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# The Effects of Delay and Probabilistic Discounting on Green Consumerism

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# THE EFFECTS OF DELAY AND PROBABILISTIC DISCOUNTING ON GREEN CONSUMERISM

by

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## ABSTRACT

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People have a tendency to discount outcomes that are delayed or probabilistic. In other words, people will sacrifice larger benefits for smaller benefits that are immediate or certain. For many environmentally-friendly ("green") products, the financial benefits are both delayed and probabilistic. The current study examined how delay and probability, as well as frame and magnitude, influenced consumers' decisions when comparing a conventional and green product. Participants were recruited from Amazon's Mechanical Turk and completed one of two experiments. In each experiment participants chose between a conventional product (low initial cost, high operating cost) and green product (high initial cost, low operating cost). Magnitude was manipulated by randomly assigning participants to a light bulb (low magnitude) or water heater (high magnitude) condition. Within each magnitude condition, promotional messages highlighted the increased operating cost of the conventional product (loss frame) or decreased operating cost of the green product (gain frame). Probability was manipulated in experiment one and inferred by the participant in Experiment 2. Results supported the recent finding that delay and probability interact. When probabilities of savings were high, participants were more likely to select the green product. This finding occurred whether probabilities were manipulated (Experiment 1) or inferred (Experiment 2). Framing and magnitude effects were inconsistent across experiments. Marketers promoting green products should take steps to reduce perceived risk associated with green products.

## TABLE OF CONTENTS

# LIST OF TABLES

Table Page

# LIST OF FIGURES

Figure Page

# CHAPTER I

## INTRODUCTION

The current rate of climate change has the potential to produce devastating effects around the world (IPCC, 2013). In light of this problem, consumers can make a lasting environmental impact with their purchase decisions (Dietz, Gardner, Gilligan, Stern, & Vandenbergh, 2009). According to a recent consumer survey by SC Johnson and the GfK market research firm (2011), the majority of Americans believe that buying sustainable products is a key component of alleviating environmental complications. However, the price of a product is still a barrier to the purchase of green (i.e., eco-friendly, sustainable) products. The survey, which sampled a representative portion of the population (i.e., controlling for age, gender, geographic region, education, race, and income), found that 79% of respondents reported that financial incentives influenced their decisions to help the environment; 49% rated financial incentives as a "major influence." Furthermore, 51% of respondents indicated that the unwillingness of consumers to pay a premium for green products was a "major reason" for environmental problems (GfK, 2011). Finally, consumers' willingness to pay a premium for green products has decreased in a variety of categories. For example, the number of respondents willing to pay a higher price for energy efficient automobiles or light bulbs decreased by more than 10% between 2008 and 2012 (GfK, 2012).

As the survey results indicated, consumers are cognizant of their impact on the environment, but the cost of green products appears to be an obstacle to consumption. Many green products, however, would actually save the consumer money over time. The cost of any product can be broken down into two dimensions: initial cost (i.e., sticker price) and operating cost. Combined, these dimensions make up a product's life cycle cost (Kaenzig &Wustenhagen,

2010). Green products vary on each of these dimensions relative to their conventional counterparts but the focus of this proposed research is only on one segment of consumer products: green products that have higher initial costs and lower operating costs compared to their conventional counterparts. For example, compact fluorescent lights (CFLs) have a higher sticker price than the equivalent incandescent bulbs. Over time, opting for CFLs will save the consumer money in the form of lower utility bills and fewer replacement costs. If consumers relied only on initial price to make decisions then incandescent bulbs would appear to be the cheaper option. Alternatively, consumers who considered the life cycle cost of the product would realize that CFLs are the most cost-effective option. Why, then, are consumers buying fewer energy efficient light bulbs when this purchase carries a financial incentive (GfK, 2012)?

The current study used a discounting framework to explain why consumers forgo the future financial benefits of green products and how consumers estimated the risks associated with purchasing green products. A nomological network was developed which integrated these factors, along with controllability and unrealistic optimism, to model the consumer decision making process for certain green products (i.e., products with a high initial cost and low operating cost).

# CHAPTER II

## DELAY DISCOUNTING

Considering the lifespan of the product when making a purchase decision is what economists and psychologists refer to as an intertemporal choice. Consumers must compare different values at different points in time (Frederick, Loewenstein, & O'Donoghue, 2002). In the light bulb example, the consumer must decide if he or she wishes to pay a little now and a lot later or a lot now and a little later. These sorts of intertemporal choices are well documented in the literature and are associated with reliable trends in behavior. One of the general tenets of intertemporal choice is that consumers discount future gains. That is, consumers judge future gains to be less valuable than immediate gains. For example, Thaler (1981) found that participants were indifferent between receiving $15 immediately and $20 after a delay of one month. Introducing a one month delay discounted the value of $20. Numerous studies have demonstrated similar patterns in decision making (for reviews see Frederick, Loewenstein, & O'donoghue, 2002; Green & Myerson, 2010; Loewenstein & Prelec, 1992). In a purchase decision between conventional and green products, delay discounting may manifest as a preference for conventional products. A conventional product provides an immediate saving in the form of a lower purchase price. The savings that are associated with green products are not recouped until some point in the future. Delayed savings are not as valuable as immediate savings and therefore consumers will opt for the conventional product.

Much of the research on discounting behavior has focused on the formulation of mathematical models (for review see Doyle, 2013). Economists traditionally favored an exponential model of discounting behavior (Samuelson, 1937) of the following form:

Eq. 1: $V = Ae^{-kD}$

where V is the present (discounted) value of the delayed reward; A is the real value of the delayed reward; e, Euler's number, is a constant; D is the delay; and k is an individual's discounting parameter (i.e., a value that adjusts the function according to individual discount rates). The exponential discount model assumes a constant discount function that produces consistent discount rates over time. Note that a positive discount rate, k, changes the equation into the more familiar continuously compounding interest formula. The exponential discounting model calculates the decrease in value of a future reward rather than the increased value from accrued interest.

An alternative to the exponential model is the hyperbolic model. Using the same notation from the exponential model, the hyperbolic discounting function is modeled as shown:

Eq. 2: $V = A / (1 + kD)$

The hyperbolic discounting function models a steep initial discounting and a leveling out over time. In other words, a delay of time D has a substantial impact on subjective valuation when people must choose between an immediate gain, $t_0$ (time 0), and a gain at time $t_0 + D$. Delay is less impactful when the alternatives are both in the future (e.g., time $t_1$ versus time $t_1 + D$; $t_1 > 0$; Green, Fristoe, & Myerson, 1994; Loewenstein & Prelec, 1992). For example, Kirby and Herrnstein (1995) found that participants, on average, preferred an immediate $21 to $25 after 10 days. However, participants' preferred $25 in 37 days compared to $21 in 27 days. Note that the delay, 10 days, is the same in both scenarios, but preferences shifted from the smaller sooner

reward to the larger later reward when adding a constant delay to both rewards. The exponential model is not able to account for this preference reversal. According to the exponential discounting function, preferences at a given delay are not impacted by the timing of the delay. In fact, multiple studies have confirmed that the hyperbolic discounting function is a better model of human, and animal, decision making than the exponential function (Johnson & Bickel, 2013; Kirby & Herrstein, 1995; Kirby & Marakovic, 1996; Mazur, 1988; Simpson & Vuchinich, 2000).

Many discounting studies follow a similar indifference point paradigm. The indifference point is the value at which a participant has an equal preference for an immediate or delayed reward. For example, Thaler (1981) found that, on average, participants were equally satisfied with receiving $15 immediately and $20 after a delay of one month. Participant indifference points are elicited in one of two ways. In some cases (e.g., Chapman, 1996; Thaler, 1981) participants completed a fill-in-the-blank task. They were required to indicate how much money received immediately would make them indifferent to a given reward at a specific delay. Alternatively, participants might be asked how much money received in the future would make them indifferent to an immediate reward. In these studies participants are only required to provide a single point estimate of their indifference point.

Other studies (e.g., Benzion, Rapoport, & Yagil, 1989; Estle et al., 2006; Kirby & Marakovic, 1996) use an iterative decision procedure. As in previous studies, participants were presented with a choice between a smaller sooner reward and a larger later reward. After the initial selection, the value of one of the rewards is adjusted until the participant reverses his or her preference from the immediate reward to the delayed reward (or vice versa). This procedure is repeated until converging on an indifference point. A full description of this method is presented in the method section below.

The mathematical description of delay discounting has a long research history, yet relatively little work has attempted to tackle the psychological underpinnings of delay discounting. One of the leading explanations for discounting behavior states that humans have a psychological need for closure. Hardisty, Appelt, and Weber (2013) refer to this need for closure as *present bias*. This bias manifests itself as a desire for immediate outcomes. When given the choice between an immediate reward and a delayed reward, the present bias influences the preference for the immediate reward. Opting for an immediate reward allows decision makers to "close the books" on this decision. Present bias is a theoretical explanation and empirical evidence supports this account of discounting behavior. Hardisty et al. (2013) asked their participants to choose between smaller immediate rewards and larger rewards to be received after one year. Additionally, participants were instructed to list their thoughts when making decisions. The thoughts were then categorized by content. In a mediation model, the proportion of thoughts that were categorized as present-biased (e.g., "I like to manage situations that arise in my life as quickly as I can" p. 353) was a significant predictor of discount rates. Other thought categories such as investment interest (e.g., "I could deposit the immediate reward in an interest earning account), future uncertainty (e.g., "I should take the money now because I don't know what the future holds"), and social norms (e.g., "Patience is a virtue") were not significant predictors of discount rates. Further evidence supporting the present bias description of delay discounting comes from the finding that many people prefer to pay off larger losses immediately rather than wait for a small discount (discounting of losses is discussed in more detail in the following section).

Furthermore, Benhabib, Bisin, and Schotter (2010) posited that the influence of the present bias has a small fixed effect on intertemporal choices. In other words, the immediacy of

a reward is worth a fixed amount, regardless of the magnitude of the rewards. Based on Benhabib et al.'s data, the present bias was estimated to be worth an average of four dollars. If the difference between an immediate and delayed reward is less than four dollars, decision makers will choose the immediate option. Alternatively, if the difference between the immediate and delayed reward is more than four dollars then decision makers will choose to accept the delay. Consumers who opt for conventional products over green products often exhibit behavior consistent with a present bias explanation of delay discounting (Hardisty et al., 2013). Conventional products provide an immediate reward in the form of a discounted initial price. According to the present bias account, consumers will opt for the green product if it confers a savings of more than four dollars. If the future savings associated with the green product are less than four dollars, then the preference for immediacy is worth more than the future savings and consumers will opt for the conventional product. However, these predictions have not been empirically tested in the domain of green purchase decisions.

**FRAMING AND MAGNITUDE EFFECTS FOR DELAY**

Thus far, only positive outcomes have been considered. However, many financial decisions are framed as losses. A framing effect occurs when behavior is altered by the presentation of the outcomes. Deciding between two gains produces different decisions than deciding between two losses. The savings linked with green products can also be framed as losses or gains. Promotional messages can be worded to highlight the savings (i.e., gains) associated with buying a green product or the cost (i.e., loss) associated with buying conventional products. Decision making scholars agree that preferences are not stable across time. Rather, preferences are constructed with each decision and are influenced by contextual

factors (for review see Lichtenstein & Slovic, 2006). It follows that the framing of promotional messages can influence purchase decisions.

Framing is a robust effect in decision making studies. Framing messages as losses or gains have asymmetric impacts on perceived value. According to prospect theory (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992), humans will take risks to avoid a loss but will not take those risks for additional gains. Tversky and Kahneman (1981) demonstrated the magnitude of this effect in their classic "Asian disease problem." Participants had to select between two treatment options for an unusual Asian disease that was expected to kill 600 people. One group of participants had to select between treatments in which (a) 200 people would be saved for sure and (b) a one-third probability of saving all 600 and a two-thirds probability of saving no one. In this condition, 72% of participants opted for treatment (a). The other group of participants had to select between treatments in which (c) 400 people would die for sure and (d) a one-third probability that no one would die and a two-thirds probability that all 600 people would die. In this condition, 78% of participants opted for treatment (d). Note that the outcome in option (a) is identical to option (c) and the outcome in option (b) is identical to option (d). Additionally, all four treatments had identical expected values. The critical difference between the two conditions was how the choices were framed. One group was deciding how many people to save (i.e., the gain frame) and the other group was deciding how many people to let die (i.e., the loss frame). Participants chose the certain option when choosing between gain scenarios but took risks when choosing between loss scenarios. They were risk averse for gains and risk seeking for losses.

Mathematical models of discount behavior predict that individuals prefer to delay losses (e.g., Kirby & Marakovic, 1995). Recall that participants in one study were indifferent between receiving an immediate $15 and $20 in one month (Thaler, 1981). In terms of losses, these same

participants *should* be indifferent between paying $15 immediately and $20 in one month. Closer examination reveals that choosing between $15 and $20 in one month has a mathematically equivalent outcome in both a loss and gain frame. In the gain scenario, the participant who opts for an immediate $15 is forgoing an additional $5 for the sake of receiving money immediately. In the loss scenario, the participant who opts to pay $20 in one month is forgoing an additional $5 for the sake of having money immediately. In other words, receiving $5 should be identical to not paying $5.

However, research has indicated that losses and gains are not discounted in a symmetric fashion (Estle et al., 2006; Kahneman & Tversky, 1979; Loewenstein & Prelec, 1992; Thaler, 1981; Tversky & Kahneman, 1992). In the discussion of gains, an increase in discounting refers to an increased preference to receive money immediately. For instance, someone who is indifferent between receiving $10 immediately and $20 in one month is displaying a steeper, or greater, discounting rate than someone indifferent to $15 immediately and $20 in one month. The person who is indifferent between an immediate $10 and delayed $20 is indicating that a one month delay discounts the value of $20 by $10. In contrast, the person indifferent between an immediate $15 and delayed $20 is only discounting the future value of $20 by $5. The effect of immediacy is stronger in the former case compared to the latter. When discussing losses, a higher discount rate refers to a stronger preference to delay payments. Someone indifferent between paying $10 now and $20 in one month is displaying greater discounting than someone indifferent between paying $15 now and $20 in one month. Discounting is greater for gains than for losses (Chapman, 1996; Estle et al., 2006; Loewenstein & Prelec, 1992; Shelley, 1994; Thaler, 1981). In other words, the preference for immediate gains is greater than the preference to delay losses. In Thaler's (1981) experiment, participants were indifferent between receiving

$15 immediately and $20 in one month. However, these participants were also indifferent between paying $15 immediately or $16 in three months. An immediate gain was worth more than a delayed loss.

Hardisty et al. (2013) found that present bias extends to losses as well. The need for closure drives people to resolve losses. Some participants were even found to show negative discounting. That is, these participants were willing to pay a premium for immediate closure. The majority of experimental designs in previous research did not allow for negative discounting. Models of discounting predict that people will sacrifice smaller immediate payments for larger later payments. Paying a larger earlier amount appeared to have two disadvantages: the payment is larger and earlier. Thus, most experiments did not include a decision between a larger sooner payment and a smaller later payment. When Hardisty et al. allowed for negative discounting they found that, on average, participants were indifferent between paying $10 immediately and $9.42 in one year. This finding in particular lends substantial support to the present bias explanation of discounting. People's need for closure superseded any potential economic benefits.

The present bias is able to explain the asymmetry between gains and losses because present bias would enhance discounting for gains and mitigate discounting for losses. In the gain frame, high discounting refers to a strong preference for immediacy. In the loss frame, high discounting refers to a strong preference for delay. Present bias, the need to receive or pay immediately, works in opposite directions in each frame.

Another factor which impacts discount rates is magnitude. Discount rates decrease as the size of the reward increases. This change in rate can be illustrated in two equivalent ways: (a) people are more willing to wait for large rewards than small rewards; or (b) in order to opt for a

delayed reward, the ratio of delayed reward to immediate reward is higher for smaller rewards than larger rewards. Numerous studies support this conclusion (Chapman, 1996; Chapman & Winquist, 1998; Estle et al., 2006; Kirby & Marakovic, 1996; Loewenstein & Prelec, 1992; Thaler, 1981). In one representative study, Kirby and Marakovic (1996) had participants choose between immediate and delayed rewards of differing amounts. They found that, on average, participants were indifferent between $15 immediately and $30 in 2.5 months while also indifferent between $42.50 immediately and $85 in 7 months. The smaller reward was discounted by one-half in 2.5 months, but the larger reward was discounted by one-half in 7 months; the discount rate is steeper for the smaller reward. If discount rates were independent of magnitude then both amounts would lose half of their value after an equivalent delay (e.g., participants would be indifferent between $42.50 immediately and $85 in 2.5 months).

Framing effects interact with the magnitude of outcomes. Large gains are discounted less than small gains, but large losses are discounted more than small losses (Estle et al., 2006; Hardisty et al., 2013). That is, people will wait for large gains and prefer to receive small gains immediately, but would rather pay off small losses immediately and postpone large losses. These findings follow the predictions of the fixed cost present bias account of delay discounting (Benhabib et al., 2010; Hardisty et al., 2013). If the present bias is worth four dollars then the present bias is more influential for small gains and losses than large gains and losses.

## DELAY DISCOUNTING AND GREEN PRODUCTS

Many studies cited thus far have applied delay discounting principles to simple monetary decisions. However, the effects have been demonstrated in other domains. For example, researchers have studied the impacts of delay discounting on specific populations such as cigarette smokers (Reynolds, Richards, Horn, & Karraker, 2004), alcoholics (Petry, 2001),

pathological gamblers (Dixon, Marley, & Jacobs, 2003), cocaine users (Heil, Johnson, Higgins, & Bickel, 2006) and credit card users (Meier & Sprenger, 2010). Other studies have focused on specific outcomes such as health decisions (Chapman, 1998), tipping behavior (Chapman & Winquist, 1998), vacation alternatives (Foxall, Doyle, Yani-de-Soriano, & Wells, 2011), food (Estle, Green, Myerson, & Holt, 2007; Odum & Rainaud, 2003), and consumer goods (Kirby & Herrnstein, 1995).

The application of delay discounting to green purchase decisions has thus far not been examined, although one study by Hardisty and Weber (2009) did examine delay discounting of environmental outcomes. In this study, participants chose between smaller, sooner improvements in air quality or larger, later improvements. Similar to studies with monetary outcomes, delayed environmental benefits were discounted. The financial incentives of buying green consumer products have not been empirically studied through a discounting framework.

Some green products and their conventional counterparts can be conceptualized as smaller sooner rewards and larger later rewards. Note that the proposed study is limited in scope to green products which have a higher initial cost but lower operating cost compared to conventional products. In turn, green products produce savings over time. The conventional product provides immediate rewards (lower initial cost) and the green product provides a larger reward but only after some delay. Furthermore, the messages used to promote green products can be framed as gains by focusing on the financial incentives of green products (e.g., "Save money over time by going green") or as losses by focusing on the higher operating cost of conventional products (e.g., "Pay higher utility bills with conventional products"). By incorporating knowledge of delay discounting, coupled with framing and magnitude effects, predictions can be made about how to best promote the adoption of green products.

If magnitude is divided into two groups (low vs. high), then the interaction between magnitude and framing (loss vs. gain) produces four possible promotional messages: the gain frame for low magnitude products, the loss frame for low magnitude products, the gain frame for high magnitude products, and the loss frame for high magnitude products. The research on the framing and magnitude interaction found that people will wait for large gains and prefer to receive small gains immediately, but would rather pay off small losses immediately and postpone large losses (Estle, et al., 2006; Hardisty et al., 2013). Therefore, for low magnitude products (e.g., light bulbs), a loss frame promotes the purchase of green products. For small losses, people prefer to make payments immediately. Thus, a green product of low magnitude will represent a small initial loss (i.e., a slightly higher initial cost) and consumers will opt to pay that immediately. The gain frame for low magnitude products will promote the purchase of a conventional product. Small gains are preferred immediately, so the savings associated with a conventional product's initial cost will be preferred. For high magnitude products (e.g., water heaters), the loss frame promotes the purchase of conventional products. People prefer to postpone large losses, and the expense associated with conventional products is not incurred until after a delay. The gain frame for high magnitude products promotes the purchase of green products. People are willing to wait for large gains, and the savings of going green are recouped after a delay. A summary of these decisions can be found in Figure 1. Note that this figure only refers to the effects of frame and magnitude in intertemporal choices. Other components will be added to this figure in further sections.

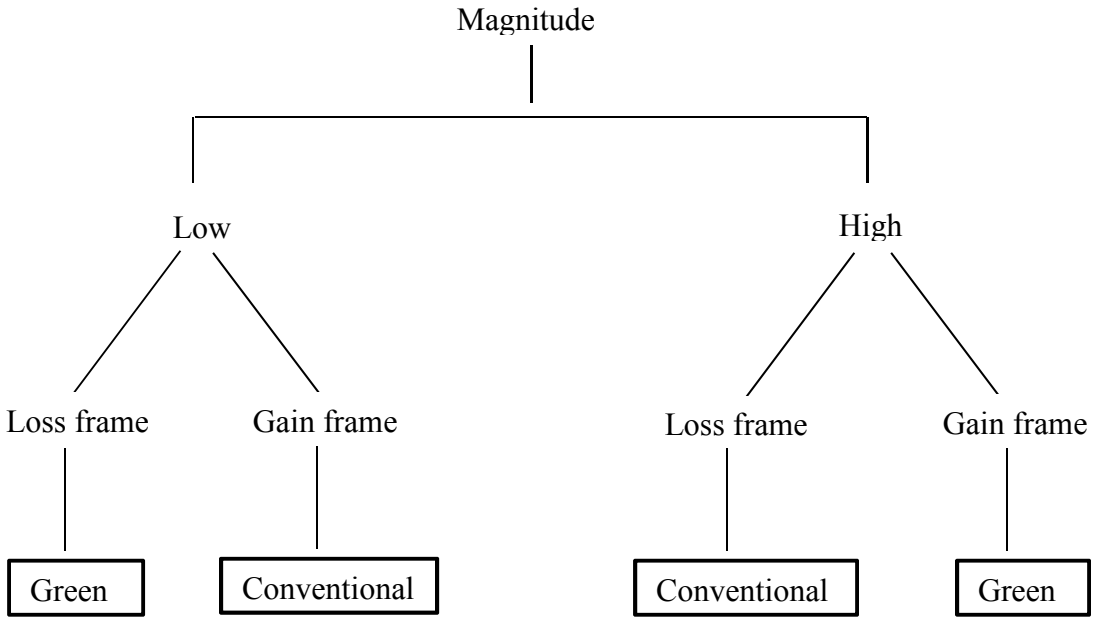


*Figure 1*. Predicted product decisions based on the framing of promotional messages (loss vs. gain) and magnitude of product cost (low vs. high). The last line represents the consumer decision to opt for a green product or a conventional product.

# CHAPTER III

## PROBABILISTIC DISCOUNTING

Another factor with the potential to influence green consumerism is probability. The savings that result from buying green products are not guaranteed. For example, the financial benefits of driving a hybrid vehicle are partially dependent upon the number of miles driven and maintenance costs. Even if consumers are aware of the reduced life cycle costs of green products, a degree of uncertainty is still present. Note that probabilistic choices refer to any situation in which individuals are choosing between multiple options with varying degrees of certainty. Although occasionally used interchangeably, the terms "risk" and "uncertainty" have distinct meanings. Risk refers to situations in which the probability of an outcome is known/given. Uncertainty refers to outcomes in which the probability is unknown (Tversky & Fox, 1995).

In a similar way that immediate options are preferred to delayed options, certain options are preferred to uncertain options when considering probabilistic choices. Kahneman and Tversky (1979) found that 80% of participants preferred a certain $3000 over a gamble for $4000 with an 80% success rate, even though the gamble represents a higher expected value. Additionally, discounting increases as uncertainty increases (Green & Myerson, 2004). For example, Ohmura, Takahashi, Kitamura, and Wehr (2006) reported that participants were indifferent between approximately 70,000 yen and a 90% chance of winning 100,000 yen. When the probability of winning 100,000 yen decreased to 70%, participants were willing to accept only 50,000 yen.

Probabilistic and delay discounting can both be modeled by similar mathematical functions (Green & Myerson, 2004). These similarities have led many scholars to propose that

delay and probabilistic discounting are the same process. Some have argued that probabilistic discounting is a product of delay discounting. Rachlin, Raineri, and Cross (1991) postulated that probabilistic choices are perceived as a series of gambles. In order to earn the payoff from an uncertain gamble, that gamble would have to be played repeatedly. For example, consider two separate gambles with different odds. One gamble has 9 to 1 odds while the other gamble has 19 to 1 odds. If individuals were to play each of these games repeatedly, the expected number of gambles before a win is higher in the case of a gamble with 19 to 1 odds. Because each successive gamble takes time, and one gamble is expected to pay off sooner than the other, the differences in probability translate to a difference in delay. Rachlin and colleagues (1991) argued that these differences in delay are truly the driving force behind probabilistic discounting and that the two phenomena are part of the same process.

Others have suggested that uncertainty is the essential underlying factor. Having to wait for a payoff increases the chances that unforeseen variables interfere with the payoff (Keren & Roelofsma, 1995). According to this view, the effects of delay are being driven by the inherent uncertainty that is associated with delay. Weber and Chapman (2005) found that, under certain circumstances, the effects of delay and uncertainty are interchangeable: the effect of immediacy is mitigated by added uncertainty and the effect of certainty is mitigated by added delay. These findings support an equivalence of probability and delay, but are not able to suggest one of these variables as the primary underlying mechanism.

Although the theories purporting an equivalence between delay and probability are intuitively appealing, there is little consensus regarding the equality of the two phenomena (Green & Myerson, 2004). Many studies have shown that framing and magnitude effects (discussed in the next section) impact the delay and probabilistic discounting functions in

separate ways (e.g., Chapman & Weber, 2006; Estle, Green, Myerson, & Holt, 2006; Shead & Hodgins, 2009). Furthermore, fMRI studies have implicated separate neural pathways when considering delayed versus probabilistic choices (Luhmann, Chun, Yi, Lee, & Wang, 2008; Weber & Huettel, 2008).

**FRAMING AND MAGNITUDE EFFECTS FOR PROBABILITY**

Probabilistic choices can also be framed in terms of gains or losses (e.g., a certain $100 loss versus a 90% chance of a $110 loss and 10% chance of no loss) and are subject to the effects of magnitude. Unlike delay discounting, magnitude effects for probabilistic discounting have only been revealed in the gain frame; magnitude effects were tested in the loss frame but no effect was observed. Studies have shown that large gains are discounted more than small gains (Estle et al., 2006; Mitchell & Wilson, 2010; Shead & Hodgins, 2009). People prefer certain gains when payoffs are large, but are willing to take risks when payoffs are smaller. These same studies have also observed a main effect of frame, with losses discounted more than gains. In sum, probabilistic losses are discounted more than probabilistic gains; large magnitudes are discounted more than small magnitudes but only in the gain frame.

# CHAPTER IV

## COMBINED EFFECT OF DELAY AND UNCERTAINTY

Purchases of green products involve the simultaneous consideration of delay and uncertainty. The savings associated with buying green products are recouped over time and the reward is not certain. Many studies have tested these discounting phenomena separately, yet comparatively few studies have examined decisions with concurrent delay and probabilistic elements. In a recent study, Vanderveldt, Green, and Myerson (2015) systematically varied five levels of probabilistic outcomes across five delays and two magnitudes. Results from this study indicated that delay and uncertainty combine multiplicatively. Probabilistic discounting was steeper when delays were short rather than long, and the effect of delay was stronger when probabilities of receiving a reward were high rather than low. In other words, as outcomes approach certainty, the relative weight of delay discounting increases. As outcomes approach immediacy, the relative weight of uncertainty increases. For certain outcomes, the choice reduces to a delay discounting task. Conversely, for immediate outcomes, the choice reduces to a probabilistic discounting task.

The majority of studies examining probabilistic discounting manipulate the level of risk for a given outcome (e.g., Estle et al., 2006; Vanderveldt et al., 2015). Probabilities of success are explicitly stated and participants must assume that these risk levels are accurate. Consumer choices are rarely based on explicit levels of risk. Rather, the uncertainty associated with possible outcomes is assumed to be imposed by the decision maker. For example, if a green product promises to save the consumer money over time, there is a degree of uncertainty concerning the likelihood that these savings will be realized. Consumers must apply their own probability estimates in purchase decisions.

## DELAY AND PROBABILITY FOR GREEN PRODUCTS

Although recent work has shed light on the interaction between delay and probabilistic discounting (Vanderveldt et al., 2015), the proposed model posits that the uncertainty associated with green purchases is largely irrelevant and delay is the only important factor. This argument is based on two critical factors: controllability and unrealistic optimism (see Figure 2). The long-term savings associated with many green products is partially the result of consumer interaction with these products. For example, hybrid or electric automobiles can save consumers money by reducing cost spent on gas. However, estimated savings are also dependent upon how a consumer uses that product (e.g., hybrid vehicles will not be cost effective if the driver decides to drive more frequently after purchasing the vehicle). Research has indicated that perceived control mitigated the uncertainty associated with future losses (Carroll, Sweeny, & Shepperd, 2006; Gilovich, Kerr, & Medvec, 1993; Highhouse, Mohammed, & Hoffman, 2002). Consumers' perceptions of future monetary outcomes are related to their perceived control over energy usage. Because consumers have control over their energy usage, outcomes become more certain.

Furthermore, people are generally overconfident in their abilities. A classic study by Svenson (1981), for example, found that nearly 90% of people in a group estimated that their driving ability was higher than the median driving ability in the group. When individuals estimate risk their assessments are more favorable for themselves than objective estimates or estimates for peers (for review see Shepperd, Klein, Waters, & Weinstein, 2013; Weinstein, 1980). Additionally, people believe that negative events are more likely to happen to others than to themselves and this effect is enhanced by perceived control (Klein & Helweg-Larsen, 2002).

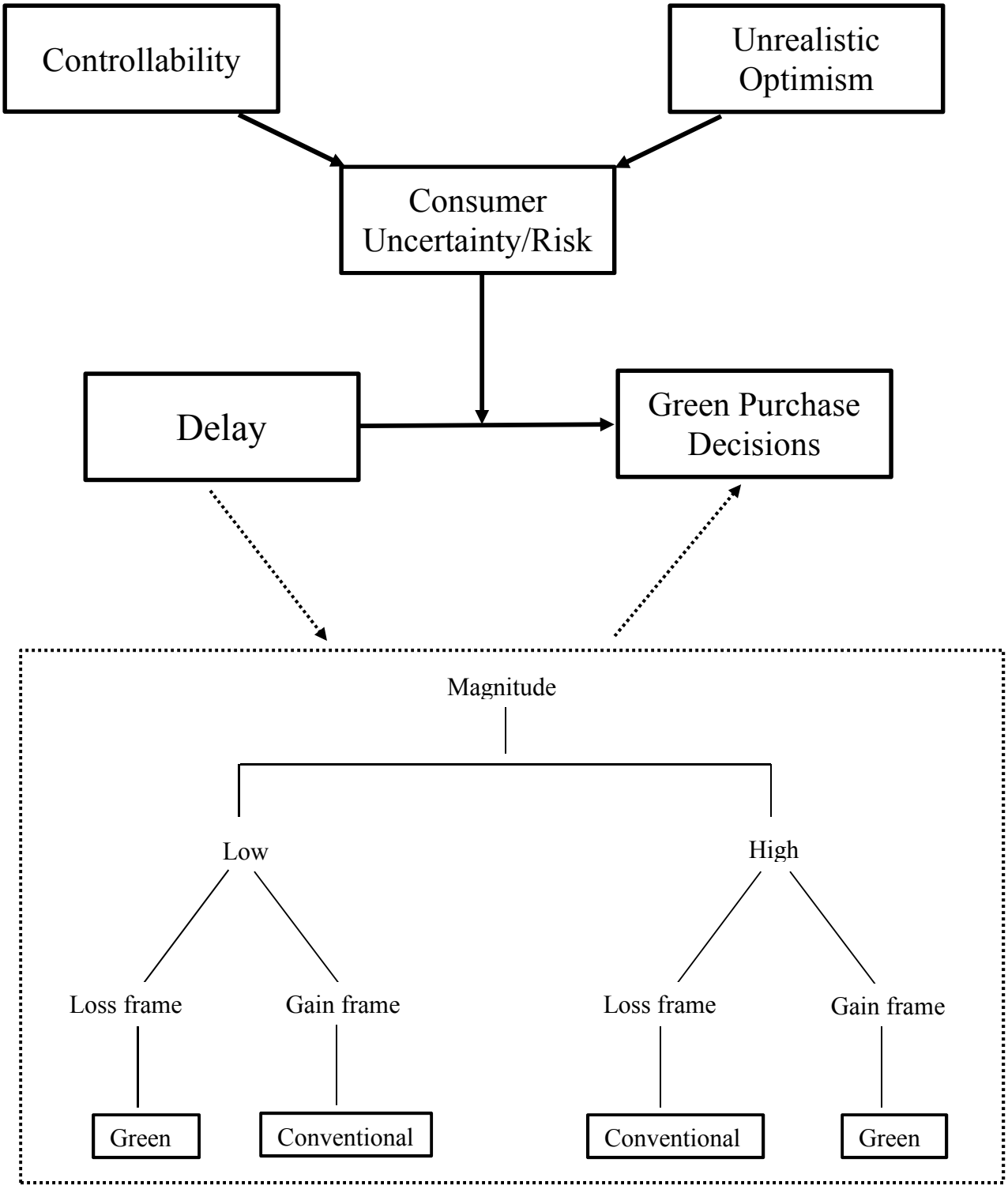


*Figure 2*. Proposed model of green purchase decisions. Controllability and unrealistic optimism reduce the effect of uncertainty. Purchase decisions are ultimately a delay discounting task. The outcomes of delay discounting are presented in the inset.

In sum, risks associated with green products are not explicitly stated. Because consumers construe their own level of uncertainty, their perceptions are subject to individual biases. The perceived control over the outcome, along with a propensity for unrealistic optimism are predicted to mitigate perceived uncertainty. When uncertainty is minimized, the interaction between probabilistic and delay discounting is reduced to a simple delay discounting task (Vandervedlt et al., 2015). Therefore, product messages should focus on the effects of delay discounting.

# CHAPTER V

## HYPOTHESES

Based on evidence from delay and probabilistic discounting, a number of predictions were made regarding the purchase of green products (see Figure 2). Specific hypotheses follow.

$H_1$: *a) When probability is high, the message frame and magnitude of the product's cost will interact. Specifically, when the magnitude is low (inexpensive), the purchase of the green product will be more likely in the loss frame than the gain frame.*

*b) When the magnitude is high (expensive), the purchase of the green product will be more likely in the gain frame than the loss frame.*

$H_2$: *a) When probability is low, the purchase of the green product will be more likely in the loss frame than the gain frame.*

*b) When probability is low, the purchase of the green product will be more likely in the low magnitude gain condition than the high magnitude gain condition.*

When taken together, hypotheses 1 and 2 can be summarized as a three-way interaction. The interaction between frame and magnitude will vary across levels of probability. Specifically, it was hypothesized that when probability was high and the products were relatively expensive, more participants would prefer the green product in the gain frame than the loss frame. Additionally, when probability was high and products were relatively inexpensive, more participants would prefer the green product in the loss frame than the gain frame. High probabilities approach certainty. Based on Vanderveldt at al.'s (2015) study, effects of probability are reduced as probabilities approach 100%. Therefore, all the predictions in the high probability conditions are based on the impact of frame and magnitude in delay discounting.

When probability was low the loss frame was expected to elicit the selection of the green product across magnitudes. Participants would opt for the conventional product in the gain frame, but the effect would be stronger at higher magnitudes.

*$H_3$: When probability levels are not explicitly stated, participants will have high confidence in their ability to save money.*

*$H_4$: Results of Experiment 2 will mimic the high probability conditions of Experiment 1. In other words, hypotheses 1a and 1b should apply to Experiment 2.*

These effects were empirically tested in two experiments. Hypotheses 1 and 2 were tested in Experiment 1. In Experiment 1, participants chose between a conventional product (low initial cost, high operating cost) and green product (high initial cost, low operating cost). The future outcomes were framed as losses (i.e., increased operating cost of the conventional product) or gains (i.e., reduced operating costs of the green product). Participants were also given the probability that the promoted outcomes would occur.

Hypotheses 3 and 4 were tested in Experiment 2. Probability estimates were not provided in Experiment 2. Rather, participants provided their own perceived probability that the future outcomes would occur. All other conditions were identical to Experiment 1. Both experiments were necessary to fully test the interaction between delay and probability. Probability is expected to play a role in these types of decisions; however, in this particular context, the effect of probability is expected to be minimal. Probabilities of savings or losses are not generally provided to consumers, so Experiment 2 is more reflective of real scenarios. However, a situation in which an individual evaluates the probability of an outcome and finds the probability to be high should have an outcome that is identical to a situation in which an individual *does not* evaluate probability. In other words, the behavioral response from a person

who does not evaluate uncertainty is indistinguishable from a person who evaluates uncertainty and finds none (i.e., an event is 100% probable). Experiment 1 attempted to show that consumers do incorporate probabilities into their decisions while Experiment 2 attempted to show that these probability evaluations were consistently high.

As noted above, risk and uncertainty have distinct meanings in the decision making literature. Following these conventions, Experiment 1 is an assessment of risk (probabilities are known) and Experiment 2 is an assessment of uncertainty (probabilities are unknown). Other fields (e.g., actuarial science) identify risk as a function of probability and magnitude. Because magnitude was also manipulated in this study, "risk" was not a proper term for a single variable. Therefore, the term probability is used to describe the percentage of time that an event occurs. In Experiment 1, probabilities are manipulated. In Experiment 2, participants' subjective rating of probability is referred to as confidence.

# CHAPTER VI

# METHOD: EXPERIMENT 1

## PARTICIPANTS

Relatively little work has investigated a priori sample size estimation for logistic regression models (hypothesis tests in the current study are conducted via logistic regression), especially for experimental designs (Hosmer & Lemeshow, 2000). However, some rules of thumb have been proposed for appropriate model fit. According to Peduzzi, Concato, Kemper, Holford, and Feinstein (1996), the minimum number of events in a dichotomous outcome variable must be at least 10 times the number of parameters in the model. In the current study, the outcome variable of interest was the selection of the green product or conventional product. The parameters in the model for Hypotheses 1 and 2 included three main effects (i.e., magnitude, risk, and frame), three two-way interactions (i.e., all possible two-way interactions), and one three-way interaction (i.e., magnitude x risk x frame). In order to test these seven parameters, at least 70 participants must select the least frequent outcome option (i.e., green product or conventional product).

Survey results (GfK, 2012) indicated that the preference for conventional products was slightly greater than the preference for green products. Additionally, some of the conditions in the current study were predicted to increase the preference for green products while other conditions are predicted to increase the preference for conventional products. Therefore, it was assumed that the overall selection of green and conventional products, collapsing across conditions, would be nearly equal. If the number of green and conventional product selections were equal then the minimum required sample size would be 140 participants (i.e., 70 instances of a green product selection and 70 instances of a conventional product selection; Peduzzi et al.,

1996). To allow for flexibility in the outcome variable, 200 participants were recruited for Experiment 1.

Participants were recruited using Amazon's crowdsourcing tool, Mechanical Turk (MTurk). MTurk workers are paid small sums to perform Human Intelligence Tasks (HIT). Each HIT is posted on the MTurk website and workers must choose to participate. Upon completion of the task, experimenters may choose to manually or automatically pay workers for their time. Studies have indicated that samples of participants using MTurk are more representative of the US population than convenience samples collected with university undergraduates (Berinsky, 2012). Additionally, a college student sample was reasoned to be detrimental to generalizability. The experimental task involved the hypothetical purchase of household goods. Many college students were presumed to have little experience purchasing water heaters or light bulbs. Results from a college student sample would not appropriately reflect the purchase decisions of actual consumers.

Within one day of posting the HIT online, 219 MTurk workers had participated in the experiment. The average age of participants was 37.19 years ($SD$ = 12.04). Participants were closely split between females (54%) and males and the majority of participants identified their racial/ethnic category as White/Caucasian (76%). Just under half (48%) of participants had attained at least a Bachelor's degree and the median annual income range was $40,000 - $49,999. Finally, most (57%) participants were either home owners or lived in a home that was owned by another member of the household (Table 1). All participants who successfully completed the study were compensated $0.25 for their time.

Table 1

*Participant Demographics*

| | Experiment 1 | Experiment 2 |
|---|---|---|
| | *N* | *n* |
| Gender | | |
| *Female* | 111 | 122 |
| *Male* | 91 | 90 |
| *Prefer not to answer* | 2 | 0 |
| Race/Ethnicity | | |
| *White* | 165 | 158 |
| *Hispanic* | 10 | 11 |
| *Black* | 25 | 25 |
| *Asian* | 10 | 26 |
| *American Indian/Alaska Native* | 6 | 3 |
| *Middle Eastern/North African* | 1 | 1 |
| Housing Status | | |
| *Own* | 116 | 122 |
| *Rent* | 80 | 87 |
| *Occupied without rent* | 7 | 5 |
| Education | | |
| *Did not finish high school* | 2 | 1 |
| *High school diploma* | 22 | 23 |
| *Some college* | 59 | 60 |
| *Associate's degree* | 23 | 19 |
| *Bachelor's degree* | 68 | 66 |
| *Some graduate school* | 5 | 3 |
| *Master's degree* | 20 | 33 |
| *Professional degree (e.g., MD, JD)* | 2 | 3 |
| *Doctorate* | 3 | 7 |

## MATERIALS

**PRODUCT CHOICE.** The primary experimental task required participants to choose between a green product and its conventional counterpart. Participants were first given the following instructions:

> Thank you for agreeing to participate. On the next screen you will be shown information about two products. Please read all of the information--including the fine print. The purchase price will be displayed below each product and information about energy costs will be displayed above one of the products. You will be required to answer a few questions about these products. Please read carefully. You will not be allowed to continue if you answer incorrectly.

After reading the instructions, participants advanced to the next page of the online instrument which displayed two products followed by three comprehension questions. The product information included a brief description, purchase price, estimates of energy costs, and images of each product (Figure 3). The size of each image was 500 x 500 pixels.

(a)


*Figure 3*. Product choice options in Experiment 1. (a) Product choices in the low probability, low magnitude, gain condition. (b) Product choices in the high probability, high magnitude, loss condition.

(b)

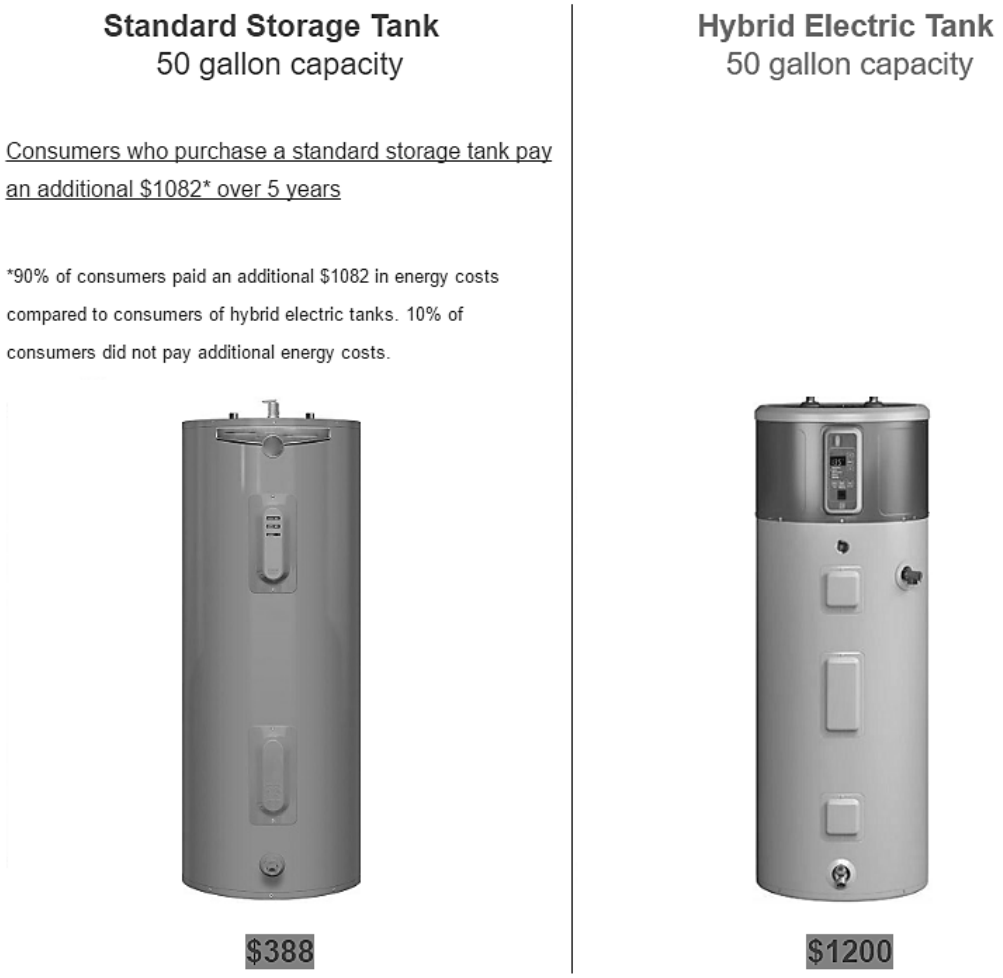


*Figure 3 Continued.*

Comprehension questions were included to ensure that participants were reading the product information. The current experiment's manipulation depended upon the participants comprehending the given information. Participants answered multiple choice questions about

the price of the conventional product (e.g., How much money does it cost to purchase the CFL bulb?), the price of the green product (e.g., How much money does it cost to purchase the LED bulb?), and a true or false question about the probability of future energy costs (e.g., The MAJORITY of consumers who purchased the standard water heater paid higher energy costs over 5 years.). Participants were required to answer all three questions correctly before advancing to the next page and were allowed unlimited attempts to pass.

The product information displayed to participants varied across three dimensions: magnitude, frame, and probability. Magnitude was represented by two classes of products. Light bulbs represented low magnitude and water heaters represented high magnitude. In the low magnitude condition, participants chose between a compact fluorescent light bulb (CFL) and a light-emitting diode bulb (LED). LED bulbs generally have a higher initial cost but lower operating costs. In the low magnitude conditions the CFL was presented with an initial cost of $2.10 and the LED bulb with an initial cost of $3.99. The LED bulb was estimated to save consumers $3.05 over five years. In the high magnitude conditions, participants chose between a water heater with a standard storage tank and a water heater with a hybrid electric tank. The standard storage tank water heater had an initial cost of $388.00 while the hybrid electric water heater had an initial cost of $1200.00. The hybrid electric tank water heater was estimated to save consumers $1082.00 over five years. All initial and operating costs are based on actual costs from online retailers and Energy Star (www.energystar.gov) savings estimates.

For both magnitude conditions, the competing products were positioned as being interchangeable. Each light bulb was a 60 watt equivalent and both water heaters had a 50 gallon capacity. No additional information was provided about performance outside of the estimated

energy costs. Additionally, logos and brand names were digitally removed from the products' images to prevent brand recognition from influencing results.

Information about energy costs was framed as either a loss or a gain. The higher energy costs of the conventional product were highlighted in the loss condition (i.e., consumers would pay higher energy bills when purchasing the conventional product) and the lower energy costs of the green product were highlighted in the gain condition. This information was positioned above the corresponding product. In other words, messages in the loss frame were displayed near the conventional product and messages in the gain frame were displayed near the green product.

Product messages also differed according to the probability of losses or gains. Each of the savings or loss estimates was qualified with a probability of success. The advertised differences in energy costs were said to be true for 90% of consumers or 10% of consumers. For example, in the low probability condition participants were told the following: "10% of consumers saved $3.05 in energy costs compared to consumers of CFLs. 90% of consumers did not save on energy costs." Note that this example comes from the low magnitude (i.e., light bulbs rather than water heaters) gain condition (i.e., the message focused on potential savings rather than additional costs). An example of a high probability message changes the order of the probability estimates: "90% of consumers saved $3.05 in energy costs compared to consumers of CFLs. 10% of consumers did not save on energy costs." In the loss conditions the messages referred to the probability of paying additional energy costs (e.g., "10% of consumers paid an additional $3.05 in energy costs compared to consumers of LEDs. 90% of consumers did not pay additional energy costs."). The difference between high probability and low probability was determined in reference to the probability of selecting the green product. For example, a 90% probability of saving money by purchasing a green product was equivalent to a 90% chance of

losing money by purchasing the conventional product. All else being equal, the high probability condition favored the green product while the low probability condition favored the conventional product. Probability estimates were displayed as a footnote (i.e., "fine print") directly beneath the estimate of the total saving or loss. A small group of graduate students piloted early versions of the survey. The phrasing used throughout the final version incorporated this early feedback to improve clarity of instructions and product messages.

Two sample conditions are displayed in Figure 3a,b. These samples comprise two of eight possible conditions. The conditions in Figure 3 provide examples from each of the two levels of magnitude, frame, and probability. All possible combinations of these three variables were used in the experiment. Product choice was measured by the participants' initial selection. After correctly answering the comprehension questions, participants were shown the following instructions: "Imagine that you must purchase one of the two products just shown. Which one would you buy? Press NEXT to make your selection. You will have a chance to review the products' details before deciding." These instructions were presented on their own page. After advancing to the next page the product information was displayed once again and participants had to fill a radio button with their desired purchase.

**DISCOUNT RATE.** To determine each participant's discount rate, product choices were made six times, including the initial selection. After the initial purchase decision, the initial cost of the conventional product changed. The instructions for this section are presented below. Note that these instructions are taken from the low magnitude condition. Instructions for the high magnitude condition replaced "CFL" with "standard storage tank."

> On the following pages you will be asked to decide between these products once again. However, <u>the price of the CFL has changed.</u> All of the other information will

remain the same.

You will decide between these products 5 more times. The price of the CFL will change each time. Try not to be influenced by your previous choices. Only consider the available information when making your decisions. In other words, treat each decision like you were seeing the products for the first time.

The price of the conventional product on each iteration of this task changed according to the participant's previous selection. The goal of this procedure was to determine the participant's indifference point—the price at which the participant would be equally satisfied with either product. If the participant chose the green product then the cost of the conventional product reduced by one-half, making the conventional product more appealing. If the participant selected the conventional product then the cost of the conventional product increased by one-half of the difference between the green and conventional product. Table 2 displays the choices from a sample participant over all six iterations.

Table 2

*Sample Data Determining One Participant's Indifference Point*

| Trial | Conventional ($) | Green ($) |
|---|---|---|
| 1 | 388* | 1200 |
| 2 | 794 | 1200* |
| 3 | 591* | 1200 |
| 4 | 692.50* | 1200 |
| 5 | 743.25 | 1200* |
| 6 | 717.88 | 1200* |

*Note*. * indicates participant's choice on individual trial. Immediate rewards were adjusted after each selection.

The participant chose the conventional product ($388) on the first trial so on the second trial the initial cost of the conventional product was increased to $794 (halfway between $388 and $1200). On trial two the participant opted for the green product. The initial cost of the conventional product was decreased to the midway point between $388 and $794. The participant had indicated a preference for the conventional product at $388 (trial 1) and a preference for a green product when the conventional product was $794 (trial 2). At this point the participant had provided a temporary upper and lower bound (i.e., any conventional product priced $388 or less would be preferred over the green product and any conventional product priced at $794 or more would lead to a preference for the green product). Nothing is known about preferences when conventional product in between $388 and $794. The degree of uncertainty between the upper and lower bound is halved after the choice on trial 3 and each successive trial after.

The indifference point was calculated after the sixth trial. Based on the sixth selection, the indifference point was determined by what would have been the price of the conventional product on the seventh trial. For example, the participant in Table 2 chose the green product in the sixth trial, indicating that the new upper bound was $717.88 (i.e., the green product would be chosen any time the conventional product was $717.88 or higher). The last selection for the conventional product was on trial 4 ($692.50). Therefore, the indifference point for this participant was $705.19 (halfway between $692.50 and $717.88). This procedure could theoretically be repeated indefinitely. Each trial increases the precision of the indifference point. Only six trials were used in the current study to reduce participant fatigue and because six trials provided variability among participants without losing meaningful differences between prices. Calculating the indifference point down to the nearest dollar or cent would require having

participants choose between green and conventional products which were nearly identical in price (e.g., a trial with a $700 conventional product followed by a trial with a $701 conventional product). This added precision was not reasoned to be worth the possible participant fatigue; further, participants' decisions and this level of detail were not expected to be reliable.

To determine the degree of discounting, Myerson, Green, and Warusawitharana's (2001) area under the curve method was employed. The area under the curve was calculated by first converting the indifference point to a proportion of the future outcome. For example, the indifference point in Table 2 was $705.19. To convert this value to the more familiar terms used in previous studies, this indifference point was first subtracted from $1200, the initial cost of the green product. Then, the immediate savings of the conventional product ($494.81) could be compared to the future savings of the green product. The immediate value of the conventional product was plotted on the y-axis as a proportion of the future value (494.81 / 1082 = 0.46). The value on the x-axis was the proportion of the maximum delay. In the current study, only one delay was given. Therefore, the value on the x-axis was one. With zero delay (x = 0) there is also zero discounting, so the first point on the graph is (0, 1). Plotting a line from (0, 1) to (1, 0.46) creates a trapezoid. The area of this trapezoid, $(x_2 - x_1)\ ((y_1 + y_2) / 2)$, provides an indication of the degree of discounting. Lower values are indicative of greater discounting.

The area under the curve method provides a theoretically-neutral estimate of discounting. In other words, area under the curve will be the same regardless of the underlying discounting function (e.g., exponential or hyperbolic). In studies with multiple delays, this method can be extended by adding successive trapezoids. For example, if participants were asked to evaluate products with advertised savings in one and five years, then trapezoids could be created by plotting indifference points at each time point. Area under the curve from time

zero to one year would be added to the area from one year to five years. Because the current study only assessed one value of delay, only one indifference point was plotted for each participant. Additionally, the method described above is specific to the gain condition, but the area under the curve can be applied to losses as well. For losses, the indifference point was not subtracted from the cost of the green product. The loss condition compared an immediate payment to a future payment. If the participant in Table 2 was in the loss condition then the value of $705.19, rather than $494.81, would have been used to calculate the area under the curve.

**ENVIRONMENTAL ATTITUDES.** Environmental attitudes were not included in any specific hypotheses. The consumer survey which motivated the current study (GfK, 2012) found that, in general, attitudes were not related to purchasing habits; the majority of consumers preferred green products yet were hesitant to pay a premium for these products. The price of the product appeared to be a bigger motivator of purchase decisions than attitudes. Furthermore, the current study employed random assignment which is likely to distribute a range of environmental attitudes across conditions. Finally, because of the applied focus of this study, the main variables of interest were limited to those which could be directly manipulated by marketers.

Although not a part of any a priori hypotheses, a measure of environmental attitudes was collected for exploratory purposes and for the possibility of additional explanatory power (i.e., to determine if the primary manipulations explained purchase behavior above and beyond the effect of environmental attitudes). Environmental attitudes were assessed via the New Ecological Paradigm scale (NEP; Dunlap, Van Liere, Mertig, & Jones, 2000). The NEP is a 15-item scale designed to measure the endorsement of an ecological worldview. According to Dunlap et al. (2000), “the NEP items primarily tap ‘primitive beliefs’ about the nature of the earth and

humanity's relationship with it" (p. 427). The NEP, which is an updated version of the New Environmental Paradigm (Dunlap & Van Liere, 1978), has shown evidence of predictive and construct validity (e.g., a significant correlation ($r$ = .57) with support for pro-environmental policies) as well as internal consistency ($\alpha$ = .83; Dunlap et al., 2000).

Participants rated their level of agreement from 1 (*strongly disagree*) to 5 (*strongly agree*) for 15 statements (e.g., Humans are severely abusing the environment). Even numbered items were worded negatively (e.g., Humans have the right to modify the natural environment to suit their needs) and were reverse-scored. Participants' NEP scores were summed across all 15 statements. Results from study 1 indicated a Cronbach's alpha of .869. Item-total correlations ranged from .343 to .686 and removal of any single item reduced reliability.

Two additional items were added to the NEP scale. One item directed participants to select mildly agree while another item directed participants to select mildly disagree. Incorrect responses to these items indicated careless responding. The 15 items of the NEP scale as well as the two attention check items were presented in the same order to all participants.

**DEMOGRAPHICS.** Participants also answered demographic questions including age, gender, race/ethnicity/origin, housing status, income, and education. Age was an open response question and gender was multiple choice among *male*, *female*, and *prefer not to answer*. The question of race/ethnicity/origin was based on the proposed changes to the 2020 United States census (Cohn, 2015). Rather than dividing race and ethnicity into two questions, participants were asked, "Which categories best describe you? You may select more than one group." Seven categories were presented as well as an open response "other" category. Question phrasing and response categories for housing status ("Which of the following describes your place of residence?"), income ("What was your total household income for the past 12 months?"), and

education ("What is the highest degree or level of school that you have completed?") were all modeled on the American Community Survey (U.S. Census Bureau, 2016). Income response categories ranged from *less than $10,000* to *$200,000 or more*. Response categories for housing status and education can be seen in Table 1. The entire instrument was developed and administered via the Qualtrics survey management system.

**PROCEDURE**

The experiment was posted along with other available HITs on MTurk's job board. Prospective participants could read a brief summary of the task as well as the estimated completion time and payment. If an MTurk worker wished to participate, they would accept the HIT. By accepting the HIT, participants were given a link to the survey instrument as well as a place to enter a completion code. Clicking the link opened the instrument in a new tab.

Participants first read a notification statement outlining the nature of the task, assurance of anonymity, payment information, and research contact information. If they wished to proceed they entered their MTurk identification number and advanced to the next page. The MTurk identification number is a unique code assigned to each worker. This number allows workers to identify participants while retaining participant anonymity. The next page of the survey included product information and comprehension questions. Correctly answering all three comprehension questions advanced participants to the product choice page. After making six product choices, participants responded to the NEP and demographic items.

The last page included debriefing as well as a completion code. The completion code was a randomly generated four digit code that was unique to each participant. These completion codes were saved along with participant data. Participants were instructed to return to the MTurk window in their web browser and enter the completion code in the space provided. At

this point the participants could close the survey and submit the HIT via MTurk. The average completion time was just over six minutes ($M$ = 363.23 s, $SD$ = 163.63 s) and times ranged from 143 to 2448 s.

Adding a unique completion code to the end of the survey allows researchers to identify which participants made it through the entire instrument. Otherwise, participants could submit the HIT without providing any data and would be paid without doing any work. Payment was administered by matching the completion codes in the saved data with the completion codes entered on MTurk. If a participant entered a code that matched one of the randomly generated completion codes then that participant was paid. Payment was transferred automatically through the Amazon interface after manually approving each respondent. Participants were typically paid within two days of completing the experiment.

**DESIGN**

The independent variables were product category (magnitude), framing, and probability. The dependent variables were product choices and area under the curve. All variables were manipulated between subjects. Participants only saw one product category, one frame, and one level of probability. Experiment 1 followed a 2 (low magnitude, high magnitude) x 2 (loss, gain) x 2 (low probability, high probability) design which equates to eight total conditions. Participants were randomly assigned to condition.

# CHAPTER VII

# METHOD: EXPERIMENT 2

## PARTICIPANTS

Recruitment procedures for Experiment 2 were identical to Experiment 1. However, all MTurk workers from Experiment 1 were prevented from participating in Experiment 2. Two hundred thirty-seven participants responded to the posting of Experiment 2. The majority of participants were female (58%) and the average age was 36.53 years (*SD* = 12.40). Seventy-one percent of participants identified as White/Caucasian and 52% had completed at least a Bachelor's degree. The median income range was $50,000 - $59,999. Most (57%) participants were either home owners or lived in a home that was owned by another member of the household (Table 1). All participants who successfully completed the study were compensated $0.25 for their time.

## MATERIALS AND PROCEDURE

The materials and procedure from Experiment 1 were repeated with two major changes. First, the probability manipulation was eliminated, leaving a 2x2 design in Experiment 2. In Experiment 1 participants were informed of the probability that the savings/losses associated with each product would be realized. In Experiment 2 participants were told that the estimates were based on national averages (Figure 4). As in Experiment 1, light bulbs and water heaters represented low and high magnitude products, respectively. Also, messages were framed in terms of losses or gains.

Experiment 2 included two additional questions, not present in Experiment 1, that were displayed immediately after participants made their first product selection. These items focused on participants' perceived confidence inherent in their purchase decisions as well as the level of

control that participants felt over their energy costs. The confidence item was presented as a slider ranging from 0% to 100%. Participants were instructed to indicate the chances that they


*Figure 4.* Product choice options in the low magnitude, loss condition (Experiment 2).

personally would achieve savings or losses at least as extreme as those previously displayed. Instructions from the high magnitude/gain condition are presented below:

> The average consumer would save $1082 over five years by purchasing the hybrid electric tank. **Think about your own energy usage.** If you purchased the hybrid electric tank, what are the chances that you personally would save *at least* $1082 over five years? Drag the bar below to indicate your answer from 0% to 100%.
>
> 0% = you definitely would not save as much as the average consumer
>
> 100 % = you definitely would save *at least as much* as the average consumer

The instructions differed according to condition. For example, in the loss condition, participants were asked about their chances to pay an additional $1082 over five years by purchasing the standard storage tank. Low probabilities in the loss condition (i.e., participants feel they are likely to pay less than the average consumer) and high probabilities in the gain condition (i.e., participants feel they are likely to save more than the average consumer) indicated high confidence. Therefore, values in the loss condition were reverse scored.

Next, participants responded to two items regarding their perceived level of control over their energy costs: "You have some control over your energy costs" and "You have limited influence over your energy costs." Response options ranged from 1 (*Strongly disagree*) to 5 (*Strongly agree*) with the latter item above being reverse scored. Both items as well as the response options were adapted from Highhouse et al. (2002). The order of presentation of these two items was randomized. All other elements of Experiment 1 that were not explicitly mentioned here were duplicated in Experiment 2. These elements include the comprehension questions, discount rate calculation procedure, NEP items ($\alpha = .733$), attentional check items, and demographics. Average completion time for Experiment 2 was just under eight minutes ($M = 465.31$ s, $SD = 355.58$ s,) and times ranged from 138 to 3883 s.

# CHAPTER VIII

# RESULTS: EXPERIMENT 1

Of the 219 initial respondents, 11 did not provide any usable data (i.e., they did not make any purchase decisions). One participant failed both attention-check questions, indicating careless responding; this participant's data was also discarded. Participants' response times were examined for extreme values. One participant took just over four hours to complete the survey. After removing this participants' data, boxplots revealed eight additional outliers. Completion times for these extreme cases ranged from 1188 seconds to 2448 seconds. These cases were examined for response patterns or abnormalities (i.e., was response time related to any other responses?) and none were found. Additionally, the removal of these data did not impact hypothesis tests or substantially change the size of any effect. Therefore, only the extreme case was removed. After this initial examination of the data, 206 participants were retained for further analysis.

## HYPOTHESES 1 AND 2

After removing problematic cases, group sizes ranged from 23 to 27 participants. Across all conditions, 109 participants selected the conventional product (52.9%) while 97 selected the green product (47.1%; Table 3). Because seven parameters were included in the following hypothesis tests, the study was sufficiently powered (Peduzzi et al., 1996)

Table 3

*Product Choices by Condition in Experiment 1*

| | *High Probability* | | | | *Low Probability* | | | |
|---|---|---|---|---|---|---|---|---|
| Frame | *Loss* | | *Gain* | | *Loss* | | *Gain* | |
| | Conv. | Green | Conv. | Green | Conv. | Green | Conv. | Green |
| Magnitude | | | | | | | | |
| *Low* | 7 | 20 | 7 | 19 | 17 | 10 | 15 | 10 |
| *High* | 9 | 18 | 12 | 14 | 21 | 2 | 21 | 4 |

*Note.* Conv. = conventional product

Taken together, hypotheses 1 and 2 stated that magnitude, risk, and frame should interact when predicting purchase decisions. The outcome variable was dichotomous (0 = *conventional product*, 1 = *green product*); thus, logistic regression analysis was used for hypothesis testing. Each predictor variables was dummy coded: magnitude (0 = *low*, 1 = *high*), probability (0 = *low*, 1 = *high*), and frame (0 = *loss*, 1 = *gain*). Because the predictor variables were experimental manipulations and because the outcome variable was dichotomous, univariate outliers were not inspected. Additionally, multivariate outliers were not detected, but this finding was largely due to the structure of the data. Values of distance, leverage, and influence are based on predicted probabilities. Randomly assigning participants to conditions limited the range of predicted probabilities. In other words, participants in the same experimental condition who selected the same product had the same predicted probability (e.g., every participant in the low risk/low magnitude/loss condition who selected the green product had identical distance, leverage, and influence values).

Variables were entered into the logistic model in three blocks: main effects, two-way interactions, and the three-way interaction. The overall model was statistically significant ($\alpha <$

.05) after entering the main effects in block one, $\chi^2(3) = 45.34$, $p < .001$. The overall model remained statistically significant after entering the two-way interaction terms, $\chi^2(6) = 48.00$, $p < .001$, but did not significantly improve the model over block one, $\chi^2(3) = 2.67$, $p = .446$. The same pattern emerged in block three. Adding the three-way interaction did not significantly improve the model, $\chi^2(1) = 0.60$, $p = .438$, yet the overall model remained statistically significant, $\chi^2(7) = 48.61$, $p < .001$. Critically, the lack of a statistically significant probability x magnitude x frame interaction provides no support for Hypotheses 1 and 2. Because blocks two and three did not contribute to model fit, only coefficients from block 1 were interpreted.

The variables of probability and magnitude had positive and negative relationships with the log-odds of purchase decisions, respectively (Table 4). Participants were more likely to choose the green product when probability was high and when magnitude was low. The odds of selecting a green product in the low probability conditions were 0.15 that of the odds in the high probability conditions. In other words, participants were 2.58 times more likely to select the green product in the high probability condition than the low probability condition. The odds of selecting a green product in the high magnitude conditions were 0.38 that of the odds in the low magnitude conditions. Selection of the green product was 1.49 times more likely in the low magnitude than high magnitude condition. Framing did not have a significant influence on purchase decisions. Though the three-way interaction was not statistically significant, hypothesis 2b made a specific prediction about a magnitude effect for gains in the low probability condition. To assess these cell mean differences, a generalized linear model was fit to the data. The proportion of participants selecting the green product in the low magnitude, low probability, gain condition was .24 higher, 95% CI [.00, .48] than the proportion in the high

magnitude, low probability, gain condition. The reported confidence interval does contain zero when rounding to two decimal places, though the lower bound is technically greater than zero.

Table 4

*Experiment 1 Logistic Regression Results Predicting Green Product Purchase by Probability, Magnitude, and Frame*

| | Block 1 | | | | Block 2 | | | | Block 3 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | β (*SE*) | *Wald* | *p* | Odds Ratio [95% CI] | β (*SE*) | *Wald* | *p* | Odds Ratio [95% CI] | β (*SE*) | *Wald* | *p* | Odds Ratio [95% CI] |
| Intercept | 1.26 (0.32) | 15.38 | <.001 | 3.53 [1.88, 6.60] | 1.16 (0.43) | 7.47 | .006 | 3.20 [1.37, 7.41] | 1.05 (0.44) | 5.72 | .017 | 2.86 [1.21, 6.77] |
| Probability | 1.87 (0.32) | 33.54 | <.001 | 0.15 [0.08, 0.29] | 1.79 (0.54) | 10.90 | .001 | 0.17 [0.06, 0.48] | 1.58 (0.59) | 7.10 | .008 | 0.21 [0.06, 0.66] |
| Magnitude | -0.97 (0.32) | 9.04 | .003 | 0.38 [0.20, 0.71] | -0.57 (0.54) | 1.09 | .296 | 0.57 [0.20, 1.64] | -0.38 (.60) | 0.35 | .552 | 0.70 [0.22, 2.27] |
| Frame | -0.06 (0.31) | 0.04 | .838 | 0.94 [0.51, 1.73] | -0.28 (0.55) | 0.25 | .620 | 0.76 [0.26, 2.25] | -0.05 (0.62) | 0.01 | .934 | 0.95 [0.28, 3.22] |
| Prob. x Magnitude | | | | | -0.88 (0.67) | 1.73 | .188 | 0.41 [0.11, 1.54] | -1.46 (1.03) | 2.01 | .156 | 0.23 [0.03, 1.75] |
| Prob. x Frame | | | | | 0.58 (0.66) | 0.79 | .373 | 1.80 [0.50, 6.53] | 0.18 (0.85) | 0.04 | .835 | 1.19 [0.23, 6.25] |
| Magnitude x Frame | | | | | -0.08 (0.66) | 0.02 | .902 | 0.92 [0.26, 3.34] | -0.49 (0.84) | 0.34 | .563 | 0.61 [0.12, 3.20] |
| Prob. x Magnitude x Frame | | | | | | | | | 1.06 (0.44) | 0.59 | .441 | 2.87 [0.20, 42.24] |

**DISCOUNT RATES**

To facilitate comparison of the current study with the extant literature, participants' discount rates were compared across conditions. As noted above, discounting was estimated by the area under the curve method (Myerson et al., 2001) rather than relying on any theoretical assumptions. Two participants did not complete the iterative choice procedure and their discount rates could not be calculated. Univariate outliers were examined via boxplots and none were detected. Therefore, 204 participants were included in the following analysis.

An analysis of variance (ANOVA) was conducted to examine the effect of probability, magnitude, and frame (and their interactions) on participants' delay discounting. Visual inspection of Q-Q plots revealed that the residuals approximated normality. Levene's test indicated homogeneity of variance, $F(7, 196) = 1.64$, $p = .127$. Results of the ANOVA are displayed in Table 5. A main effect of magnitude was observed with greater discounting in the high magnitude ($M = 0.76$, $SD = 0.19$) than low magnitude ($M = 0.84$, $SD = 0.25$) condition. Additionally, probability interacted with frame. When probabilities were high, gains were discounted more steeply than losses. However, when probabilities were low, losses were discounted more steeply than gains (Figure 5). Analysis of simple effects revealed that the framing effect was statistically significant in the low probability, $F(1,196) = 21.78$, $p < .001$, partial $\eta^2 = .100$, and high probability, $F(1,196) = 24.73$, $p < .001$, partial $\eta^2 = .112$, conditions. Main effects of probability and frame were not statistically significant, nor were any other interactions.

Table 5

*ANOVA Results of the Impact of Probability, Magnitude, and Frame, on Area Under the Curve*

| *Source* | *SS* | *df* | *MS* | *F* | *p* | partial $\eta^2$ |
|---|---|---|---|---|---|---|
| Probability | 0.011 | 1 | 0.011 | 0.27 | .606 | .001 |
| Magnitude | 0.335 | 1 | 0.335 | 8.41 | .004 | .041 |
| Frame | 0.003 | 1 | 0.003 | 0.08 | .774 | <.001 |
| Probability x Magnitude | 0.001 | 1 | 0.001 | 0.03 | .867 | <.001 |
| Probability x Frame | 1.852 | 1 | 1.852 | 46.48 | <.001 | .192 |
| Magnitude x Frame | 0.012 | 1 | 0.012 | 0.31 | .581 | .002 |
| Probability x Magnitude x Frame | 0.042 | 1 | 0.042 | 1.04 | .308 | .005 |
| Error | 7.809 | 196 | 0.040 | | | |

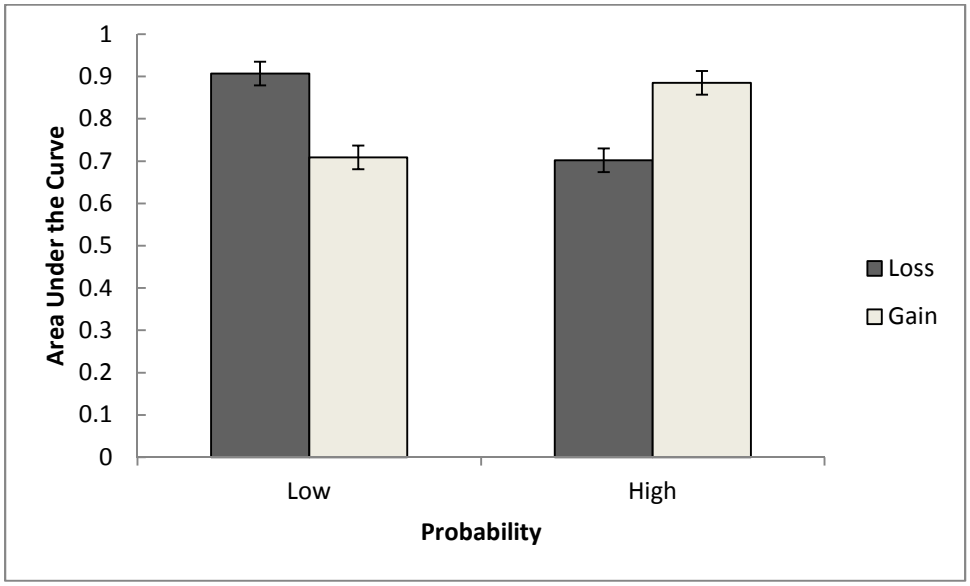


*Figure 5.* Area under the curve for two levels of probability and frame (Experiment 1). Smaller values indicate greater discounting.

## EXPLORATORY ANALYSES

**NEP.** The impact of environmental attitudes on purchase decisions was explored by adding scores on the NEP to the logistic regression model. Five participants did not respond to over two-thirds of the items on the NEP. These participants were discarded from further analysis. Three participants had missing data for one or two items. Missing values for these participants were addressed via multiple imputation and analyses were pooled across five imputations.

NEP scores ranged from 25 to 75 ($M = 54.10$, $SD = 9.98$). The distribution of scores approached normality, with only a slight negative skew (skewness = -0.12). No univariate outliers were detected. The logistic regression analysis described above was replicated but with NEP scores entering the model first, before the main effects of probability, magnitude, and frame. The purpose of this analysis was to determine if the experimental manipulations could influence purchase decisions beyond individual attitudes. Multivariate outliers were addressed prior to the regression analysis but none were found. The logistic model with only NEP scores was not statistically significant, $\chi^2(1) = 1.72$, $p = .190$. Further analysis replicated the previous finding without NEP scores in the model: only the main effects of probability, $\beta = 1.85$, $p < .001$, and magnitude, $\beta = -0.97$, $p = .003$, were statistically significant. The odds ratio of probability was 0.16, 95% CI [0.11, 0.22], while the odds ratio of magnitude was 0.38, 95% CI [0.27, 0.52].

A final logistic regression model tested potential interactions between environmental attitudes (i.e., NEP scores) and experimental conditions (e.g., was the magnitude effect different for people with low and high NEP scores?). Again, environmental attitudes had no impact on product selections. Just like the previous analyses, only risk and magnitude affected product choice. All interactions with environmental attitudes were not statistically significant ($p > .05$).

**DEMOGRAPHICS.** Prior evidence has suggested that women are more likely than men to endorse eco-friendly attitudes and behaviors (Brough, Wilkie, Ma, Isaac, & Gal, 2016; Davidson & Freudenburg, 1996). Similar results were obtained in the current study. Women's scores on the NEP scale ($M$ = 56.18, $SD$ = 9.59) were significantly higher than men's scores ($M$ = 51.74, $SD$ = 9.90), $t(198) = -3.21$, $p = .002$, Cohen's $d = 0.46$. No other demographic variables were related to environmental attitudes.

To facilitate comparisons of other demographic variables, education and housing status were recoded. Education was collapsed into three levels (completed high school or less, education beyond high school through a Bachelor's degree, completion of any post-Bachelor's education) and dummy coded with the Bachelor's degree as the reference group. In the housing status variable the "occupy without rent" category was removed due to its small sample size ($n$ = 7), leaving only two groups (rented versus owned by a member of the household). Main effects of gender, age, housing status, education, and income were not statistically significant predictors or purchase decisions or discount rates ($p > .05$). Of particular interest was the income by magnitude interaction. Presumably, current levels of income would differentially affect products of high and low magnitudes. However, this interaction was also not statistically significant.

# CHAPTER IX

# RESULTS: EXPERIMENT 2

Of the 237 initial respondents, only 220 provided usable data. As in Experiment 1, only one participant failed both attention-check items. One participant's response time (3883 s) was nearly double that of the next longest response time (1999 s), a difference of more than 30 minutes. All other response times were within four minutes of the next highest value. After removal of the extreme value, boxplots indicated the presence of five additional extreme outliers. Examination of these cases did not reveal any abnormal response patterns. Following the rationale presented in Experiment 1, these cases were retained. Thus, 218 participants remained for further analysis.

## HYPOTHESES 3 AND 4

Group sizes ranged from 53 to 56 participants. Across all groups, 81 participants selected the conventional product (37.2%) while 137 selected the green product (62.8%). The proportion of participants selecting the green product ranged from 56.6% in the high magnitude/loss condition to 67.3% in the low magnitude/gain condition (Table 6). Average confidence ratings were 52.22 ($SD$ = 32.05) but values differed across condition (Table 7). Ratings of controllability were relatively uniform across conditions ($M$ = 7.68, $SD$ = 1.56). No outliers were detected for confidence or controllability ratings.

Table 6

*Product Choices by Condition in Experiment 2*

| Frame | *Loss* | | *Gain* | | *Total* | |
|---|---|---|---|---|---|---|
| | Conv. | Green | Conv. | Green | Conv. | Green |
| Magnitude | | | | | | |
| *Low* | 18 | 36 | 18 | 37 | 36 | 73 |
| *High* | 23 | 30 | 22 | 34 | 45 | 64 |
| *Total* | 41 | 66 | 40 | 71 | 81 | 137 |

*Note.* Conv. = conventional product

Table 7

*Confidence Ratings by Condition in Experiment 2*

| | Frame | | | | | |
|---|---|---|---|---|---|---|
| | *Loss* | | *Gain* | | *Total* | |
| | *M* | *SD* | *M* | *SD* | *M* | *SD* |
| Magnitude | | | | | | |
| *Low* | 27.48 | 26.88 | 72.25 | 24.91 | 50.01 | 34.22 |
| *High* | 44.77 | 27.24 | 63.43 | 29.35 | 54.36 | 29.73 |
| *Overall* | 36.05 | 28.30 | 67.80 | 27.48 | | |

Hypothesis 3 stated that, in the absence of explicit probability estimates, participants would display high confidence in their ability to save money when purchasing the green product (or to avoid losing money when purchasing the conventional product). Although no explicit cutoff value was selected to determine the threshold of "high confidence," one would predict a negatively skewed distribution with a mean greater than 50% (i.e., most people believe that they

have a greater-than-chance opportunity to outperform the projected losses or savings). As seen in Figure 5, the distribution of scores centers around 50% and with very little skew (skewness = -0.09). These results do not support Hypothesis 3.

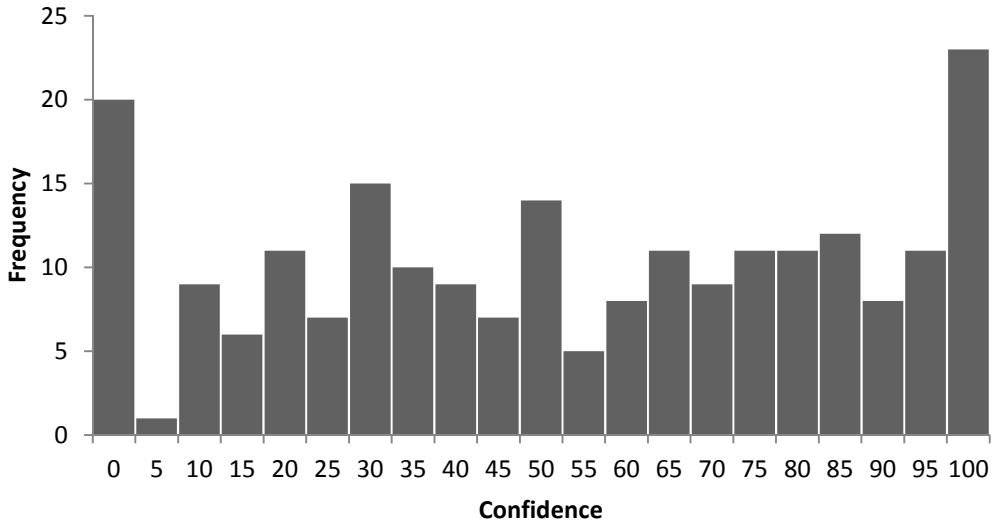


*Figure 6.* Distribution of confidence ratings in Experiment 2.

Interestingly, confidence values were higher in the gain conditions than the loss conditions. These differences in confidence values were tested in a 2 (frame) x 2 (magnitude) ANOVA. Visual inspection of residuals and Levene's test, $F(3, 216) = 0.95$, $p = .418$, satisfied assumptions of normality and homogeneity of variance, respectively. Results of the ANOVA indicated a significant main effect of frame, $F(1, 216) = 75.18$, $p < .001$, partial $\eta^2 = .258$, and frame by magnitude interaction, $F(1, 216) = 13.67$, $p < .001$, partial $\eta^2 = .060$. The main effect of magnitude was not statistically significant, $F(1, 216) = 1.23$, $p = .251$, partial $\eta^2 = .006$. Following up the significant interaction, simple effects analysis revealed that the effect of frame

was stronger in the low magnitude condition, $F(1, 216) = 76.48$, $p < .001$, partial $\eta^2 = .261$, than the high magnitude condition, $F(1, 216) = 12.37$, $p = .001$, partial $\eta^2 = .054$.

The fact that Hypothesis 3 was not supported weakened the rationale for Hypothesis 4. However, the relationships between frame, magnitude, and product choice were still addressed in Experiment 2. Logistic regression was conducted with two blocks of predictors. Like Experiment 1, the main effects were entered in block 1 and interaction in block 2. The overall model was not statistically significant after block 1, $\chi^2(2) = 1.72$, $p = .422$, or block 2, $\chi^2(3) = 1.78$, $p = .618$. Neither frame, magnitude, nor their interaction had any influence on product selections (Table 8). Hypothesis 4 was not supported.

Table 8

*Experiment 2 Logistic Regression Results Predicting Green Product Purchase by Magnitude and Frame*

| | Block 1 | | | | Block 2 | | | |
|---|---|---|---|---|---|---|---|---|
| | β (*SE*) | *Wald* | *p* | Odds Ratio [95% CI] | β (*SE*) | *Wald* | *p* | Odds Ratio [95% CI] |
| Intercept | 0.66 (0.25) | 7.06 | .008 | 1.92 [1.19, 3.12] | 0.69 (0.29) | 5.77 | .016 | 2.00 [1.13, 3.52] |
| Magnitude | -0.36 (0.28) | 1.60 | .207 | 0.70 [0.40, 1.22] | -0.43 (0.40) | 1.14 | .285 | 0.65 [0.30, 1.43] |
| Frame | 0.10 (0.28) | 0.13 | .718 | 1.11 [0.64, 1.92] | 0.03 (0.41) | 0.01 | .946 | 1.03 [0.46, 2.28] |
| Magnitude x Frame | | | | | 0.14 (0.56) | 0.06 | .801 | 1.1 [0.38, 3.48] |

Confidence and controllability did not produce the expected effects, but their impact on purchase decisions was analyzed by adding these variables to the logistic regression model. Main effects and interactions were entered in separate blocks and the final model was statistically significant, $\chi^2(11) = 62.29$, $p < .001$. Effects of frame, controllability, the magnitude x frame interaction, and frame x controllability interaction were all statistically significant but qualified by a higher-order interaction (Table 9). A significant frame x confidence interaction indicated that increased confidence was related to an increased likelihood of selecting the green product but only in the gain frame (Figure 7). The influence of controllability on green purchase decisions depended upon magnitude and frame. As participants feelings of controllability increased, the probability of choosing the green product decreased in the high magnitude, loss condition but had no effect in the gain frame. In the low magnitude condition, increased feelings of controllability were associated with an increased likelihood of purchasing the green product in the loss frame and an opposite effect in the gain frame (Figure 8).

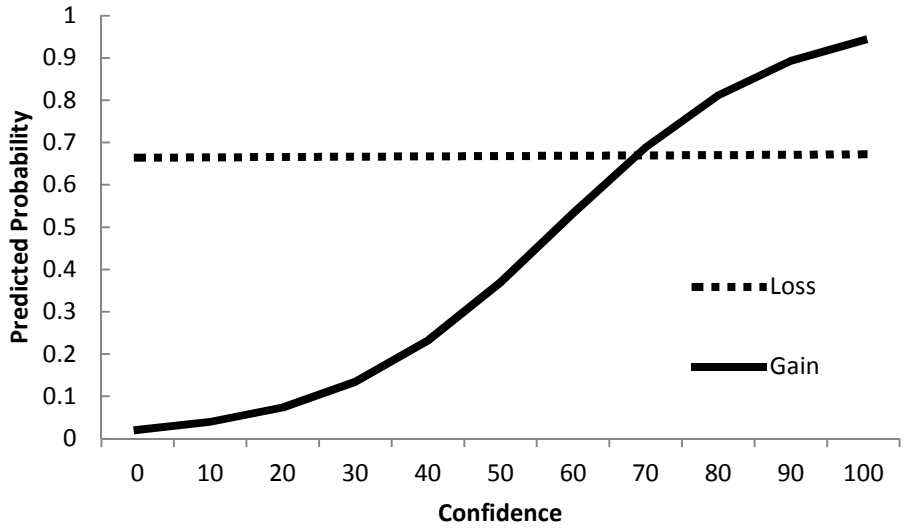


*Figure 7.* Probability of selecting the green product in Experiment 2 as a function of confidence and frame.

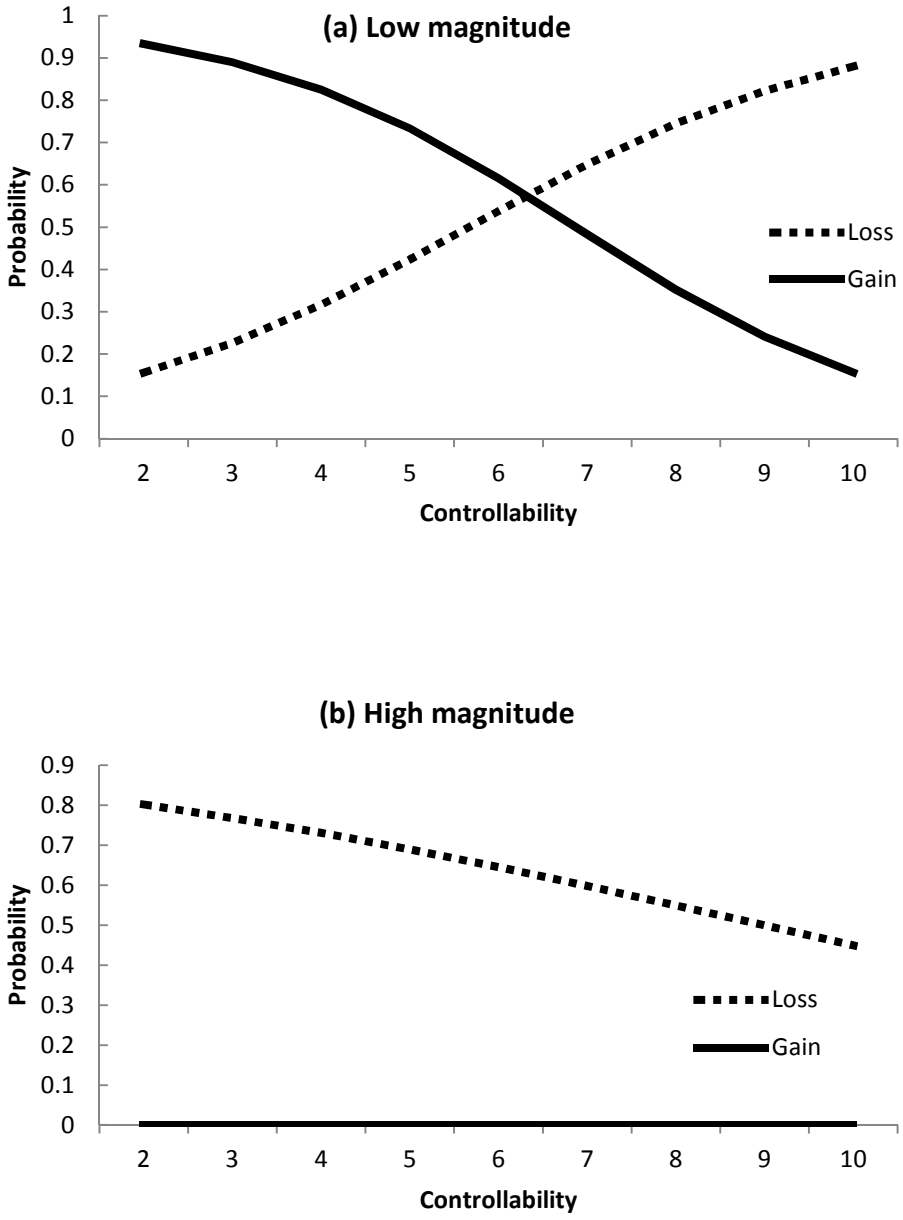


*Figure 8.* Probability of selecting the green product in Experiment 2 as a function of controllability in the low magnitude (a) and high magnitude (b) conditions.

Table 9

*Experiment 2 Logistic Regression Predicting Green Product Purchase by Magnitude, Frame, Confidence, and Controllability*

| | Block 1 | | | | Block 2 | | | | Block 3 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | β | *SE* | *O.R.* | [95% CI] | β | *SE* | *O.R.* | [95% CI] | β | *SE* | *O.R.* | [95% CI] |
| Intercept | 1.17*** | 0.29 | 3.23 | [1.83, 5.69] | 0.73 | 0.39 | 2.08 | [0.97, 4.46] | 0.93* | 0.46 | 2.54 | [1.03, 6.24] |
| Magnitude | -0.51 | 0.30 | 0.61 | [0.34, 1.09] | -0.49 | 0.44 | 0.61 | [0.24, 1.58] | -0.67 | 0.55 | 0.51 | [0.18, 1.50] |
| Frame | -0.62 | 0.35 | 0.54 | [0.27, 1.07] | -1.12 | 0.62 | 0.33 | [0.09, 1.10] | -1.37* | 0.67 | 0.25 | [0.07, 0.94] |
| Controllability | 0.12 | 0.10 | 1.12 | [0.93, 1.36] | 0.24 | 0.16 | 1.28 | [0.93, 1.75] | 0.46* | 0.19 | 1.59 | [1.09, 2.32] |
| Confidence | 0.02*** | 0.01 | 1.02 | [1.01, 1.04] | 0.001 | 0.01 | 1.00 | [0.98, 1.02] | 0.002 | 0.01 | 1.00 | [0.98, 1.03] |
| Mag x Frame | | | | | 0.66 | 0.78 | 1.93 | [0.42, 8.94] | -9.25 | 3.70 | <.001 | [0.00, 0.14] |
| Mag x Controllability | | | | | -0.19 | 0.21 | 0.83 | [0.55, 1.25] | -0.66* | 0.28 | 0.52 | [0.30, 0.89] |
| Mag x Confidence | | | | | 0.001 | 0.01 | 1.00 | [0.98, 1.03] | -0.01 | 0.02 | 0.99 | [0.96, 1.02] |
| Frame x Controllability | | | | | -0.27 | 0.23 | 0.77 | [0.49, 1.20] | -1.00** | 0.38 | 0.37 | [0.18, 0.78] |
| Frame x Confidence | | | | | 0.07*** | 0.02 | 1.07 | [1.04, 1.10] | 0.07** | 0.02 | 1.07 | [1.02, 1.12] |
| Mag x Frame x Controllability | | | | | | | | | 1.34** | 0.50 | 3.83 | [1.45, 10.2] |
| Mag x Frame x Confidence | | | | | | | | | 0.01 | 0.03 | 1.01 | [0.95, 1.07] |

*Note.* Mag = magnitude. * $p < .05$; ** $p < .01$; *** $p < .001$

**DISCOUNT RATES**

As in Experiment 1, discount rates were calculated according to the area under the curve (Myerson et al., 2001). Because confidence scores were continuous, the degree of discounting was assessed in a linear regression. One participant did not complete the iterative choice procedure and was excluded from analysis. No univariate outliers were detected. Two cases were identified as potential multivariate outliers, but these data had very little overall impact on parameter estimates. Results of hypothesis tests did not differ when the cases were included or excluded, so these cases remained in the data set. Residuals approached normality and the assumption of homoscedasticity was also satisfied. The maximum value of the variance inflation factor was 4.45, so multicollinearity was not problematic.

Main effects of frame, magnitude, and confidence (mean centered) were entered into the first block of the regression model followed by all two-way interactions in block two and the three-way interaction in block three. The overall model was statistically significant after blocks one and two but block three did not explain additional variance, $\Delta F(1, 210) = 0.55$, $p = .459$, $\Delta R^2 = .002$. After dropping the three-way interaction, the overall model remained statistically significant, $F(6, 211) = 14.51$, $p < .001$, $R^2 = .292$. High magnitude products were discounted more than low magnitude products, but this main effect was qualified by a frame x magnitude interaction (Table 10). The effect of magnitude was larger for losses than gains. An interaction between confidence and frame was also statistically significant. Confidence decreased discounting for gains but had little effect on losses (Figure 9).

Table 10

*OLS Regression Results of the Impact of Magnitude, Frame, and Confidence on Area Under the Curve*

| | *B* | *SE B* | *β* | *t* |
|---|---|---|---|---|
| Intercept | 0.89 | 0.030 | | 27.01*** |
| Magnitude | -0.12 | 0.038 | -0.31 | -3.27** |
| Frame | -0.02 | 0.044 | -0.04 | -0.41 |
| Confidence | 0.0003 | 0.001 | 0.06 | 0.46 |
| Magnitude x Frame | 0.15 | 0.056 | 0.33 | 2.69** |
| Magnitude x Confidence | 0.0002 | 0.001 | -0.02 | -0.25 |
| Frame x Confidence | 0.01 | 0.001 | 0.40 | 4.44*** |

*Note.* ** $p < .01$; ** $p < .001$

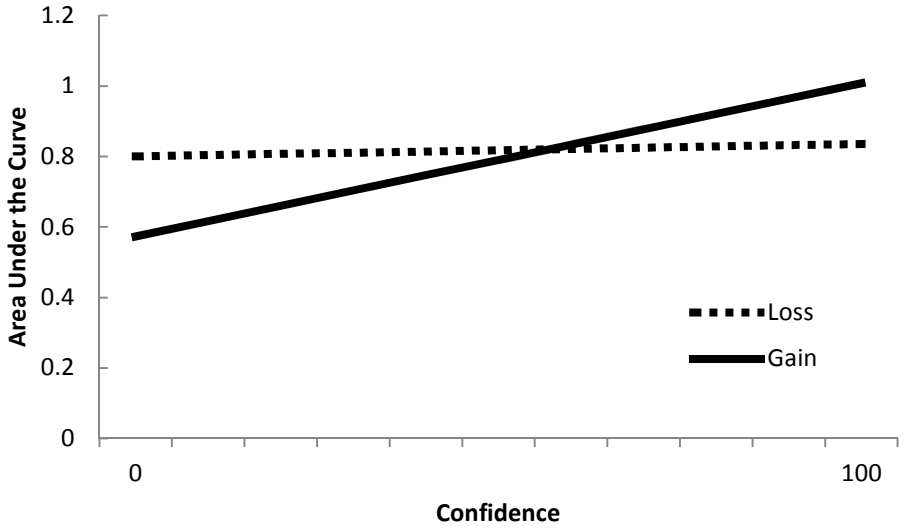


*Figure 9.* Interaction of frame and confidence on area under the curve (Experiment 2). Lower values indicate greater discounting.

## EXPLORATORY

**NEP.** The impact of participants' environmental attitudes was again addressed by incorporating NEP scores into the analysis of product choices. Two participants did not respond to any NEP items and were excluded. Three other participants were missing responses for one to three items. These data points were estimated using the same multiple imputation procedure described in Experiment 1. Additionally, no multivariate outliers were detected. NEP scores ranged from 27 to 66 and were approximately normally distributed (skewness = -0.31).

Using logistic regression analysis, mean-centered NEP scores were entered in the first block, followed by main effects and interactions in blocks two and three, respectively. Environmental attitudes were statistically significant predictors of product choices: $\chi^2$ tests of the model containing NEP scores and the intercept reached significance for each imputation ($p <$ .01). Wald tests of individual parameter estimates were also statistically significant ($p < .01$) across all imputations for NEP scores, $\beta_{pooled} = 0.06$, $SE_{pooled} = 0.02$, and the intercept, $\beta_{pooled} = 0.56$, $SE_{pooled} = 0.14$. For participants with average NEP scores ($M = 51.23$, $SD = 7.51$), the probability of selecting the green product was 63.60%. For participants with NEP scores one standard deviation above the mean, the probability of selecting the green product was 72.53%. The addition of experimental variables (i.e., frame, magnitude) and interaction terms did not significantly contribute to the model ($p > .05$).

**DEMOGRAPHICS.** Unlike Experiment 1, environmental attitudes did not differ across genders in Experiment 2. Scores on the NEP scale were approximately equal for men ($M =$ 51.25, $SD = 7.66$) and women ($M = 51.52$, $SD = 7.30$), $t(210) = -0.27$, $p = .791$, Cohen's $d =$ 0.04. Gender was also not predictive of product choices when entered in a logistic regression model alone, $\chi^2(1) = 0.02$, $p = .898$, as a two-way interaction terms, $\chi^2(3) = 0.13$, $p = .127$, or as

an interaction with both frame and magnitude, $\chi^2(1) = 0.35$, $p = .554$. As in Experiment 1, no other demographic variables were significant predictors of purchase decisions or discount rates.

# CHAPTER X

# DISCUSSION

For a certain class of green products, higher initial costs are offset by the prospect of future savings. However, these future savings are not guaranteed; they are probabilistic. How an individual operates a new product influences the payoff. For example, an energy efficient light bulb may advertise a specific reduction in energy bills, but actual savings are dependent upon an individual's use. The monetary benefits of "going green" are therefore subjected to two major factors: delay and probability. The current research investigated how these two factors combined to influence purchase decisions for green products.

For years, psychologists and economists have studied delay and probabilistic discounting in simple monetary decisions (Frederick et al., 2002; Green & Myerson, 2010; Loewenstein & Prelec, 1992). These studies have largely isolated either delay or probability, yet many real-world decisions incorporate both factors. Only recently (Vanderveldt et al., 2015) have scholars begun to systematically examine the influence of delay in probabilistic choices (and vice versa). The application of delay and probabilistic discounting to green purchase decisions is a logical fit, but one that is thus far missing from the literature.

Delay and probability have been found to interact with one another (Vanderveldt et al., 2015) such that an increase in delay decreases the impact of probability while a decrease in probability (i.e., the outcomes are less likely) decreases the impact of delay. Also, delay and probability are each moderated by frame and magnitude (Estle et al., 2006; Green and Myerson, 2010). A framing effect occurs when a change in the wording of a decision elicits a different preference (Tversky & Kahneman, 1981). In the current study, frame was manipulated by presenting messages about the losses associated with conventional products (i.e., increased

energy bills relative to green products) or the gains associated with green products (i.e., reduced energy bills relative to conventional products). Magnitude refers to the size of losses or gains. In the current study, light bulbs (low magnitude) and water heaters (high magnitude) represented two levels of magnitude. Both framing and magnitude have been shown to differentially impact delay and probabilistic discounting (Estle et al., 2006; Green & Myerson, 2010). Based on the extant literature, specific hypotheses were formulated regarding the impact of delay and probability, as well as the moderating influences of frame and magnitude, in green purchase decisions. These hypotheses were empirically tested in a series of two experiments.

Hypotheses 1 and 2, when combined, posited that probability, frame, and magnitude would interact. In other words, a frame by magnitude interaction would vary across levels of probability. When probabilities were high, framing was expected to have opposite effects in the low and high magnitude conditions. Specifically, the purchase of the green product was expected to be associated with the loss frame for low magnitude products and the gain frame for high magnitude products. When probabilities were low (i.e., a 10% chance of recouping the savings associated with the green product), participants were expected to opt for the green product more often in the loss frame than the gain frame. However, within the gain frame, inexpensive green products were expected to be chosen more often than expensive green products.

The three-way interaction between probability, frame, and magnitude was not statistically significant. Thus, hypotheses 1 and 2 were not fully supported. When the projected savings of the green product were 90% certain, framing effects were not observed in the low or high magnitude conditions. Hypothesis 2 was partially supported. As predicted, a magnitude effect did occur in the gain frame. Participants were more likely to choose the low magnitude green

product than the high magnitude green product. However, this same magnitude effect was unexpectedly present in the loss frame.

Although probability, frame, and magnitude did not interact as expected, probability and magnitude had considerable influence on participants' decisions. When participants were told that the differences in operating costs were 90% certain (high probability conditions), nearly 67% of participants opted for the green product. When the differences in operating costs were 10% certain (low probability conditions), only 26% of participants chose the green product. This result is not surprising. When comparing initial costs, the conventional product has the advantage. The monetary advantage of the green product lies in its reduced operating costs. Participants were deciding between the guaranteed benefit of a conventional product and a probabilistic benefit of the green product. When the benefits associated with the green product were more likely, participants were more likely to select the green product.

Across levels of probability and frame, participants were also more likely to select the green product in the low magnitude conditions. When choosing between an LED and CFL bulb, 56.2% opted for the green product (i.e., the LED). When choosing between a standard and hybrid electric water heater, 37.6% opted for the green product (i.e., the hybrid electric). Discounting was greater for relatively expensive products than inexpensive products. This finding is consistent with previous research on losses but not gains (Benhabib et al., 2010; Estle et al., 2006; Hardisty et al., 2013; Mitchell & Wilson, 2010). Notably, framing had no effect on participants' choices.

One possible explanation of the main effect of magnitude, and why it did not interact with frame, is that the framing manipulation was not effective. The differences in frames were only manipulated for the delayed outcomes. In other words, the operating costs were subject to

the framing manipulation but the initial costs were not. For example, participants in the low magnitude conditions were told that the LED bulb could produce a savings of $3.05 over five years that the CFL bulb could produce a loss of $3.05 over five years. In both the gain and loss conditions participants were told that the initial price of the CFL was $2.10 and the initial price of the LED was $3.99. Therefore each purchase, regardless of frame, was subject to at least one loss (i.e., the initial cost). Previous research on "mental accounting" (Thaler, 1985) suggests that people prefer to integrate multiple losses into a single mental transaction. If the loss frame became salient when comparing the initial costs of each product, participants may have evaluated each decision based on the total amount that they stood to lose, even in the gain conditions.

One critical prediction in the current study was that consumers would be sensitive to the probabilistic nature of green purchase decisions. The main effect of probability in Experiment 1 supported the idea that consumers evaluated this factor when making decisions. However, information presented in Experiment 1 was not reflective of real-world product choices. By law, when estimated energy costs are provided, these costs must reflect *typical* product use. Experiment 2 attempted to capture the impact of delay and probabilistic discounting in a task that was higher in ecological validity.

In Experiment 2, potential losses and gains were not presented with probability estimates. Rather, participants were told that the losses or gains were typical of the average consumer. Probability estimates were inferred by each participant. They were asked to provide their own rating of the likelihood of future savings or losses. This rating was conceptualized as an indication of confidence. Past research has demonstrated that people overestimate the likelihood that positive events will happen to them (unrealistic optimism; Shepperd et al., 2013) and events are viewed as being less risky when individuals have control over the outcomes (Highhouse et

al., 2002). Based on these findings, participants were expected to perceive the purchase of a green product as being low-risk (high confidence). When product messages were framed as savings, participants were expected to be overly confident in their ability to save at least as much as advertised. In the loss frame, participants were expected to rate themselves as being less likely than average to lose as much as the advertised value. These self-ratings of confidence would then align with the high probability conditions in Experiment 1.

Participants in Experiment 2 did not display unrealistic optimism. Therefore, hypothesis 3 was not supported. Unexpectedly, the confidence ratings were dependent upon experimental condition. Participants were more confident in their ability to *save* money than they were in their ability to *not lose* money. This effect was stronger for low magnitude products (light bulbs) than high magnitude products (water heaters). Rather than experiencing unrealistic optimism, participants appeared to think that the product messages, regardless of frame, would apply to them. In order to compare scores across conditions, confidence values in the loss frame were reverse scored (i.e., a low probability of losing money was treated equivalently to a high probability of saving money). Without reverse scoring, confidence values were nearly equal in each condition. For example, the average likelihood of *paying an additional* $3.05 when purchasing the CFL was 73%. The average likelihood of *saving* $3.05 by purchasing the LED was 72%. These results suggest that participants assumed the advertised value would apply to their own energy usage, regardless of frame. Participants expected their own energy costs to be comparable to that of the average consumer.

Hypothesis 4 stated that participants' unrealistic optimism and controllability ratings in Experiment 2 would lead to choices that mimicked the high probability conditions of Experiment 1. Although participants did not experience unrealistic optimism, the effects of frame and

magnitude were examined in Experiment 2 as well. Neither frame, magnitude, nor their interaction had an influence on product choices. Hypothesis 4 was not supported.

The model in Figure 2 shows that probability and delay were proposed to interact. However, the expected ceiling effect of probability ratings was thought to minimize the influence of probability. Because the ceiling effect was not observed, the impact of varying levels of probability on purchase decisions could be tested. A significant frame by confidence interaction was observed. In the loss frame, increasing confidence had very little effect on the overall likelihood of purchasing a green product. In the gain frame, increasing confidence was associated with an increased likelihood of selecting the green product. In other words, participants who were more confident that they would save the advertised amount by going green were more likely to select the green product. This finding is consistent with prospect theory (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992). The benefit of the green product (i.e., future savings) is risky because the savings are not guaranteed. The benefit of the conventional product (i.e., reduced initial price) is less risky because the initial price is guaranteed. In the gain frame, people are traditionally risk averse—they prefer certain gains. In Experiment 2, when participants viewed the green product as risky (i.e., less confidence in the savings being recouped), they preferred the certain gain of the green product. As subjective risk evaluations decreased, the likelihood of selecting the risky green product increased.

The subjective likelihood that participants would lose money by selecting the conventional product did not impact purchase decisions. According to prospect theory (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992), people are risk seeking in the loss frame. They are willing to take chances to avoid a loss. Prospect theory can partially explain the loss frame of Experiment 2 as well. Participants who rated themselves as more likely to lose

money by purchasing the conventional product were willing to take risks (i.e., purchase the green product) to avoid this loss. The unexplained cases are the participants who rated themselves as unlikely to lose money by purchasing the conventional product. If these participants did not think that they would lose money when purchasing the conventional product, then a comparison of initial prices should favor the purchase of the conventional product. This view of participants' decision processes is undoubtedly overly simplistic. Participants in the loss condition were asked about the likelihood that they would lose *at least as much as* the advertised amount. Even participants who were certain that they would lose less than advertised, who were rated as highly confident in Experiment 2, still may have assumed some degree of loss. In other words, participants may have been 95% confident that they would lose less than $1082 by purchasing a conventional water heater, but they may still associate the conventional product with a loss anywhere in the range from $0 to $1081. These participants may have still been risk seeking to avoid losses even if the loss was not expected to be of the advertised magnitude. Another possibility is that these high-confidence participants did not expect to lose as much money with the conventional product because they generally practice eco-friendly behavior. These participants may have been more likely in general to purchase green products regardless of potential savings or losses.

Finally, controllability was expected to contribute to the ceiling effect in subjective probability (confidence) ratings, but controllability and confidence were not related. Controllability did have an effect on purchase decisions, though. When comparing water heaters, increased feelings of controllability decreased the likelihood of selecting the green product, but only in the loss frame. No effect was observed in the gain frame for water heaters. When comparing light bulbs, controllability had opposite effects for losses and gains. Increased

controllability increased the likelihood that participants selected the green product in the loss frame. However, increased controllability decreased the likelihood that participants selected the green product in the gain frame. Past research indicated that negative outcomes are seen as being less likely when people perceive increased control over those outcomes. The findings of Experiment 2 did not align with these predictions.

Taken together, results of experiments 1 and 2 offer a number of insights into green purchase behavior. First, the probability of the future outcome, whether explicitly provided or subjectively rated by participants, was a major factor in purchase decisions. While the predictions in Figure 2 were not fully supported, the results of the current study do support the inclusion of probability into a model of green purchase decisions. Second, participants were responsive to the advertised future outcomes. In Experiment 1, the pattern of results suggested that participants were largely basing their decisions on future outcomes. People were in favor of the green product when the probability of future savings was high and were in favor of the conventional product when the probability of future savings was low. In Experiment 2, the majority of participants believed that they were likely to experience the advertised outcome, regardless of frame. When participants were told that the average consumer paid extra money over time by purchasing the conventional product, the majority of participants believed that they were likely to experience similar or greater losses. When participants were told that the average consumer would save money over time by purchasing the green product, the majority of participants believed that they were likely to experience similar or greater savings.

Any conclusions about other variables should be made with reservation. Magnitude, for example, was a significant predictor of purchase decisions in Experiment 1 but not in Experiment 2 even though the magnitude manipulation was the same in both experiments.

Environmental attitudes were predictive of decisions in Experiment 2 but not in Experiment 1. In Experiment 2, controllability interacted with magnitude and frame, but in a manner inconsistent with previous work. Demographic variables were not predictive of purchase decisions in either experiment. More work is needed to accurately assess the influence of these factors in green purchase decisions.

## PRACTICAL IMPLICATIONS: GREEN MARKETING

The results of the current study have implications for marketers of green products. First, participants did appear to base their decisions on future outcomes. Participants were not making decisions based solely on the initial price of each product. Consumers have indicated that the higher cost of green products can be prohibitive to their purchase (GfK, 2012), but highlighting the operating cost may help people overcome this obstacle. Another finding related to product labels was that participants were mostly convinced that the advertised operating costs would be applicable in their own situation. In Experiment 2, operating costs were labeled as consumer averages. Previous research has suggested that people tend to believe that they will outperform the average. However, the current study found that people were not overly optimistic when predicting their own energy usage. Overall, prior beliefs about individual energy use did not appear to affect how participants perceived the product messages. If a product advertised losses over five years, then participants felt that those losses would apply to them. If a product advertised savings over five years, then participants felt that those savings would apply to them.

Although most participants felt that the advertised savings or losses were likely to occur, ratings of probability did impact purchase decisions. Increasing consumer confidence in the financial benefits of green products will increase the likelihood that these products are purchased. When consumers perceive potential losses they will employ risk reduction strategies.

Consumers frequently rely on branding information such as image or loyalty (Johnson & Bruwer, 2004; Roselius, 1971; Yeung, Yee, & Morris, 2010), but they may also engage in information-seeking behavior (Beatty & Smith, 1987; Murray, 1991). In a retail setting, knowledgeable employees may be able to reduce these levels of perceived risk. Additionally, access to efficiency information, such as the results of government or private testing, may increase the likelihood that the green product is purchased.

Of all the variables in the current study, frame is the easiest to manipulate by marketers. Unfortunately, framing did not have a consistent impact on purchase decisions. In both experiments, the purchase of the green product was equally likely in the loss and gain frame. Frame did interact with confidence in Experiment 2. When consumer confidence is low, utilizing the loss frame will increase the preference for green products. When confidence is high, the gain frame will increase the preference for green products (Figure 2). Based on these results, framing can only be properly utilized when additional information (i.e., confidence) is present. Unless marketers can accurately assess the level of consumer confidence, framing is not a viable strategy. However, changing the way in which frame is manipulated may produce different results (see limitations below).

**THEORETICAL IMPLICATIONS: DISCOUNT RATES**

The hypotheses in the current study were focused on the impact of discounting on a single purchase, but most of the previous research has been about the *amount* of discounting under different conditions. Discount rates were collected in the current study to facilitate comparisons with previous research. These results are discussed here.

The current study contributed to the relatively sparse literature on the combination of delayed and probabilistic discounting. This study was one of the first to examine the interaction

of delay and probability for losses and gains of different magnitudes. When probabilities were low, discounting was greater for gains than losses. When probabilities were high, discounting was greater for losses than gains. The same effect emerged when probability was given (Experiment 1) or inferred by the participant (Experiment 2). Although these results provide further evidence of an interactive effect between delay and probability, the effects were not observed in the predicted direction. The results of Vanderveldt and colleagues' study suggested that as certainty increased the effect of probability diminished, leaving only the effect of delay. Research on delay discounting has found that gains are discounted more than losses but that frame and magnitude interact. In both of the current experiments, as certainty (probability) increased, discounting was greater in the loss frame than gain frame—the opposite effect found in previous studies. Additionally, the impact of magnitude on discount rates was minimal compared to the extant literature. In Experiment 2, consistent with prior work, large losses were discounted more than small losses. However, no effect of magnitude was found in the gain frame. These results are inconsistent with a present bias explanation of discounting (Hardisty et al., 2013).

Vanderveldt et al. (2015) found that, when probability and delay were combined, probability appeared to be the most influential factor (i.e., the effect of probability on delay was greater than the effect of delay on probability). However, due to methodological concerns, the authors could not rule out the potential of this result being an experimental artifact. The current study also found probability to be an overwhelmingly influential factor, but suffers from the same methodological concerns as Vanderveldt et al. More research is needed to systematically examine this interaction.

## LIMITATIONS

One of the most obvious limitations of the current study is the simulated nature of the experimental task. Participants did not have to use their own money. Previous research has shown that discount rates are approximately equal in studies with real or hypothetical scenarios (Johnson & Bickel, 2013; Lagorio & Madden, 2005), but these studies did not require participants to lose a large magnitude of money. No controlled study will require participants to spend $1200 of their own money, so the generalizability of these results is somewhat limited. However, the distribution of product choices was not extreme in favor of one product or the other. If participants were not influenced by cost then other factors, such as social desirability, would have presumably led to an unequal distribution of product choices.

A critical limitation in the current study was the framing manipulation. As noted above, in every experimental condition participants were forced to consider at least one loss when evaluating the initial price of each product. Regardless of the future savings or losses that were highlighted, purchasing a product required the loss of money. Participants may have mentally restructured the alternatives in the gain frame to focus on potential losses (Thaler, 1985). One solution is to frame the initial costs in terms of savings or losses instead of leaving the differences to be framed by the participant. For example, the initial costs of the conventional and green water heaters were $388 and $1200, respectively. Rather than listing the two separate initial costs, the gain frame would indicate that the conventional product provides an immediate $812 savings while the green product provides a $1082 saving over five years. In the loss frame, the green product would be listed as an immediate $812 payment and the conventional product as a $1082 payment over five years.

## FUTURE RESEARCH

Testing a new framing manipulation, described in the previous section, is one direction for future research. However, the type of scenarios presented in the current study should not be abandoned. It is worth investigating how consumers are conceptualizing these decisions. When comparing two products, are consumers viewing the initial costs relative to one another (i.e., subtracting one price from the other) or individually? Additionally, how are consumers framing the initial and future costs? When the savings associated with green products are advertised, consumers may be associating the initial cost with a loss and the reduced operating cost as a gain. Thus far, research on intertemporal choice has focused on the comparison of immediate versus future gains and immediate versus future losses. Scenarios that combine multiple frames into one decision (e.g., how much are consumers willing to lose up front for a future gain) might be the best way to study green products.

Another avenue of future research involves the interaction of probability and delay. The results of this study indicated that probability does affect decisions with delayed outcomes, but this interaction is still not well understood. To properly describe the probability x delay interaction, varying levels of delay need to be systematically combined with levels of probability. The current study only assessed a delay of five years in every condition. Addressing multiple levels of delay would provide theoretical benefits by further examining the probability x delay interaction, but would also allow marketers to optimize their product messages. The benefits of a green product could be promoted at any point across the product's lifespan. For example, the reduced energy costs of a green water heater could be described as a saving of $1082 over five years (the number used in the current study), $216 over one year, $1514 over seven years, etc. Shorter delays highlight more immediate benefits while longer

delays highlight a larger absolute value. What is the optimal combination of delay and magnitude for changing consumer preferences?

Another factor that was not addressed in the current study is the environmental benefit of green products. Only the financial benefits were manipulated. One prior study found that environmental outcomes are discounted in a manner similar to monetary outcomes (i.e., immediate benefits are more valuable than future benefits; Hardisty et al., 2013), but the purchase of green products has both financial and environmental consequences. The environmental benefits were implied in the current study by reduced energy usage, but the overall environmental benefits were not provided. To fully understand green purchase behavior, both environmental and financial outcomes need to be explored.

Finally, the effects of controllability and confidence were not consistent with previous research. Participants were not overly optimistic in their ability to outperform the average, and controllability did not have a consistent effect on purchase behavior across frames and magnitude. These unexpected effects could be specific to the context of green purchases, or they could be the result of boundary conditions. For example, levels of confidence were high in the gain frame and low in the loss frame. This effect may be specific to a consumer context and mediated by another factor such as trust (Chen & Chang, 2013). An alternative explanation is that confidence is susceptible to framing effects, regardless of context. Future research should more carefully examine the role of these variables.

# CHAPTER XI

# CONCLUSIONS

The current study was one of the first to apply the principles of delay and probabilistic discounting to green purchase decisions. Results of two experiments revealed that participants were responsive to the probability of future rewards or losses. Selection of the green product was more likely when probability was high, regardless of their how these probabilities were estimated (i.e., explicit versus implicit). Marketers may increase the preference for green products by reducing the uncertainty associated with future outcomes. These results support an emerging area of research on the interaction of delay and uncertainty. Prior research has found an influence of magnitude and frame on discounting behavior, but the current study did not reveal any conclusive evidence about these variables in the context of green purchase decisions.

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# APPENDIX A

## EXPERIMENT 1 PROTOCOL

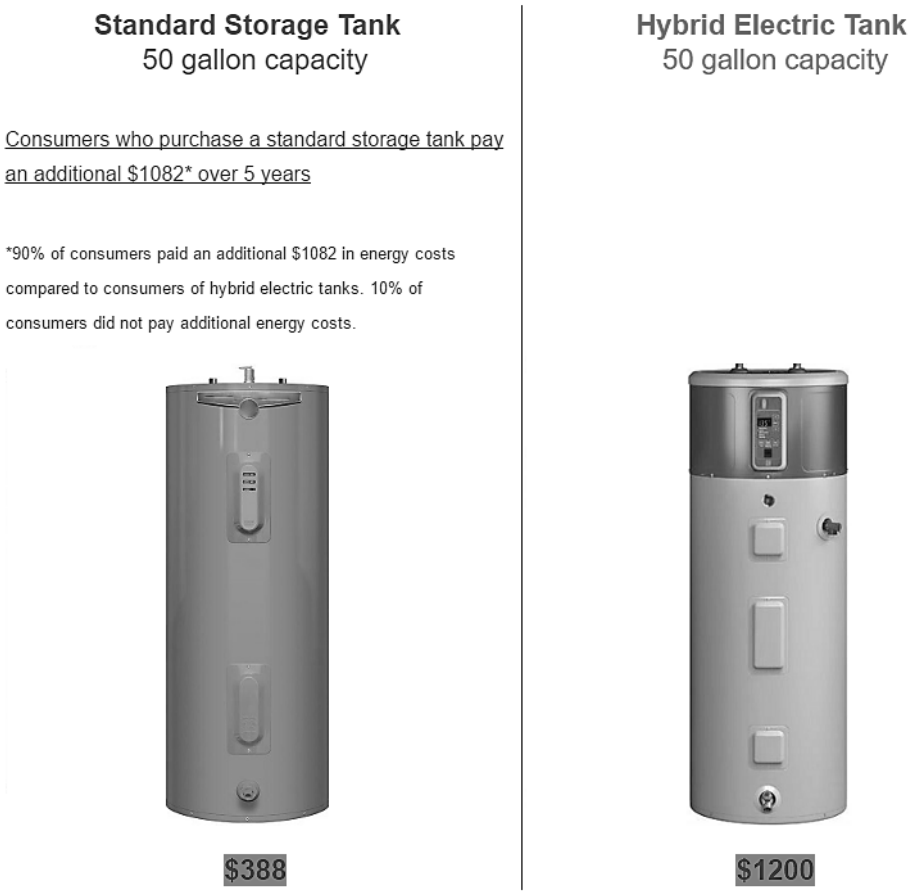
Page

1. **Notification statement**: *omitted*

2. **Instructions**: Thank you for agreeing to participate. On the next screen you will be shown information about two products. Please read all of the information--including the fine print. The purchase price will be displayed below each product and information about energy costs will be displayed above one of the products.

   You will be required to answer a few questions about these products. Please read carefully. You will not be allowed to continue if you answer incorrectly.

3. **Comprehension check: questions, responses, and images varied by condition. Sample items from the high magnitude, high probability, loss condition are shown below.**



Page

How much money does it cost to purchase the standard water heater?

- ❍ $388
- ❍ $1200
- ❍ $1082

How much money does it cost to purchase the hybrid electric water heater?

- ❍ $1200
- ❍ $388
- ❍ $1082

The MAJORITY of consumers who purchased the standard water heater paid higher energy costs over 5 years.

- ❍ True
- ❍ False

4. **Instructions:** Imagine that you must purchase one of the two products just shown. Which one would you buy? Press NEXT to make your selection. You will have a chance to review the products' details before deciding.

5.

**Standard Storage Tank**
50 gallon capacity

Consumers who purchase a standard storage tank pay an additional $1082* over 5 years

*90% of consumers paid an additional $1082 in energy costs compared to consumers of hybrid electric tanks. 10% of consumers did not pay additional energy costs.

$388

**Hybrid Electric Tank**
50 gallon capacity

$1200

Which product would you purchase?

Standard storage tank - $388 ❍

Hybrid electric tank - $1200 ❍

Page

6. **Instructions:** Thank you for your selection. On the following pages you will be asked to decide between these products once again. However, the price of the standard storage tank has changed. All of the other information will remain the same.

   You will decide between these products 5 more times. The price of the standard storage tank will change each time. Try not to be influenced by your previous choices. Only consider the available information when making your decisions. In other words, treat each decision like you were seeing the products for the first time.

7-11. **Iterative choice procedure:** *omitted*

12. **NEP Scale Instructions**: Thank you for your responses thus far. Next, you will see statements about the relationship between humans and the environment. For each one, please indicate whether you STRONGLY AGREE, MILDLY AGREE, are UNSURE, MILDLY DISAGREE, or STRONGLY DISAGREE with it.
    **15 NEP items were distributed across three pages. Two attentional check items included. * denotes reverse scoring**

13. Listed below are statements about the relationship between humans and the environment. For each one, please indicate whether you STRONGLY AGREE, MILDLY AGREE, are UNSURE, MILDLY DISAGREE, or STRONGLY DISAGREE with it.
    - We are approaching the limit of the number of people the earth can support
    - Humans have the right to modify the natural environment to suit their needs*
    - When humans interfere with nature it often produces disastrous consequences
    - Human ingenuity will insure that we do NOT make the earth unlivable*
    - Humans are severely abusing the environment

14. Listed below are statements about the relationship between humans and the environment. For each one, please indicate whether you STRONGLY AGREE, MILDLY AGREE, are UNSURE, MILDLY DISAGREE, or STRONGLY DISAGREE with it.
    - The earth has plenty of natural resources if we just learn how to develop them*
    - Plants and animals have as much right as humans to exist
    - The balance of nature is strong enough to cope with the impacts of modern industrial nations*
    - Please select MILDLY AGREE for this question
    - Despite our special abilities humans are still subject to the laws of nature
    - The so-called "ecological crisis" facing humankind has been greatly exaggerated*

Page

15. Listed below are statements about the relationship between humans and the environment. For each one, please indicate whether you STRONGLY AGREE, MILDLY AGREE, are UNSURE, MILDLY DISAGREE, or STRONGLY DISAGREE with it.
    - The earth is like a spaceship with very limited room and resources
    - Please select MILDLY DISAGREE for this question
    - Humans were meant to rule over the rest of nature*
    - The balance of nature is very delicate and easily upset
    - Humans will eventually learn enough about how nature works to be able to control it*
    - If things continue on their present course, we will soon experience a major ecological catastrophe

16. Please answer the following questions about yourself.

Age (*open response*)

Gender

- ❍ Female
- ❍ Male
- ❍ Prefer not to answer

Which categories best describe you? You may select more than one group.

- ❑ White
- ❑ Hispanic, Latino, or Spanish origin
- ❑ Black or African American
- ❑ Asian
- ❑ American Indian or Alaska Native
- ❑ Middle Eastern or North African
- ❑ Native Hawaiian or Other Pacific Islander
- ❑ Some other race, ethnicity, or origin _____

Page

16 (continued)

What was your total household income for the past 12 months?

- ❍ Less than $10,000
- ❍ $10,000 to $14,999
- ❍ $15,000 to $19,999
- ❍ $20,000 to $24,999
- ❍ $25,000 to $29,999
- ❍ $30,000 to $34,999
- ❍ $35,000 to $39,999
- ❍ $40,000 to $44,999
- ❍ $45,000 to $49,999
- ❍ $50,000 to $59,999
- ❍ $60,000 to $74,999
- ❍ $75,000 to $99,999
- ❍ $100,000 to $124,999
- ❍ $125,000 to $149,000
- ❍ $150,000 to $199,999
- ❍ $200,000 or more

Which of the following describes your place of residence? Check one

- ❍ Owned by you or someone else who lives in the home. Include homes with and without mortgages.
- ❍ Rented
- ❍ Occupied without rent

What is the highest degree or level of school that you have COMPLETED? Check one

- ❍ Did not finish high school
- ❍ High school diploma
- ❍ Some college but no degree
- ❍ Associate's degree
- ❍ Bachelor's degree
- ❍ Some graduate work but no graduate degree
- ❍ Master's degree
- ❍ Professional degree beyond a Bachelor's (example: MD, JD)
- ❍ Doctorate degree (example: PhD, EdD)

Page

17. **Completion code and debriefing:** *omitted*

# APPENDIX B

## EXPERIMENT 2 PROTOCOL

Page

1. **Notification statement**: *omitted*

2. **Instructions**: Thank you for agreeing to participate. On the next screen you will be shown information about two products. Please read all of the information--including the fine print. The purchase price will be displayed below each product and information about energy costs will be displayed above one of the products.

   You will be required to answer a few questions about these products. Please read carefully. You will not be allowed to continue if you answer incorrectly.

3. **Comprehension check: questions, responses, and images varied by condition. Sample items from the low magnitude, loss condition are shown below.**

Page

How much money does it cost to purchase the LED bulb?

- ❍ $3.99
- ❍ $2.10
- ❍ $3.05

How much money does it cost to purchase the CFL bulb?

- ❍ $3.99
- ❍ $2.10
- ❍ $3.05

For the AVERAGE consumer, which product is associated with higher energy costs?

- ❍ CFL
- ❍ LED

4. **Instructions:** Imagine that you must purchase one of the two products just shown. Which one would you buy? Press NEXT to make your selection. You will have a chance to review the products' details before deciding.

5.

**Compact Fluorescent Light Bulb (CFL)**
60 Watt Equivalent

Consumers who purchase a CFL pay an additional $3.05* over 5 years

*Estimates are based on national average energy costs.

$2.10

**Light-Emitting Diode Light Bulb (LED)**
60 Watt Equivalent

$3.99

Which product would you purchase?

CFL - $2.10 ❍ LED - $3.99 ❍

Page

6.


**Confidence:** The average consumer would pay an additional $3.05 over five years by purchasing the CFL bulb. **Think about your own energy usage.** If you purchased the CFL bulb, what are the chances that you personally would pay *at least* $3.05 over five years? Drag the bar below to indicate your answer from 0% to 100%.

0% = you definitely would not pay as much as the average consumer
100 % = you definitely would pay *at least as much* as the average consumer


**Controllability:** Please indicate your level of agreement with the following statements. **Participants responded from Strongly disagree to Strongly agree on a five point measure.**

- You have some control over your energy costs.
- You have limited influence over your energy costs.

Page

7. **Instructions:** Thank you for your selection. On the following pages you will be asked to decide between these products once again. However, the price of the CFL bulb has changed. All of the other information will remain the same.

   You will decide between these products 5 more times. The price of the standard storage tank will change each time. Try not to be influenced by your previous choices. Only consider the available information when making your decisions. In other words, treat each decision like you were seeing the products for the first time.

8-12. **Iterative choice procedure:** *omitted*

13. **NEP Scale Instructions**: Thank you for your responses thus far. Next, you will see statements about the relationship between humans and the environment. For each one, please indicate whether you STRONGLY AGREE, MILDLY AGREE, are UNSURE, MILDLY DISAGREE, or STRONGLY DISAGREE with it.
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14. Listed below are statements about the relationship between humans and the environment. For each one, please indicate whether you STRONGLY AGREE, MILDLY AGREE, are UNSURE, MILDLY DISAGREE, or STRONGLY DISAGREE with it.
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    - Humans have the right to modify the natural environment to suit their needs*
    - When humans interfere with nature it often produces disastrous consequences
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    - The balance of nature is strong enough to cope with the impacts of modern industrial nations*
    - Please select MILDLY AGREE for this question
    - Despite our special abilities humans are still subject to the laws of nature
    - The so-called "ecological crisis" facing humankind has been greatly exaggerated*

Page

16. Listed below are statements about the relationship between humans and the environment. For each one, please indicate whether you STRONGLY AGREE, MILDLY AGREE, are UNSURE, MILDLY DISAGREE, or STRONGLY DISAGREE with it.
    - The earth is like a spaceship with very limited room and resources
    - Please select MILDLY DISAGREE for this question
    - Humans were meant to rule over the rest of nature*
    - The balance of nature is very delicate and easily upset
    - Humans will eventually learn enough about how nature works to be able to control it*
    - If things continue on their present course, we will soon experience a major ecological catastrophe

17. Please answer the following questions about yourself.

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Gender

- ❍ Female
- ❍ Male
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Which categories best describe you? You may select more than one group.

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- ❑ Black or African American
- ❑ Asian
- ❑ American Indian or Alaska Native
- ❑ Middle Eastern or North African
- ❑ Native Hawaiian or Other Pacific Islander
- ❑ Some other race, ethnicity, or origin _____

Page

17 (continued)

What was your total household income for the past 12 months?

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- ❍ $10,000 to $14,999
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- ❍ $150,000 to $199,999
- ❍ $200,000 or more

Which of the following describes your place of residence? Check one

- ❍ Owned by you or someone else who lives in the home. Include homes with and without mortgages.
- ❍ Rented
- ❍ Occupied without rent

What is the highest degree or level of school that you have COMPLETED? Check one

- ❍ Did not finish high school
- ❍ High school diploma
- ❍ Some college but no degree
- ❍ Associate's degree
- ❍ Bachelor's degree
- ❍ Some graduate work but no graduate degree
- ❍ Master's degree
- ❍ Professional degree beyond a Bachelor's (example: MD, JD)
- ❍ Doctorate degree (example: PhD, EdD)

Page

18. **Completion code and debriefing:** *omitted*

# VITA

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## EDUCATION

Old Dominion University: PhD in Applied Experimental Psychology, Expected 2017
Old Dominion University: MS in Psychology, 2014
University of Illinois at Urbana-Champaign: BS in Psychology; minor in Business, May 2010.

## PUBLICATIONS

Langlais, P. J., & Bent, B. J. (in press). Effects of training and environment on graduate students' self-rated knowledge and judgments of responsible research behavior. *Ethics & Behavior* doi: 10.1080/10508422.2016.1260014

Langlais, P. J. & Bent, B. J. (2013). Individual and organizational predictors of the ethicality of graduate students' responses to research integrity issues. *Science and Engineering Ethics.* Advance online publication. doi: 10.1007/s11948-013-9471-2

## CONFERENCE PRESENTATIONS

Streets, V. N., & Bent, B. J. (2016, April). *Evaluation of OCBs and CWBs: Behavior or Task Framing?* Poster presented at the Society for Industrial and Organizational Psychology Annual Conference, Anaheim, CA.

Bent, B. J. (2015, November). *The Effects of Delay and Probabilistic Discounting on Green Consumerism.* Poster presented at the Society for Judgment and Decision Making Annual Conference, Chicago, IL.

Langlais, P. J. & Bent, B. J. (2015, May). *Graduate Students' Judgment of Ethical Research Behavior*. Poster presented at the Association for Psychological Science Annual Convention, New York City, NY.

Langlais, P.J. & Bent, B. J. (2014, May). *Graduate Students' Perception of Research Climate: A Case Study.* Poster presented at the Association for Psychological Science Annual Convention, San Francisco, CA.

## TEACHING EXPERIENCE

**Course Instructor**
2016, Fall – 2017, Spring. PSYC 410: Human Cognition
2015, Fall – 2016, Summer. PSYC 201: Introduction to Psychology.
2014, Summer – 2015, Summer; 2017, Spring. PSYC 318: Research Methods in Psychology.