, 2011)**. If you do not want to be contacted please just provide us with your name so you can receive your 0.5 bonus marks. However, if you are interested in having a chance at receiving monetary reward please provide us with your email/phone in addition to your name. Any questions?

Name:___________________________________

Email:___________________________________

Phone:___________________________________

Choice Set 1. Please fill in your preferred option between A or B in each of 21 questions. Note that Option A (the risky option) is the same in all questions in this set.

	Option A (risky loss)	Option B (sure loss)	Decision A or B
1	Lose <u>$100</u> with 80% chance or lose <u>nothing</u> with 20% chance in 2-weeks	Lose $0 for sure in 2-weeks	◯ ◯
2		Lose $5 for sure in 2-weeks	◯ ◯
3		Lose $10 for sure in 2-weeks	◯ ◯
4		Lose $15 for sure in 2-weeks	◯ ◯
5		Lose $20 for sure in 2-weeks	◯ ◯
6		Lose $25 for sure in 2-weeks	◯ ◯
7		Lose $30 for sure in 2-weeks	◯ ◯
8		Lose $35 for sure in 2-weeks	◯ ◯
9		Lose $40 for sure in 2-weeks	◯ ◯
10		Lose $45 for sure in 2-weeks	◯ ◯
11		Lose $50 for sure in 2-weeks	◯ ◯
12		Lose $55 for sure in 2-weeks	◯ ◯
13		Lose $60 for sure in 2-weeks	◯ ◯
14		Lose $65 for sure in 2-weeks	◯ ◯
15		Lose $70 for sure in 2-weeks	◯ ◯
16		Lose $75 for sure in 2-weeks	◯ ◯
17		Lose $80 for sure in 2-weeks	◯ ◯
18		Lose $85 for sure in 2-weeks	◯ ◯
19		Lose $90 for sure in 2-weeks	◯ ◯
20		Lose $95 for sure in 2-weeks	◯ ◯
21		Lose $100 for sure in 2-weeks	◯ ◯

Question 1A.
What is the **<u>maximum</u>** amount you would accept to lose **<u>for sure</u>** instead of playing out the gamble of losing $100 with 80% chance or $0 with 20% chance?

Answer: I would accept to lose maximum $_______ for sure rather than lose $100 with 80% chance.

Question 1B.
How **<u>unattractive</u>** was Option B in this decision on a scale of 0 to 9 (0 being not unattractive at all and 9 being very unattractive)?

Answer: _______

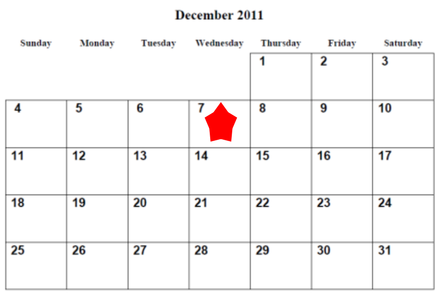
Question 1C.
How important was **<u>the probability of loss</u>** in your decisions on a scale of 0 to 9 (0 being not important at all and 9 being very important)?

Answer: ________

Question 1D.
How important was **<u>the amount of loss</u>** in your decisions on a scale of 0 to 9 (0 being not important at all and 9 being very important)?

Answer: ________

Choice Set 2. Please fill in your preferred option between A or B in each of 21 questions. Note that Option A (the risky option) is the same in all questions in this set.

	Option A (risky loss)	Option B (sure loss)	Decision A or B
1		Lose $0 for sure in 2-weeks	
2		Lose $5 for sure in 2-weeks	
3	Lose <u>$100</u> with 20% chance or lose <u>nothing</u> with 80% chance in 2-weeks	Lose $10 for sure in 2-weeks	
4		Lose $15 for sure in 2-weeks	
5		Lose $20 for sure in 2-weeks	
6		Lose $25 for sure in 2-weeks	
7		Lose $30 for sure in 2-weeks	
8		Lose $35 for sure in 2-weeks	
9		Lose $40 for sure in 2-weeks	
10		Lose $45 for sure in 2-weeks	
11		Lose $50 for sure in 2-weeks	
12		Lose $55 for sure in 2-weeks	
13		Lose $60 for sure in 2-weeks	
14		Lose $65 for sure in 2-weeks	
15		Lose $70 for sure in 2-weeks	
16		Lose $75 for sure in 2-weeks	
17		Lose $80 for sure in 2-weeks	
18		Lose $85 for sure in 2-weeks	
19		Lose $90 for sure in 2-weeks	
20		Lose $95 for sure in 2-weeks	
21		Lose $100 for sure in 2-weeks	

Question 2A.
What is the **<u>maximum</u>** amount you would accept to lose **<u>for sure</u>** instead of playing out the gamble of losing $100 with 20% chance or $0 with 80% chance?

Answer: I would accept to lose maximum $_______ for sure rather than lose $100 with 20% chance.

Question 2B.
How **<u>unattractive</u>** was Option B in this decision on a scale of 0 to 9 (0 being not unattractive at all and 9 being very unattractive)?

Answer: _______

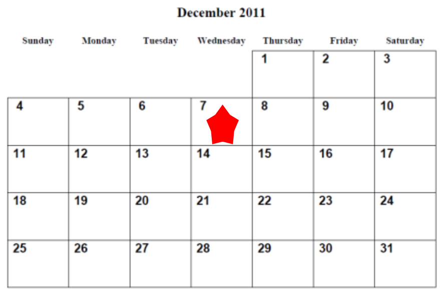
Question 2C.
How important was the **<u>probability of loss</u>** in your decisions on a scale of 0 to 9 (0 being not important at all and 9 being very important)?

Answer: ________

Question 2D.
How important was the **<u>amount of loss</u>** in your decisions on a scale of 0 to 9 (0 being not important at all and 9 being very important)?

Answer: ________

Choice Set 3. Please fill in your preferred option between A or B in each of 9 questions. Note that Option A (the risky option) is the same in all questions in this set.

<table>
<tr><th></th><th>Option A (risky loss)</th><th>Option B (sure loss)</th><th>Decision
A or B</th></tr>
<tr><td>1</td><td rowspan="9">Lose <u>$70</u> with 80% chance or lose <u>$30</u> with 20% chance in 2-weeks

</td><td>Lose $30 for sure in 2-weeks</td><td>○ ○</td></tr>
<tr><td>2</td><td>Lose $35 for sure in 2-weeks</td><td>○ ○</td></tr>
<tr><td>3</td><td>Lose $40 for sure in 2-weeks</td><td>○ ○</td></tr>
<tr><td>4</td><td>Lose $45 for sure in 2-weeks</td><td>○ ○</td></tr>
<tr><td>5</td><td>Lose $50 for sure in 2-weeks</td><td>○ ○</td></tr>
<tr><td>6</td><td>Lose $55 for sure in 2-weeks</td><td>○ ○</td></tr>
<tr><td>7</td><td>Lose $60 for sure in 2-weeks</td><td>○ ○</td></tr>
<tr><td>8</td><td>Lose $65 for sure in 2-weeks</td><td>○ ○</td></tr>
<tr><td>9</td><td>Lose $70 for sure in 2-weeks</td><td>○ ○</td></tr>
</table>

Question 3A.
What is the **maximum** amount you would accept to lose **for sure** instead of playing out the gamble of losing $70 with 80% chance or $30 with 20% chance?

Answer: I would accept to lose maximum $_______ for sure rather than lose $70 with 80% chance or lose $30 with 20% chance.

Question 3B.
How **unattractive** was Option B in this decision on a scale of 0 to 9 (0 being not unattractive at all and 9 being very unattractive)?

Answer: _______

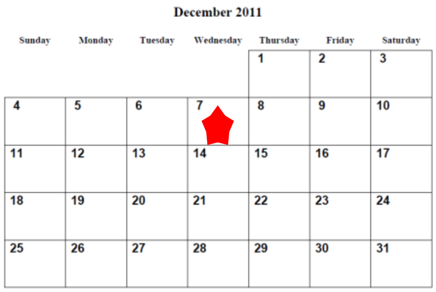
Question 3C.
How important was the **probability of loss** in your decisions on a scale of 0 to 9 (0 being not important at all and 9 being very important)?

Answer: ________

Question 3D.
How important was the **amount of loss** in your decisions on a scale of 0 to 9 (0 being not important at all and 9 being very important)?

Answer: ________

Choice Set 4. Please fill in your preferred option between A or B in each of 9 questions. Note that Option A (the risky option) is the same in all questions in this set.

<table>
<tr><th></th><th>Option A (risky loss)</th><th>Option B (sure loss)</th><th>Decision
A or B</th></tr>
<tr><td>1</td><td rowspan="9">Lose $70 with 20% chance or lose $30 with 80% chance in 2-weeks

</td><td>Lose $30 for sure in 2-weeks</td><td>◯ ◯</td></tr>
<tr><td>2</td><td>Lose $35 for sure in 2-weeks</td><td>◯ ◯</td></tr>
<tr><td>3</td><td>Lose $40 for sure in 2-weeks</td><td>◯ ◯</td></tr>
<tr><td>4</td><td>Lose $45 for sure in 2-weeks</td><td>◯ ◯</td></tr>
<tr><td>5</td><td>Lose $50 for sure in 2-weeks</td><td>◯ ◯</td></tr>
<tr><td>6</td><td>Lose $55 for sure in 2-weeks</td><td>◯ ◯</td></tr>
<tr><td>7</td><td>Lose $60 for sure in 2-weeks</td><td>◯ ◯</td></tr>
<tr><td>8</td><td>Lose $65 for sure in 2-weeks</td><td>◯ ◯</td></tr>
<tr><td>9</td><td>Lose $70 for sure in 2-weeks</td><td>◯ ◯</td></tr>
</table>

Question 4A.
What is the **maximum** amount you would accept to lose **for sure** instead of playing out the gamble of losing $70 with 20% chance or $30 with 80% chance?

Answer: I would accept to lose maximum $_______ for sure rather than lose $70 with 20% chance or lose $30 with 80% chance.

Question 4B.
How **unattractive** was Option B in this decision on a scale of 0 to 9 (0 being not unattractive at all and 9 being very unattractive)?

Answer: _______

Question 4C.
How important was the **probability of loss** in your decisions on a scale of 0 to 9 (0 being not important at all and 9 being very important)?

Answer: ________

Question 4D.
How important was the **amount of loss** in your decisions on a scale of 0 to 9 (0 being not important at all and 9 being very important)?

Answer: ________

Appendix D
Experiment 1: 2-month Delay Questionnaire

Instructions:

This is a study in risky decision making. You will be answering a series of choice questions about your preference between a sure and risky loss. Please note that there are no right or wrong answers. We are only interested in your preferences. You will be asked 60 questions regarding a choice between two losses. You will also be asked a few questions about your feeling regarding the choices you have made. The whole survey should take from 15-30 minutes.

In the questions you'll be answering Option A will always represent a risky loss while Option B will represent a sure loss.
For example one of your choices could be:

Option A: Lose $90 with 80% chance or $10 with 20% chance vs.
Option B: Lose $50 for sure

As an incentive to make realistic decisions, we will choose a few of you *randomly* out of the entire pool of participants to receive a monetary reward by actually playing out one of the 60 questions you have answered. We will do this by providing you with a base of $100 dollars and then taking away however much is decided by your choice. Then we will pick one of the 60 questions you have answered randomly and proceed to play out the choice in front of you. If your choice is the sure loss in that question you'll simply be paid the difference between $100 and the amount you decided to lose for sure. If, on the other hand, you've chosen the risky option in that question, we will resolve that uncertainty using a random number generator to determine your gains.

For instance, in the example above, say you were chosen to play out one choice and we randomly selected that choice question to play out. Then you would get $50 if you chose Option B. If in this particular question if you've chosen Option A, we will actually play this choice out using a random number generator and depending on the outcome you will either lose $90 or $10 and be paid $10 or $90 respectively.

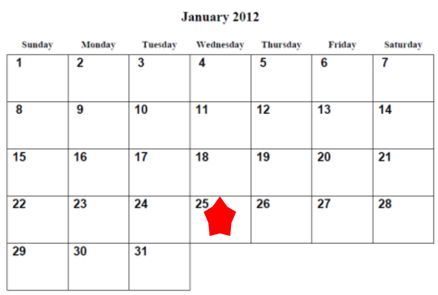
We will contact you if you are one of the few that will actually play out one of your choices and gains a monetary reward to come see us **in two months (January 25, 2012)**. Hence, make your choices as if you were losing the money **in two months (January 25, 2012)**. If you do not want to be contacted please just provide us with your name so you can receive your 0.5 bonus marks. However, if you are interested in having a chance at receiving monetary reward please provide us with your email/phone in addition to your name. Any questions?

Name:____________________________________

Email:____________________________________

Phone:____________________________________

Choice Set 1. Please fill in your preferred option between A or B in each of 21 questions. Note that Option A (the risky option) is the same in all questions in this set.

	Option A (risky loss)	Option B (sure loss)	Decision A or B
1		Lose $0 for sure in 2-months	◯ ◯
2		Lose $5 for sure in 2-months	◯ ◯
3	Lose <u>$100</u> with 80% chance or lose <u>nothing</u> with 20% chance in 2-months	Lose $10 for sure in 2-months	◯ ◯
4		Lose $15 for sure in 2-months	◯ ◯
5		Lose $20 for sure in 2-months	◯ ◯
6		Lose $25 for sure in 2-months	◯ ◯
7		Lose $30 for sure in 2-months	◯ ◯
8		Lose $35 for sure in 2-months	◯ ◯
9		Lose $40 for sure in 2-months	◯ ◯
10		Lose $45 for sure in 2-months	◯ ◯
11		Lose $50 for sure in 2-months	◯ ◯
12		Lose $55 for sure in 2-months	◯ ◯
13		Lose $60 for sure in 2-months	◯ ◯
14		Lose $65 for sure in 2-months	◯ ◯
15		Lose $70 for sure in 2-months	◯ ◯
16		Lose $75 for sure in 2-months	◯ ◯
17		Lose $80 for sure in 2-months	◯ ◯
18		Lose $85 for sure in 2-months	◯ ◯
19		Lose $90 for sure in 2-months	◯ ◯
20		Lose $95 for sure in 2-months	◯ ◯
21		Lose $100 for sure in 2-months	◯ ◯

Question 1A.
What is the **maximum** amount you would accept to lose **for sure** instead of playing out the gamble of losing $100 with 80% chance or $0 with 20% chance?

Answer: I would accept to lose maximum $_______ for sure rather than lose $100 with 80% chance.

Question 1B.
How **unattractive** was Option B in this decision on a scale of 0 to 9 (0 being not unattractive at all and 9 being very unattractive)?

Answer: _______

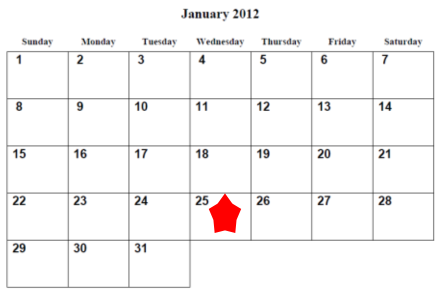
Question 1C.
How important was **the probability of loss** in your decisions on a scale of 0 to 9 (0 being not important at all and 9 being very important)?

Answer: ________

Question 1D.
How important was **the amount of loss** in your decisions on a scale of 0 to 9 (0 being not important at all and 9 being very important)?

Answer: ________

Choice Set 2. Please fill in your preferred option between A or B in each of 21 questions. Note that Option A (the risky option) is the same in all questions in this set.

	Option A (risky loss)	Option B (sure loss)	Decision A or B
1		Lose $0 for sure in 2-months	◯ ◯
2		Lose $5 for sure in 2-months	◯ ◯
3	Lose <u>$100</u> with 20% chance or lose <u>nothing</u> with 80% chance in 2-months	Lose $10 for sure in 2-months	◯ ◯
4		Lose $15 for sure in 2-months	◯ ◯
5		Lose $20 for sure in 2-months	◯ ◯
6		Lose $25 for sure in 2-months	◯ ◯
7		Lose $30 for sure in 2-months	◯ ◯
8		Lose $35 for sure in 2-months	◯ ◯
9		Lose $40 for sure in 2-months	◯ ◯
10		Lose $45 for sure in 2-months	◯ ◯
11		Lose $50 for sure in 2-months	◯ ◯
12		Lose $55 for sure in 2-months	◯ ◯
13		Lose $60 for sure in 2-months	◯ ◯
14		Lose $65 for sure in 2-months	◯ ◯
15		Lose $70 for sure in 2-months	◯ ◯
16		Lose $75 for sure in 2-months	◯ ◯
17		Lose $80 for sure in 2-months	◯ ◯
18		Lose $85 for sure in 2-months	◯ ◯
19		Lose $90 for sure in 2-months	◯ ◯
20		Lose $95 for sure in 2-months	◯ ◯
21		Lose $100 for sure in 2-months	◯ ◯

Question 2A.
What is the **<u>maximum</u>** amount you would accept to lose **<u>for sure</u>** instead of playing out the gamble of losing $100 with 20% chance or $0 with 80% chance?

Answer: I would accept to lose maximum $_______ for sure rather than lose $100 with 20% chance.

Question 2B.
How **<u>unattractive</u>** was Option B in this decision on a scale of 0 to 9 (0 being not unattractive at all and 9 being very unattractive)?

Answer: _______

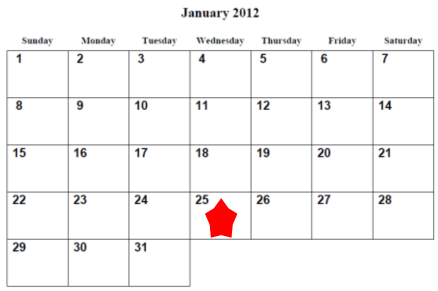
Question 2C.
How important was the **<u>probability of loss</u>** in your decisions on a scale of 0 to 9 (0 being not important at all and 9 being very important)?

Answer: ________

Question 2D.
How important was the **<u>amount of loss</u>** in your decisions on a scale of 0 to 9 (0 being not important at all and 9 being very important)?

Answer: ________

Choice Set 3. Please fill in your preferred option between A or B in each of 9 questions. Note that Option A (the risky option) is the same in all questions in this set.

<table>
<tr><th></th><th>Option A (risky loss)</th><th>Option B (sure loss)</th><th>Decision
A or B</th></tr>
<tr><td>1</td><td rowspan="9">Lose <u>$70</u> with 80% chance or lose <u>$30</u> with 20% chance in 2-months

</td><td>Lose $30 for sure in 2-months</td><td>◯ ◯</td></tr>
<tr><td>2</td><td>Lose $35 for sure in 2-months</td><td>◯ ◯</td></tr>
<tr><td>3</td><td>Lose $40 for sure in 2-months</td><td>◯ ◯</td></tr>
<tr><td>4</td><td>Lose $45 for sure in 2-months</td><td>◯ ◯</td></tr>
<tr><td>5</td><td>Lose $50 for sure in 2-months</td><td>◯ ◯</td></tr>
<tr><td>6</td><td>Lose $55 for sure in 2-months</td><td>◯ ◯</td></tr>
<tr><td>7</td><td>Lose $60 for sure in 2-months</td><td>◯ ◯</td></tr>
<tr><td>8</td><td>Lose $65 for sure in 2-months</td><td>◯ ◯</td></tr>
<tr><td>9</td><td>Lose $70 for sure in 2-months</td><td>◯ ◯</td></tr>
</table>

Question 3A.
What is the **maximum** amount you would accept to lose **for sure** instead of playing out the gamble of losing $70 with 80% chance or $30 with 20% chance?

Answer: I would accept to lose maximum $_______ for sure rather than lose $70 with 80% chance or lose $30 with 20% chance.

Question 3B.
How **unattractive** was Option B in this decision on a scale of 0 to 9 (0 being not unattractive at all and 9 being very unattractive)?

Answer: _______

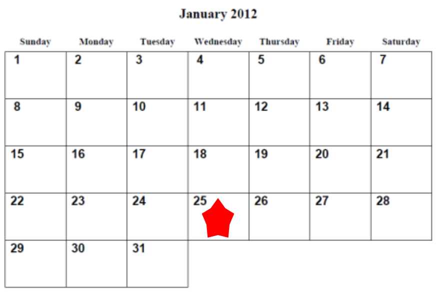
Question 3C.
How important was the **probability of loss** in your decisions on a scale of 0 to 9 (0 being not important at all and 9 being very important)?

Answer: ________

Question 3D.
How important was the **amount of loss** in your decisions on a scale of 0 to 9 (0 being not important at all and 9 being very important)?

Answer: ________

Choice Set 4. Please fill in your preferred option between A or B in each of 9 questions. Note that Option A (the risky option) is the same in all questions in this set.

	Option A (risky loss)	Option B (sure loss)	Decision A or B
1	Lose <u>$70</u> with 20% chance or lose <u>$30</u> with 80% chance in 2-months 	Lose $30 for sure in 2-months	◯ ◯
2		Lose $35 for sure in 2-months	◯ ◯
3		Lose $40 for sure in 2-months	◯ ◯
4		Lose $45 for sure in 2-months	◯ ◯
5		Lose $50 for sure in 2-months	◯ ◯
6		Lose $55 for sure in 2-months	◯ ◯
7		Lose $60 for sure in 2-months	◯ ◯
8		Lose $65 for sure in 2-months	◯ ◯
9		Lose $70 for sure in 2-months	◯ ◯

Question 4A.
What is the **<u>maximum</u>** amount you would accept to lose **<u>for sure</u>** instead of playing out the gamble of losing $70 with 20% chance or $30 with 80% chance?

Answer: I would accept to lose maximum $_______ for sure rather than lose $70 with 20% chance or lose $30 with 80% chance.

Question 4B.
How **<u>unattractive</u>** was Option B in this decision on a scale of 0 to 9 (0 being not unattractive at all and 9 being very unattractive)?

Answer: _______

Question 4C.
How important was the **<u>probability of loss</u>** in your decisions on a scale of 0 to 9 (0 being not important at all and 9 being very important)?

Answer: ________

Question 4D.
How important was the **<u>amount of loss</u>** in your decisions on a scale of 0 to 9 (0 being not important at all and 9 being very important)?

Answer: ________

Appendix E
Experiment 2: No-delay Questionnaire

Instructions:

This is a study in risky decision making in the insurance domain. You will be reading about hypothetical losses in car rental for a one day trip. You will decide on the maximum amount of money you would be willing to spend in order to purchase insurance to cover a loss based on varying given scenarios. There will be a total of 3 sets of scenarios with each set comprising of 2 parts. In each set the first part will involve a $200 loss and the second part will involve a $2000 loss if the insurance is not purchased. Varying probabilities corresponding to the chance of loss will also be given to aid you in making your decision. Please note that there are no right or wrong answers. We are only interested in your preferences.

Imagine the following scenarios happening **<u>today</u>**:

Scenario 1a: You are renting a car **<u>for today</u>** and are offered a breakdown insurance that will cover an auto repair service man coming out to fix your car in the case of an engine malfunction. Suppose you know from the National Motorists Association that there is a 10% chance that the car will breakdown. If you do not buy the insurance and the car breaks down it will cost you $200.

What is the maximum amount you will pay for this insurance: ______________

Scenario 1b: Now suppose instead of $200, it costs $2000 if the car breaks down (the probability remains the same).

What is the maximum amount you will pay for this insurance: ______________

Scenario 2.1a: You are renting a car **<u>for today</u>** and know that you must leave some electronic equipment in the car. You are offered a loss prevention insurance that will cover the equipment if it is stolen. Suppose you know from the National Motorists Association that there is a 50% chance that someone will steal the equipment. If you do not buy the insurance and the equipment is stolen it will cost you $200.

What is the maximum amount you will pay for this insurance: ______________

Scenario 2b: Now suppose instead of $200, it costs $2000 if the equipment is stolen (the probability remains the same).

What is the maximum amount you will pay for this insurance: ______________

Scenario 3.1a: You are renting a car **<u>for today</u>** and you will be transporting an endangered animal. Suppose that you must have a permit in order to transport the animal or you will incur a fine. Suppose you know from the National Motorists Association that there is a 90% chance that you will be stopped by an authority. If you do not buy the permit and you are stopped it will cost you $200.

What is the maximum amount you will pay for this permit: ______________

Scenario 3b: Now suppose instead of $200, it costs $2000 if you are stopped (the probability remains the same).

What is the maximum amount you will pay for this permit: ______________

Appendix F
Experiment 2: 2-month Delay Questionnaire

Instructions:

This is a study in risky decision making in the insurance domain. You will be reading about hypothetical losses in car rental for a one day trip. You will decide on the maximum amount of money you would be willing to spend in order to purchase insurance to cover a loss based on varying given scenarios. There will be a total of 3 sets of scenarios with each set comprising of 2 parts. In each set the first part will involve a $200 loss and the second part will involve a $2000 loss if the insurance is not purchased. Varying probabilities corresponding to the chance of loss will also be given to aid you in making your decision. Please note that there are no right or wrong answers. We are only interested in your preferences.

Imagine the following scenarios happening **in 2-months**:

Scenario 1a: You are renting a car **in 2-months** and are offered a breakdown insurance that will cover an auto repair service man coming out to fix your car in the case of an engine malfunction. Suppose you know from the National Motorists Association that there is a 10% chance that the car will breakdown. If you do not buy the insurance and the car breaks down it will cost you $200.

What is the maximum amount you will pay for this insurance: ______________

Scenario 1b: Now suppose instead of $200, it costs $2000 if the car breaks down (the probability remains the same).

What is the maximum amount you will pay for this insurance: ______________

Scenario 2.1a: You are renting a car **in 2-months** and know that you must leave some electronic equipment in the car. You are offered a loss prevention insurance that will cover the equipment if it is stolen. Suppose you know from the National Motorists Association that there is a 50% chance that someone will steal the equipment. If you do not buy the insurance and the equipment is stolen it will cost you $200.

What is the maximum amount you will pay for this insurance: ______________

Scenario 2b: Now suppose instead of $200, it costs $2000 if the equipment is stolen (the probability remains the same).

What is the maximum amount you will pay for this insurance: ______________

Scenario 3.1a: You are renting a car **in 2-months** and you will be transporting an endangered animal. Suppose that you must have a permit in order to transport the animal or you will incur a fine. Suppose you know from the National Motorists Association that there is a 90% chance that you will be stopped by an authority. If you do not buy the permit and you are stopped it will cost you $200.

What is the maximum amount you will pay for this permit: ______________

Scenario 3b: Now suppose instead of $200, it costs $2000 if you are stopped (the probability remains the same).

What is the maximum amount you will pay for this permit: ______________

Appendix G
Experiment 2: 1-year Delay Questionnaire

Instructions:

This is a study in risky decision making in the insurance domain. You will be reading about hypothetical losses in car rental for a one day trip. You will decide on the maximum amount of money you would be willing to spend in order to purchase insurance to cover a loss based on varying given scenarios. There will be a total of 3 sets of scenarios with each set comprising of 2 parts. In each set the first part will involve a $200 loss and the second part will involve a $2000 loss if the insurance is not purchased. Varying probabilities corresponding to the chance of loss will also be given to aid you in making your decision. Please note that there are no right or wrong answers. We are only interested in your preferences.

Imagine the following scenarios happening **<u>in 1-year</u>**:

Scenario 1a: You are renting a car **<u>in 1-year</u>** and are offered a breakdown insurance that will cover an auto repair service man coming out to fix your car in the case of an engine malfunction. Suppose you know from the National Motorists Association that there is a 10% chance that the car will breakdown. If you do not buy the insurance and the car breaks down it will cost you $200.

What is the maximum amount you will pay for this insurance: ______________

Scenario 1b: Now suppose instead of $200, it costs $2000 if the car breaks down (the probability remains the same).

What is the maximum amount you will pay for this insurance: ______________

Scenario 2.1a: You are renting a car **<u>in 1-year</u>** and know that you must leave some electronic equipment in the car. You are offered a loss prevention insurance that will cover the equipment if it is stolen. Suppose you know from the National Motorists Association that there is a 50% chance that someone will steal the equipment. If you do not buy the insurance and the equipment is stolen it will cost you $200.

What is the maximum amount you will pay for this insurance: ______________

Scenario 2b: Now suppose instead of $200, it costs $2000 if the equipment is stolen (the probability remains the same).

What is the maximum amount you will pay for this insurance: ______________

Scenario 3.1a: You are renting a car **<u>in 1-year</u>** and you will be transporting an endangered animal. Suppose that you must have a permit in order to transport the animal or you will incur a fine. Suppose you know from the National Motorists Association that there is a 90% chance that you will be stopped by an authority. If you do not buy the permit and you are stopped it will cost you $200.

What is the maximum amount you will pay for this permit: ______________

Scenario 3b: Now suppose instead of $200, it costs $2000 if you are stopped (the probability remains the same).

What is the maximum amount you will pay for this permit: ______________

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