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AN EXAMINATION OF MEAT CONSUMPTION AS A PRO-ENVIRONMENTAL BEHAVIOR AND ITS WEAK CORRELATION TO DELAY DISCOUNTING

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by

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This study presented meat consumption as an environmentally relevant behavior (ERB) and examined how the delay to an environmental loss might affect peoples' decisions to eat meat. Participants completed a delay discounting survey where they selected what percentage of meat they would eliminate from their diet based on varying delays to rising sea levels flooding of their neighborhood. After watching a brief educational video, participants completed the survey a second time to examine whether the video had any influence on discounting rates in the post-survey. Participants also completed the 27-Item Monetary Choice Questionnaire (MCQ; Kirby & Marakovic, 1996) in order to compare individuals' monetary discounting rates to their environmental discounting rates. Data were analyzed using calculations of area under the curve (AUC) and Mazur's (1987) hyperbolic discounting equation. Results showed that the average percentage of meat that people chose to eliminate from their diets decreased as a function of the delay to the environmental loss, the educational video was effective in reducing environmental discounting rates, and discounting rates for monetary outcomes were positively and significantly correlated with discounting rates for environmental outcomes. Implications, limitations, and avenues for future research are discussed.

Keywords: delay discounting, environmental behavior, climate change, meat consumption

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CHAPTER 1

INTRODUCTION

Environmental Health

For as long as humans have existed, we have survived by relying on our planet's life-sustaining resources. We need Earth's air to breathe, land to live on, and water to drink. Those elements also sustain the lives of other organisms on which we rely for food. Beyond those very basic needs, humans are now heavily dependent on earth's renewable and non-renewable resources for the production of energy and materials. All of this production and consumption inevitably results in waste that must return to the Earth. Trash, wastewater, and greenhouse gases (GHGs) go back into the ground, rivers, lakes, oceans, and atmosphere (Motesharrei et al., 2016). All of that pollution contributes to climate change and therefore puts those life-sustaining resources on which we rely in jeopardy.

Changes in our planet's climate affect a variety of domains including public health, agriculture, water supplies, energy production and use, land use and development, and recreation (Environmental Protection Agency [EPA], 2016b). For instance, the acidification of the oceans caused by carbon dioxide absorption not only affects the health of the ocean itself, but also the health of everyone whose livelihoods and nutrition depend upon the ocean (EPA, 2016a). And other shifts in climate, such as changing rainfall patterns, drought, flooding, and the geographical redistribution of pests and diseases, significantly affect agricultural production. In causing these problems, climate change continues to hinder our ability to ensure global food security and achieve sustainable development (Food and Agriculture Organization of the United Nations [FAO], 2020).

When GHGs are released into the environment, they trap heat in the Earth's atmosphere and trigger climate change in the form of global warming (FAO, 2020). As the term suggests, global warming involves a rise in the temperature of the Earth's atmosphere. Since the pre-industrial period (1850-1900), the Earth's global average surface temperature has risen by about 1.0°C, and it continues to increase by about 0.2°C each decade (Intergovernmental Panel on Climate Change [IPCC], 2018). This warming affects the environment in several capacities, some of which include rising sea levels, coastal flooding, and land loss (EPA, 2016a). Because mountain glaciers and ice sheets are melting, and ocean water increases in volume as it warms (i.e., thermal expansion), the global sea level has risen about eight inches since 1880, and three of those inches have been gained since just 1993 (Dzaugis, 2018). At the current rate, scientists have projected that the global average sea level could rise as many as eight more feet by the year 2100 (NASA, 2020b). In order to avoid significantly detrimental outcomes, scientists warn that the mean global temperature must be limited to no more than 1.5°C above pre-industrial temperatures (Masson-Delmotte et al., 2018).

Human Behavior and Climate Change

Since the mid-20th century, the most significant factor contributing to climate change has been GHGs produced by human activities, (i.e., anthropogenic GHGs; EPA, 2017). A report by the IPCC found that the sector of Agriculture, Forestry, and Other Land Use (AFOLU) accounts for 24% of anthropogenic GHG emissions, making it the largest contributor next to electricity and heat production, which accounts for 25% (Pachauri & Meyer, 2014). As research expands, studies have continued to find that the mass production of food, and more specifically the mass production of animal-based food, plays a prominent role in exacerbating climate change (Gerber et al., 2013; Springmann et al., 2016; Carl & Tilman, 2017; Rojas-Downing, 2017). This is due

to the fact that many livestock animals like cows, sheep, goats, and buffalo have ruminant digestive systems which cause them to emit a high rate of the GHG methane. On top of this, the manure management systems that are used in livestock production are also a source of methane as well as another GHG, nitrous oxide (Calvo Buendia et al., 2019; NASA, 2020a). Given these findings, experts have begun to explore different options for mitigating the effects of food production on climate change, reporting that integrated response options such as improved livestock management, reduction in the loss and waste of food, and changes in human diets can reduce GHG emissions like methane and nitrous oxide and provide significant benefits for mitigation (Edenhofer et al., 2014).

Hedenus et al. (2014) explored the possible GHG mitigation benefits of changes in food production and consumption by comparing the CO2-equivalent emissions (units in Gton CO2eq/year) resulting from five different hypothetical scenarios over the course of the next 50 years. In the reference (REF) or baseline scenario, food consumption and livestock production were aligned with FAO projections. Next, the increased productivity (IP) scenario used the same food production data as the REF scenario, while also involving more efficient livestock production (i.e., increased feed-to-product ratios). In the technical mitigation (TM) scenario, food consumption was again the same as the REF scenario, livestock production was the same as the IP scenario, and additional dedicated technical measures were included as well (e.g., improved nitrogen efficiency, altered manure management, fat additives to ruminants, and reduced methane from rice). The final two scenarios involved the same livestock productivity and technical measures as the TM scenario but differed in the area of food consumption. In the climate carnivore (CC) scenario, 75% of ruminant meat and dairy products were replaced by other meats, while in the flexitarian (FL) scenario, 75% of all meat and dairy products were

replaced by plant-based foods.

In comparison to recent reports that agricultural CO2-equivalent emissions were at 7.1 gigtons per year in 2019 (FAO, 2020), results of this study found that at baseline (i.e., REF scenario), emissions will be approximately 13 gigatons per year in 2070. When increased efficiency in livestock production are combined with dedicated mitigation measures (i.e., TM scenario), emissions are estimated to be 7.7 gigatons per year in 2070, and when 75% of all meat and dairy products are replaced by plant-based foods (i.e., FL scenario), emissions are estimated to be as low as 3 gigatons per year in 2070. With the FL scenario contributing significantly lower GHG emissions than any other scenario across all global regions and time frames, the authors concluded that "reduced ruminant meat and dairy consumption will be indispensable" in our efforts to prevent a global temperature increase greater than 1.5°C (Hedenus et al., 2014).

Mitigation through Dietary Change

There have been a variety of other studies over the last decade which have also shown that diets high animal products, particularly red meat, contribute a much higher percentage of GHG emissions relative to more plant-based diets (Stehfest et al., 2009; Popp et al., 2010; González et al., 2011; Poore & Nemecek, 2018), and that reducing meat consumption is a worthwhile strategy for mitigating climate change (Berners-Lee et al., 2012; Westhoek et al., 2014; Ranganathan et al., 2016; Springmann et al., 2018). Furthermore, a systematic review of 63 different studies on the impacts of dietary change on greenhouse gas emissions found that significant environmental benefits can be achieved by shifting current Western diets (Aleksandrowicz, 2016). The review identified 14 common dietary patterns which could reduce GHG emissions by as much as 70-80%. The most significant environmental benefits came from diets with the largest reductions in animal-based foods, with ruminant meat having the greatest

impact, followed by other meat, then dairy.

Additionally, a report released by the IPCC in 2019 specifically states that a dietary shift away from meat can reduce GHG emissions, reduce cropland and pasture requirements, enhance biodiversity protection, and reduce mitigation costs. Moreover, a decrease in the demand for meat products would allow for decreased production intensity, which could also reduce soil erosion and benefit a variety of other environmental issues such as deforestation and decreased use of fertilizer (nitrogen and phosphorus), pesticides, water and energy (Shukla et al., 2019). Without a shift in dietary trends, the human diet could contribute to an estimated 80% increase in global agricultural GHG emissions from food production by 2050 (Tilman & Clark, 2014). While this information may be unsettling, we can take comfort in the fact that if it is our behavior that is causing the problem, we have the power to address the problem by changing that behavior. To facilitate pro-environmental behavior (PEB), researchers have made a variety of recommendations including strategies to increase public knowledge/awareness of the issue, developing monetary and non-monetary incentives (Edenhofer et al., 2014), and making changes in public policy such as command and control tactics or price-based approaches (Carrico et al., 2018),

Challenges in Facilitating Behavioral Change

Facilitating change of any kind is often a daunting and difficult task, and facilitating a shift in an entire population's dietary habits is likely no exception. Beyond the frank explanation that people simply do not like change, researchers have cited a variety of factors that contribute to the difficulty in facilitating this type of PEB. For instance, one study found that most participants were simply unaware of the link between animal-based foods and environmental outcomes (Cole et al., 2009), while another advised against pairing the two factors after results

indicated that doing so provoked resistance among climate change skeptics (De Boer et al., 2013). The validity of the research on environmentally relevant behavior (ERB), which often utilizes self-reporting as the main source of data collection, has also been attributed to the challenges in facilitating PEB. Some researchers have questioned the validity of self-reporting and have cautioned against utilizing it as the sole measure of ERB (Chao & Lam, 2011). Other ERB research has been criticized for the limited scope of variables that are typically investigated, suggesting that studies have placed too much focus on mentalistic constructs like attitudes, biases, beliefs, and values (Newsome & Alavosius, 2011).

Additionally, our society is set up in a way that makes eating factory-farmed meat much more convenient and affordable than almost any other alternative (Simon, 2013). Some researchers have described this dilemma as a contrast between individual interest and common interest, where individual interests are often satisfied at the expense of common interests (Wittman & Sircova, 2018). In today's world, engaging in PEB in order to fulfill the general interest of environmental sustainability is often less enjoyable, less convenient, more costly, and more time-consuming. For instance, a person's individual interest in stopping for a quick and cheap burger from the drive-thru would conflict with the common interest in promoting environmental health through reduced meat consumption (e.g. opting for a meatless alternative that is often more expensive with limited availability and/or variety). Regarding the fulfillment of public interest, the responsibility for and adverse effects of one individual's behavior are diffused across all members of the affected group. Thus, in this case, the effects of eating one burger are impalpable, even though the sum of such actions can have detrimental effects.

Todorov (2010) has suggested that behavior analysts direct people to the more immediate consequences within their own communities, rather than focusing on the long-term, large-scale

"end-of-the-world" outcomes of climate change. Clearly a temporal conflict is at play here, between short-term and long-term interests. Environmental sustainability is a long-term interest of the public, the outcome of which lies far off in the future, while the short-term self-interest of getting a burger at the drive-thru involves a much more immediate outcome. The same can be said about lawmakers' decisions regarding climate policy. The lawmaker must assess the degree of risk involved, as one decision could result in general long-term outcomes regarding the health of our environment, while another decision could result in personal short-term outcomes regarding monetary income and job security (Edenhofer et al., 2014). Such circumstances have led researchers to hypothesize that individuals who are typically more hedonistic and impulsive are more likely to satisfy a short-term individual interest rather than engage in PEB to fulfill the long-term common interest of environmental sustainability (Kaplan et al., 2014; Wittman & Sircova, 2018; McKerchar et al., 2018).

Delay Discounting

The processes involved in the decision-making dilemmas described above can be quantified with the behavioral economics concept of discounting. Discounting involves a framework that can be used to guide our understanding of how time, probability, and other variables affect the subjective value of a given outcome (McKerchar et al., 2018). Delay, or temporal, discounting describes a situation where a person chooses a smaller, more immediate reward (SIR) over a larger, more delayed reward (LDR; Samuelson, 1937). For example, when given a choice between earning $500 now (SIR), or $700 a month from now (LDR), the one-year delay actually decreases the subjective value of the $700, and the individual opts for the $500, the value of which has comparatively increased based on the immediacy with which it will be received.

While discounting is traditionally analyzed in the context of monetary gains and losses (Kirby & Marakovic, 1996), its application can be expanded to a variety of other situations involving behavioral choices. For instance, imagine a man goes to his doctor and she tells him that he needs to lose some weight. Later that day, he goes to his nephew's birthday party and someone offers him a piece of cake. Now the man is faced with a choice between an immediate reward or a delayed and probabilistic reward. If he decides to eat the cake, there is a very high probability that he will experience the pleasure of that immediately. On the other hand, if he chooses to forego the cake, he won't experience the reward of hitting his target weight until much later down the line, and the probability that he will experience that reward will not necessarily be guaranteed by this one decision.

Given these circumstances, people often have a tendency to devalue (i.e., "discount") long-term (i.e., "delayed") outcomes in comparison to outcomes that will be experienced more immediately, even when the delayed outcome is much more significant (Madden & Bickel, 2010). Consider once again the example above: even though most would agree that enjoying physical health is more important in the long run, they may still be more likely to lean towards enjoying a piece of cake instead. In other words, they may behave impulsively, opting for the "smaller-sooner" reward rather than the "larger-later" reward (Rachlin & Green, 1972).

Researchers often collect discounting data through surveys that require participants to respond to multiple hypothetical scenarios involving different SIRs and LDRs (Kirby & Marakovic, 1996). After a person has responded to a number of discounting scenarios, a pattern of responding will often emerge regarding how drastically a given delay will decrease the subjective value of a given outcome for that person. This pattern is often attributed to a person's level of impulsivity, and it is referred to as a discounting rate (Białaszek et al., 2019). For

instance, if you were given the choice between receiving a five-dollar bill today or a one-hundred-dollar bill tomorrow, and you chose the five-dollar bill, you would be displaying a very steep discounting rate because, for you, a delay of just one day would decrease the value of that larger bill by more than 95%.

When a person takes a discounting survey, there will eventually be a point at which the value of an immediate outcome is equal to the subjective value of the delayed outcome. This is called the indifference point, or switch point, because it is the point at which a person switches from choosing the SIR to the LDR, or vice versa (Białaszek et al., 2019). For instance, given the choice between receiving $70 now or $100 a year from now, imagine your friend chose $70; and given the choice between receiving $60 now or $100 a year from now, he chose $100, meaning his indifference point would be somewhere around $65 for that delay.

Survey data are used to calculate participants' indifference points at several different delays. When these indifference points are plotted on a graph, we see that the subjective value of an outcome tends to decline on a hyperbolic curve, meaning that steeper decreases in value occur when the delay to the outcome is shorter (Thaler, 1981). This means that if your same friend from the example above was asked to choose between receiving $70 five years from now or $100 six years from now, he would be more likely to choose the $100 in that scenario, even though the delay between the two outcomes is still the same (one year). There are a number of formulas, or discounting models, researchers can utilize to quantify and describe these discounting rates, one of the most prominent being Mazur's (1987) hyperbolic discounting equation (Madden & Bickel, 2010; Kaplan et al., 2014). Further details on this will be discussed in the next section.

Research has shown that those who discount money steeply also tend to discount other

commodities steeply, and that discounting rates remain similar across real and hypothetical rewards (Johnson & Bickel, 2002; Odum, 2011). This generality is particularly noteworthy because delay discounting has been correlated with a wide range of socially significant choice-based behaviors, and steep discounting (i.e., impulsive behavior) is associated with a variety of those behaviors which are maladaptive (Białaszek et al., 2019). In recent years, studies have examined discounting behavior in relation to food (Appelhans et al., 2018), nicotine (Amlung & MacKillop, 2014; García-Pérez et al., 2020), alcohol (Phung et al., 2019); opioids (Landes et al., 2012; Karakula et al., 2016), and other drugs (Brody et al., 2014). Other studies have focused on addictions to gambling (Dixon & Holton, 2009; Shead et al., 2019), video gaming (Lavigne, 2010; Buono et al., 2017), the internet (Saville et al., 2010; Wölfling et al., 2020), and pornography (Negash et al., 2016), as well as criminal behavior (Lee et al., 2017) and sexual behavior (Hermann et al., 2014).

As discounting research expands, evidence of its utility and predictive validity continues to grow. For instance, Snider et al. (2019) asked 303 daily smokers to complete a delay discounting task and then answer questions about the frequency with which they typically engage in maladaptive behaviors related to health and finance. Results showed that delay discounting significantly predicted participants' engagement in behaviors pertaining to drug use, finances, fitness, food, health, household savings, and personal development. Another study used delay discounting to significantly predict academic engagement and grade point averages for college drinkers (Acuff et al., 2017). Lastly, a study that investigated the predictive validity of delay discounting for individuals in recovery from substance abuse found that participants who had discounted less were not currently in relapse and reported longer periods of recovery, greater confidence in their abilities to remain abstinent, higher income, and more education (Athamneh

et al., 2019).

Targeting Discount Rates for Behavior Change

With so much evidence supporting discounting as a valid predictor or correlate for such a wide variety of choice-based behaviors, it seems natural that the next step would be to investigate interventions that might influence a person's discounting rate. As such, researchers have begun developing and testing a variety of environmental manipulations to assess their impact on discounting curves (Koffarnus et al., 2013). The aim in doing this is to minimize the tendency towards impulsive decision-making and, therefore, the undesirable consequences that often result. For instance, Yi et al. (2008) implemented a contingency management intervention which rewarded smokers with cash for reducing the number of cigarettes they smoked over the course of five days. Along with a control group involving no intervention, participants completed delay discounting assessments prior to and after the five days. Results showed that participants who received the contingency management intervention had significant decreases in discount rates for both money and cigarettes.

A few of the researchers from the above study later collaborated to investigate the effects of working memory training on delay discounting among adults who were in treatment for stimulant addiction (Bickel et al., 2011). While some of the adults were randomly assigned to receive a control training, others received a working memory training that involved exercising memory skills such as recall of auditory and visual words and numbers. The participants completed monetary discounting assessments both prior to and after receiving either training. Results indicated that while the discount rates of those who received the control training remained unchanged, the working memory training was successful in significantly decreasing discount rates.

Additionally, a series of studies conducted by Malkoc et al. (2010) found that participants who engaged in concrete versus abstract thinking tended to show increases in discount rates. For instance, in one experiment, a "concrete thinking" group was instructed to consider the implications of the Digital Millennium Copyright Act for one particular person they know, while an "abstract thinking" group was instructed to consider the implications for all music consumers. Participants were then asked how much money they would pay to avoid a delay in the receipt of a $45 rebate. Results showed that the concrete group had higher discount rates as they were willing to pay more to receive the rebate sooner. Another experiment in this series instructed one group of participants to complete a word search puzzle made up of concrete words (e.g., names of fruit) while another group completed a puzzle made up of abstract words (e.g., adjectives about fruit). Again, the concrete group showed higher rates of discounting when presented with a similar scenario involving the receipt of a gift card (Malkoc et al., 2010).

The effects of context and relational frames on discount rates have also been explored in the literature. For example, Dixon et al. (2006) examined changes in the discount rates of pathological gamblers in relation to the location in which the discounting assessments were conducted. Results showed that when participants completed the assessments at an off-track betting facility, their discounting rates were much higher in comparison to when those same participants completed the assessments at a coffee shop. Changes in the discount rates of pathological gamblers were examined again in a later study which used a relational training procedure to alter the function of previously neutral stimuli (Dixon & Holton, 2009). After completing a discounting assessment which included pink squares behind larger-later rewards and purple squares behind smaller-sooner rewards, participants completed a series of match-to-sample trials where pink squares were associated with larger amounts of money and purple

squares with lower amounts of money. The same discounting assessment was then presented a second time, and results showed that participants' discount rates effectively decreased after relational training.

Framing effects were also explored by Radu et al. (2011) in the context of "explicit-zero" framing, where discounting choices are presented along with the default or null outcomes that would typically be implied but not stated. For instance, instead of presenting a choice as "$10 today or $17 in 23 days" it is presented as "$10 today and $0 in 23 days, or $0 today and $17 in 23 days". Research has shown that explicit-zero framing promotes a reduction in discounting (Magen et al., 2008), and Radu et al. (2011) went on to explore two possible reasons that might explain why this occurs. One hypothesis is that explicit-zero framing might create the impression of a sequence, making "$10 today and $0 in 23 days" appear to be a declining sequence, while "$0 today and $17 in 23 days" would appear to be an improving sequence, perhaps making the participant more inclined to choose the improving sequence.

However, when Radu et al. (2011) extended explicit-zero framing to past discounting, the improving sequence hypothesis no longer held up. Instead, the authors concluded that a hypothesis involving temporal attention provides the better explanation, finding that an increase in temporal attention to distant past and future events is effective in reducing discount rates. In other words, explicit-zero framing works because it draws the subject's attention away from the "now" and behavior becomes less influenced by immediate gratification. The temporal attention hypothesis was further supported when it was shown to be effective even without utilizing explicit-zero framing. When participants were simply asked to recall how long ago they experienced random events in their past prior to completing a delay discounting assessment (without explicit-zero framing) they still displayed a reduction in discounting in comparison to a

control group (Radu et al., 2011).

Delay Discounting and Pro-Environmental Behavior (PEB)

Given its validity and potential for significant societal benefits, researchers in psychology and behavior have recently begun applying discounting research to human behavior in the context of yet another socially significant domain, that of environmental sustainability (Berry et al., 2017). Similar to behaviors that promote physical health, many types of PEB involve higher response costs up front, paired with much longer delays to reinforcement. Thus, so far, research has shown that many types of PEB are also subject to delay discounting (Hirsh et al., 2015).

For example, Hardisty and Weber (2009) conducted a study in which 90 individuals completed discounting surveys on both monetary and environmental gains and losses. For the monetary discounting survey, participants first read the scenario, "Imagine you just won a lottery, worth $250, which will be paid to you immediately. However, the lottery commission is giving you the option of receiving a different amount, paid to you one year from now." Participants then responded to 10 questions which asked if they would prefer to receive the $250 immediately, or receive $410 (or $390, or $370, etc.) one year from now. Similar questions were used to determine the indifference point for the monetary loss survey, where participants were told to imagine that they got a parking ticket which they could pay immediately or one year in the future. For the air quality questionnaire, participants first read the following scenario:

> Imagine the local county government is considering a temporary change to its emissions policy to study the effects of air quality on human health and local wildlife. The particulate output of nearby factories and power plants would be immediately reduced (or increased) for a period of three weeks, after which time the air quality would return to its former level, but the government is also considering making the change one year in the future, for a different length of time.

Participants then responded to a series of questions which asked their preference in choices such as, "Worse air quality for 21 days, or worse air quality one year from now for 35 days."

Indifference points were fit Mazur's (1987) hyperbolic discounting equation in order to calculate and compare the *k* values that resulted from the different scenarios. Results indicated that participants discounted monetary gains and losses ($k = 0.35$ and $k = 0.06$) in a similar way to air quality gains and losses ($k = 0.45$ and $k = 0.08$). These results were further supported by a follow-up study which replicated some of these procedures and again found that participants' discounting rates for monetary outcomes were positively and significantly correlated to discounting rates for air quality (Berry et al., 2017).

Environmental outcomes were also shown to be discounted when Kaplan et al. (2014) examined the role of discounting processes in relation to soil pollution. The study involved 163 undergraduate students who completed a delay discounting questionnaire. Before responding to a series of statements and questions, the students first read the following vignette:

> Imagine that you own and operate a farm on the outskirts of town where you grow and sell vegetables. One day disaster strikes! A strike of lightening causes a large wildfire near your farm. Uncontrolled fires produce a lot of air pollution. After a while, this pollution will settle down and also pollute the soil and groundwater. Your farm is at risk.

Following this vignette were a series of statements and questions that read:

> Within [x delay], polluted groundwater will reach the farm. When that happens, no one will be able to buy or eat vegetables from your farm for a long time. What percentage of your time would you devote to solving the issue?

The delay values were one month, six months, one year, three years, five years, and ten years. Participants indicated their answers by marking an "X" on the visual analogue scale (VAS), a measurement tool comprising a horizontal line with descriptive anchors at each end. For this study, the left end of the VAS was labeled "0%" and the right end was labeled "100%".

Participants' responses were fit to Mazur's (1987) hyperbolic discounting equation in order to solve for *k*, which is the discount parameter that indicates how much a person values future outcomes relative to present outcomes. The median *k* values for individual and aggregated

data were .033 and .032, respectively, meaning that the amount of time participants were willing to spend on addressing an environmental outcome was a hyperbolic function of the delay until its occurrence (Kaplan et al., 2014).

The current study seeks to expand environmental discounting research to the topic of meat consumption. The purpose of this study is to evaluate how the delay to an environmental loss affects peoples' decisions to consume meat. Participants' discount rates of monetary choices will also be assessed and analyzed in relation to their environmental discount rates. Lastly, environmental discount rates will be assessed a second time to examine whether a brief educational video has any influence on discounting or level of concern in a post-assessment. Data will be analyzed using calculations of area under the curve (AUC) and Mazur's (1987) hyperbolic discounting equation. Implications, limitations, and avenues for future research will be discussed.

CHAPTER 2

METHODOLOGY

Participants

A convenience sample of 167 adults volunteered to participate in this study. Individuals were recruited through public posts to social media and emails requesting their participation in an online survey, which included the opportunity to be entered into a drawing to win a $15 Amazon gift card. Inclusion criteria required that participants had eaten meat within the last 30 days, were at least 18 years old, and gave consent to participate in the study. Additionally, any surveys that were less than 97% complete or did not otherwise meet criteria for quality (details discussed in results section) were excluded from the study. The remaining sample of 113 participants was composed of 91 females and 22 males, with a mean age of 41.2 years (range = 22 to 77, *SD* = 12.7).

Materials and Procedures

Participants accessed the internet using their smartphones, tablets, computers, etc. Upon clicking the link provided in the email or social media flyer, participants were taken to the online consent form on a survey platform called Qualtrics. Prior to being granted access to the survey, participants were required to indicate their informed consent, confirm that they were at least 18 years of age or older, and confirm that they had consumed meat within the last thirty days. After the consent and screener questions, participants were asked to provide demographic information including age, gender, ethnicity, annual income, region of residence, level of education completed, and field of occupation/study. At the end of the demographics questionnaire, participants were asked what percentage of their typical diet is made up of meat, and what percentage of their meals typically contain meat. Each of these questions was accompanied by a

visual analog scale (VAS) labeled 0% on the left end and 100% on the right end. Participants clicked and dragged a marker along the line to indicate their answers.

After providing their demographic information, participants were taken to the first part of the discounting survey to answer hypothetical questions about money. For this study, the 27-item Monetary Choice Questionnaire (MCQ) was administered to measure participants' discount rates, as it is the most extensively validated and widely used discounting task in the literature to date (Kirby & Marakovic, 1996; Kirby et al., 1999; Kaplan et al., 2016). The MCQ requires the participant to indicate their preferences among 27 pairs of smaller-sooner/larger-later monetary rewards. The monetary rewards were hypothetical; amounts ranged from $0 to $85 and delays ranged from 0 days to 186 days.

Following completion of the MCQ, participants were asked to indicate how strongly they agreed or disagreed with two separate statements: (a) Greenhouse gas emissions are producing a serious threat to life on our planet as we know it; and (b) Industrial meat production is one of the planet's top contributors to greenhouse gas emissions. Participants answered by selecting one of seven responses ranging from "strongly agree" to "strongly disagree".

On the next screen, participants read the following vignette before responding to an environmental discounting survey, or diet survey, involving a series of hypothetical scenarios:

> Imagine you live in a home along the coast and increases in greenhouse gases are causing sea levels to rise. Experts have projected that unless the population reduces industrial meat production/consumption by 90%, coastal neighborhoods will soon be under water. Given this information, please respond to the scenarios below.

A series of six scenarios followed, each accompanied by a VAS labeled "0%" on the left end and "100%" on the right end. The scenarios read:

> Within [X Delay], rising sea levels will begin reaching the outskirts of your neighborhood, causing some businesses to close and residents to evacuate. Move the marker on the line below to indicate what percentage of meat you will eliminate from

your diet.

The delay lengths were one month, six months, one year, three years, five years, and ten years, consistent with those used in the study by McKerchar et al. (2014).

In the next screen, participants were shown a brief (about five minutes) informational video titled, *The Diet that Helps Fight Climate Change* (Vox, 2017). The video, which is produced by the University of California and hosted by conservation scientist Dr. M. Sanjayan, presents an evidence-based discussion about the effects of industrial meat production on climate change and how we can shift our diets in order to better support the environment. It includes interviews with scientists and researchers, animation and graphic depictions of statistics like charts and graphs, and images of food and people eating. Participants were then required to answer two questions about the video's content to help ensure attention and comprehension before continuing to the next section. If a question was answered incorrectly, participants received an error message suggesting that they review the video once more before attempting to answer the questions again.

After answering both video questions correctly, participants were granted access to the final section of the survey, where they were asked how strongly they agreed or disagreed with the same two statements about GHGs and industrial meat production from earlier in the survey. Finally, participants were asked to respond once more to the same six environmental discounting scenarios from earlier in the survey (identical to those described above). Upon finishing the questionnaire, participants received a thank you message which also provided them with an opportunity to provide their email address in order to be entered into a drawing to win a $15 Amazon gift card.

Data Analysis

Data from the environmental discounting surveys were analyzed by calculating area under the curve (AUC), a strategy for estimating degrees of discounting proposed by Myerson, Green, and Warusawitharana (2001). For the current study, AUC values were calculated using a discounting calculator that was created in Excel 2010 based on a tutorial from Reed et al. (2012). To calculate AUC values, indifference points are plotted on the *y*-axis as a function of delay plotted along the *x*-axis, creating a curved line. Vertical lines are then drawn from each data point straight down to the *x*-axis, creating a series of trapezoids under the curve. The area of each trapezoid is calculated, and the sum of those areas yields an AUC estimate. The equation for this analysis is:

$$\text{AUC} = \sum (x_2 - x_1)\,[(y_1 + y_2)/2], \tag{1}$$

where x_1 and x_2 are the successive delay values (i.e., number of months), and y_1 and y_2 are the subjective values (i.e., percentage of meat eliminated). Finally, to calculate a total proportion of AUC, the summed AUC is divided by the total possible AUC. The total possible AUC is equal to the maximum width (i.e., delay; 120 months) multiplied by the height (i.e., undiscounted amount; 100%). AUC values range from 0 to 1, with lower values indicating a steeper discounting curve.

Data collected from the MCQ were analyzed based on *k* values calculated by the 27-Item Monetary Choice Questionnaire Auto-Scorer developed by Kaplan et al. (2016). The auto-scorer estimates participants' overall *k* values based on their response patterns across all 27 items. An individual *k* value for each item can first be calculated according to Mazur's (1987) discounting equation, a commonly used hyperbolic model with considerable descriptive support (Kirby & Marakovic, 1996; Hardisty & Weber, 2009):

$$V = A / (1+kD). \quad (2)$$

In terms of the data collected from the MCQ, *V* represents the amount of money available today, *A* represents the amount of money available in the future, and *D* represents the delay (in days). The equation can then be solved for *k*, the fitted parameter (i.e., rate of discounting) which describes how much someone values future outcomes relative to present outcomes. For instance, if the equation results in $k = 0$, the present and future are being valued equally. When *k* is above zero, future outcomes are being discounted (the higher the *k*, the larger the discount rate), meaning the participant prefers gains to be immediate rather than delayed. Conversely, a *k* below zero indicates negative discounting, meaning the participant prefers gains to be delayed. Thus, *k* values negatively correlate with the AUC values derived from Equation (1), meaning that participants with high *k* values (i.e., those who discount steeply) will have low AUC values. For the MCQ, the auto-scorer generates a consistency score (described in further detail below) for each of the 27 *k* values, and the geometric mean of the two *k* values with the highest consistency scores then becomes the participant's overall *k* value.

To clarify the delay discounting results a bit further, a technique presented by Yoon and Higgins (2008) was utilized. The technique is adapted from a commonly used method for quantifying the effects of drugs in receptor pharmacology via the *ED*50, the drug dose that is observed to produce 50% of the maximum possible effect (Ross & Kenakin, 2001). When different variables cause changes in dose-response functions, those changes can then be observed, described, and contrasted as changes in *ED*50 values. To adapt this method to delay discounting, the *ED*50 would be the *effective delay* (e.g., number of days), rather than *effective dose*, that discounts the value of a reward (e.g., money) by 50%, and it is calculated using the formula:

$$ED50 = 1 / k. \quad (3)$$

Next, Non-Impulsive and Impulsive groups were formed based on a median split of participants' *k* values from the MCQ. The two groups were then compared based on participants' AUC values from the diet survey to assess whether any relationship existed between impulsivity and meat consumption as an environmentally relevant behavior. Because AUC data were not normally distributed, the Mann-Whitney *U* test was used to compare AUC values across Impulsive and Non-Impulsive groups. Within-group comparisons of pre-survey and post-survey AUC values were performed using the Wilcoxon signed rank test. To analyze the data gathered from the agree/disagree statements in the environmental survey, participants' responses were converted to numeric values according to a 7-point Likert scale (7 = Strongly Agree, 6 = Agree, 5 = Somewhat Agree…1 = Strongly Disagree) and a mean score was calculated for each statement. Finally, a Pearson correlation coefficient was calculated to determine whether there was any significant correlation between the *k* values from the MCQ and the AUC values from the diet survey. Because the *k* values from the MCQ were not normally distributed, they were log10-transformed for analysis. Statistical analyses were conducted using IBM SPSS Statistics 27, with the statistical significance level set at .05.

Data Quality

To control for careless or random responding on behalf of the participant, the data collected were assessed for quality prior to analysis. In the MCQ, three additional questions were included as "attention checks" in which participants were presented with a choice between a smaller amount of money today or a larger amount of money today (e.g., "Which would you rather have? $30 today or $45 today"). If a participant chose the smaller amount for at least two of the three questions, their data were eliminated from the study. For the present study, data from

one participant were excluded based on a failure to pass the attention checks.

Additionally, consistency scores were calculated for the MCQ to assess how consistent participants' response patterns were prior to, at, and following their switch points (i.e., the point at which the participant switches from SIR choices to LDR choices). For instance, imagine that the numbers from each of the 27 items (i.e., questions) were plugged into Equation (2), producing 27 individual *k* values, one for each item. For each item, the participant is required to choose either the SIR or the LDR. If the participant chooses the SIR, their *k* value would logically be equal to or greater than the *k* value calculated for that item. On the other hand, if the participant chooses the LDR, their *k* value would logically be equal to or less than the *k* value for that item. Given these presumptions, for each item, the degree to which the participant's response is consistent with their preceding and succeeding responses is calculated.

To determine a consistency score for each item, the calculator counts the number of times the participant selected an SIR prior to the given *k* value, and the number of times they selected an LDR at and/or following the given *k* value. The sum of those two numbers is then divided by the total number of possible responses (i.e., 27) to determine the consistency score. As mentioned above, the geometric mean of the two *k* values with the highest consistency scores then becomes the participant's overall *k* value. The larger the consistency score, the more consistent the response pattern. Consistency scores which are less than 75% may indicate careless or random responding. There were no participants with consistency scores lower than 75% in the current study, so no data were eliminated from analysis due to inconsistency.

Finally, an algorithm developed by Johnson and Bickel (2008) was used to identify nonsystematic data from the environmental loss survey. Specifically, if any subjective value (i.e., percentage of meat eliminated from diet; starting with the second delay) was greater than the

preceding subjective value by more than 20%, suggesting that further delay caused the subjective value to *increase* rather than *decrease*, data from that survey were excluded from the study. In terms of the diet survey, consider the first two questions. The first question asks how much meat participants would eliminate from their diet if rising sea levels will reach their neighborhood within one month, and the second question, within six months. An example of systematic data would show that the person selected a higher percentage at the one-month delay, because when the loss is more immediate, the value of reducing meat consumption in order to prevent that loss increases.

On the other hand, imagine a participant chose to reduce meat consumption by just 10% when the delay to the environmental loss was only one month, and they chose to reduce by 40% at the six-month delay, when the environmental loss was actually less imminent. This would be considered nonsystematic, as the participant is suggesting that the value of reducing meat consumption in order to prevent an environmental loss *decreases* as the loss becomes more imminent. Furthermore, applying the algorithm described above, data from this participant would be eliminated, as the subjective value of 40% is more than 20% greater than the preceding subjective value of 10%. In the current study, the data from six participants were found to be nonsystematic and thus were eliminated prior to data analysis.

CHAPTER 3

RESULTS

Of the 167 people originally screened, 113 were ultimately included for data analysis. Eight participants were excluded from the study after confirming that they had not eaten any meat within the last 30 days, 39 participants completed less than 97% of the survey, and data from eight participants failed to meet the established quality standards. Figure 1 shows a flow diagram detailing the number of participants excluded at each check point.

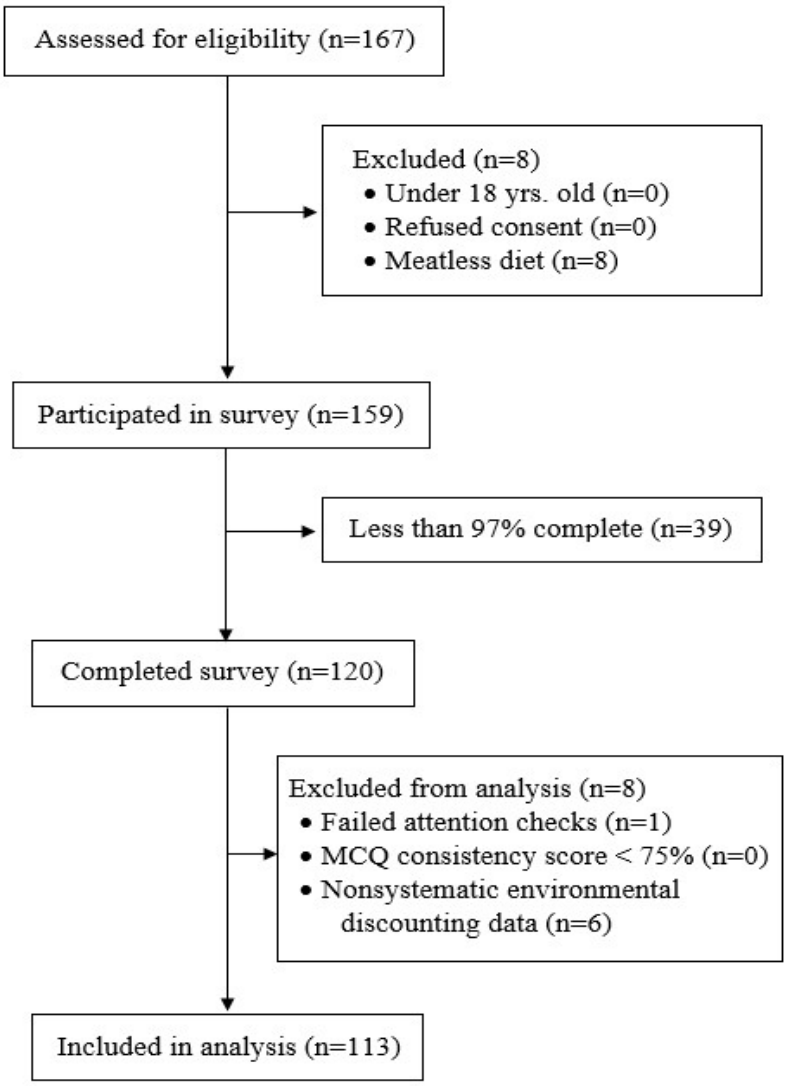

Figure 1. *Flow Diagram of Participant Exclusion*. Flow chart depicting process for eliminating participants based on exclusion criteria.

Of the remaining 113 participants, the majority identified themselves as female (80.5%) and white (86.7%). Hispanic or Latino participants made up 5.3% of the sample, followed by 3.5% Asian, 1.8% African American or black, 1.8% multiracial, and 0.9% Native Hawaiian or Pacific Islander. The mean age of participants was 41.2 years (*SD* = 12.7), with 42.5% of individuals ranging from 26 to 35 years old, and 24.8% ranging from 36 to 45 years old. On average, participants reported that 39.4% (*SD* = 18.7%) of their diets comprise meat, and 52.7% (*SD* = 24.8%) of their meals contain meat. Table 1 displays a complete list of the demographic data collected for this study.

Table 1

Participant Demographics

Characteristics	N	%	M	SD
Percentage of diet containing meat			39.4	18.3
1% - 19%	10	8.8		
20% - 39%	46	40.7		
40% - 59%	38	33.6		
60% - 79%	17	15		
80% +	2	1.8		
Percentage of meals containing meat			52.7	24.8
1% - 19%	6	5.3		
20% - 39%	29	25.7		
40% - 59%	30	26.5		
60% - 79%	28	24.8		
80% +	20	17.7		
Age			41.2	12.7
18 - 25 yrs. old	2	1.8		
26 - 35 yrs. old	48	42.5		
36 - 45 yrs. old	28	24.8		
46 - 55 yrs. old	14	12.4		
56 - 65 yrs. old	16	14.2		
66 - 75 yrs. old	4	3.5		
76 yrs. old +	1	0.9		
Gender				
Female	91	80.5		
Male	22	19.5		
Other	0	0		
Ethnicity				
American Indian or Alaska Native	0	0		
Asian	4	3.5		
Black or African American	2	1.8		
Hispanic or Latino	6	5.3		
Native Hawaiian or Pacific Islander	1	0.9		
White	98	86.7		
Bi/Multiracial	2	1.8		

Note. Demographic characteristics of participants included in study.

Table 1 (continued)

Participant Demographics Continued

Characteristics	N	%
Annual Income		
Less than $25,000	7	6.2
$25,000 - $44,999	20	17.7
$45,000 - $64,999	21	18.6
$65,000 - $84,999	22	19.5
$85,000 - $104,999	14	12.4
$105,000 +	29	25.7
Region of Residence		
Midwest	85	75.2
Northeast	2	1.8
South	11	9.7
West	15	13.3
Education		
High school diploma	6	5.3
Some post-secondary coursework	8	7.1
Associate degree	6	5.3
Bachelor's degree	40	35.4
Some graduate-level coursework	15	13.3
Master's degree	34	30.1
Doctorate	4	3.5
Field of Occupation/Study		
Agriculture, forestry, fishing, and hunting	1	0.9
Construction	0	0
Education and health services	44	38.9
Financial activities	6	5.3
Information	8	7.1
Leisure and hospitality	1	0.9
Manufacturing	1	0.9
Mining, quarrying, and oil and gas extraction	0	0
Other services (e.g., repair & maintenance, beauty services, religious/social/advocacy organizations, etc.)	26	23
Professional and business services	19	16.8
Public administration	3	2.7
Transportation and utilities	3	2.7
Wholesale and retail trade	1	0.9

Note. Demographic characteristics of participants included in study.

Figure 2 shows the mean percentages of meat that participants chose to eliminate from their diets as a function of the delay to an environmental loss (i.e., flooding due to rising sea levels) for the pre- and post-surveys on diet. For both surveys, the average percentage of meat eliminated decreased as a function of the delay to the environmental loss. From pre-survey to post-survey, the average percentage of meat that participants chose to eliminate from their diets increased. When those mean scores were plotted, the pre-survey data had an AUC value of .537, and the post-survey data had a slightly higher AUC value of .625.

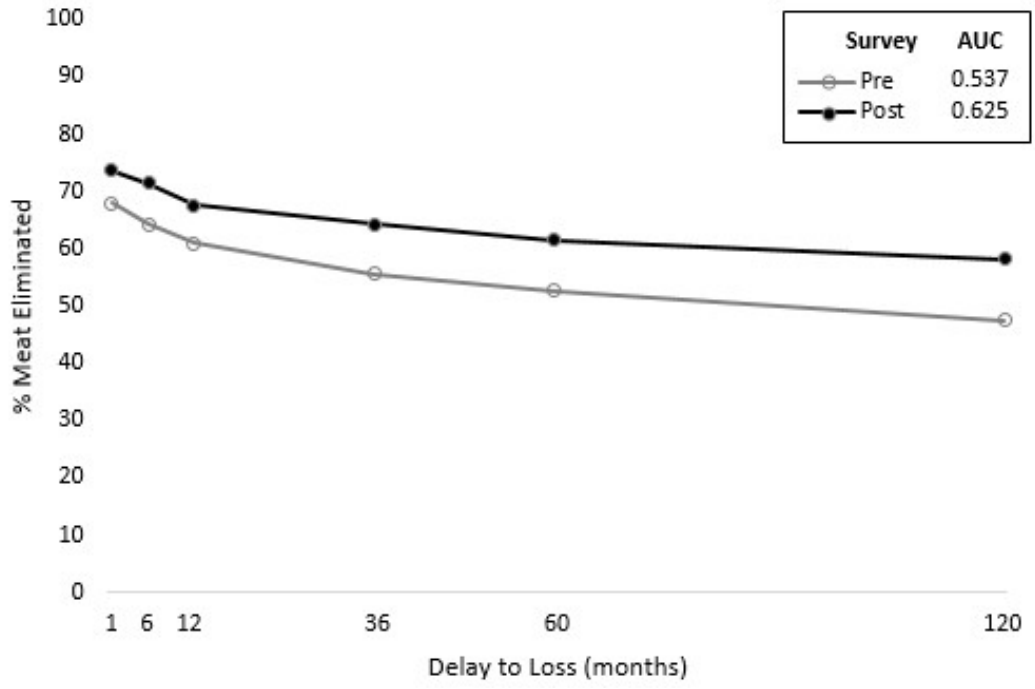

Figure 2. *Mean Percentages of Meat Eliminated as Function of Delay.* Line graph displaying the mean percentages of meat that participants chose to eliminate from their diets as a function of the delay to an environmental loss for the pre-survey and post-survey.

Individually, from pre-survey to post-survey, 63 participants chose to decrease meat consumption, 40 participants showed no change, and 10 participants chose to increase their meat consumption. A comparison of the AUC values from the pre-survey and post-survey is displayed in Figure 3. Again, participants' average AUC values were .537 (range = 0 to .996, *SD* = .33) for

the pre-survey, and .625 (range = 0 to .996, *SD* = .322) for the post-survey. Statistical significance was confirmed by the results of the Wilcoxon signed rank test, $Z = -5.83$, $p < .001$.

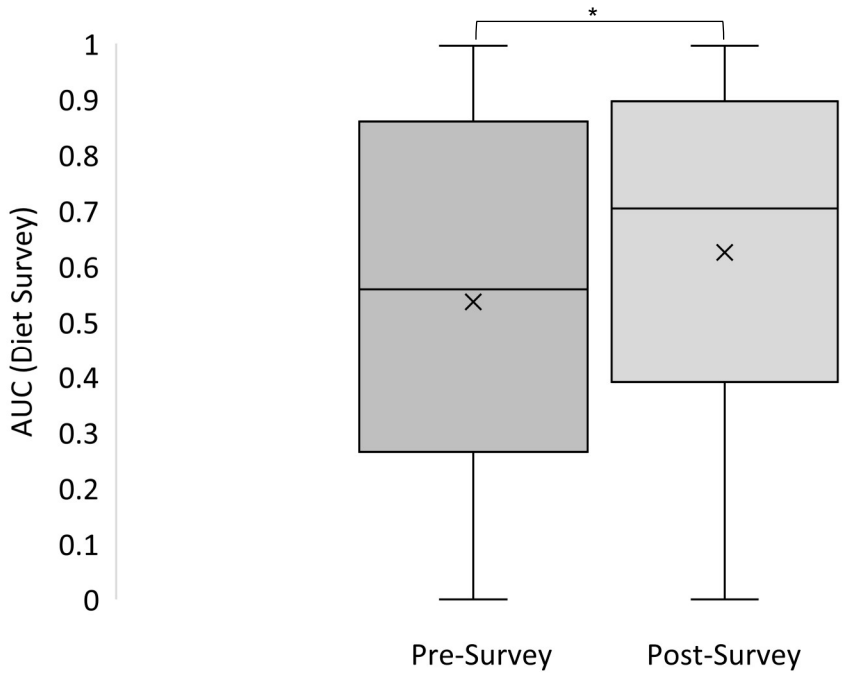

Figure 3. *Boxplot of AUC Values from Pre-Survey and Post-Survey.* Boxplot of participants' AUC values from pre-survey and post-survey. The *x* and horizontal line in each box represent the mean and median AUC values, respectively. * $p < .001$.

Next, participants' responses regarding how strongly they agreed or disagreed with the statements about climate change were converted to numeric values based on a 7-point Likert scale (1 = Strongly Disagree, 7 = Strongly Agree). For the statement that GHG emissions are producing a serious threat to life on our planet, participants' mean response was 6 (i.e., "Agree") for the pre-survey (*SD* = 1.4), and 6.2 (i.e., "Agree", slightly stronger) for the post-survey (*SD* = 1.2). For the statement that industrial meat production is one of the planet's top contributors to GHG emissions, participants' mean response was 5.3 (i.e., "Somewhat Agree") for the pre-survey (*SD* = 1.2), and 6.1 (i.e., "Agree") for the post-survey (*SD* = .2).

For a more detailed analysis of the results of the diet survey, Non-Impulsive and Impulsive groups were formed based on a median split of participants' *k* values from the MCQ.

Participants in the Non-Impulsive group had individual *k* values between 0 and .005 (mean = .002, *ED*50 = 500 days, *SD* = .001), and participants in the Impulsive group had individual *k* values between .006 and .249 (mean = .034, *ED*50 = 29 days, *SD* = .046). For both groups and both surveys, the mean percentages of meat that participants chose to eliminate from their diets decreased as a function of the delay to the environmental loss (i.e., flooding due to rising sea levels). Figure 4 shows the mean scores for both groups. AUC values for the Non-Impulsive group were .58 (pre-survey) and.643 (post-survey), and AUC values for the Impulsive group were .486 (pre-survey) and .605 (post-survey).

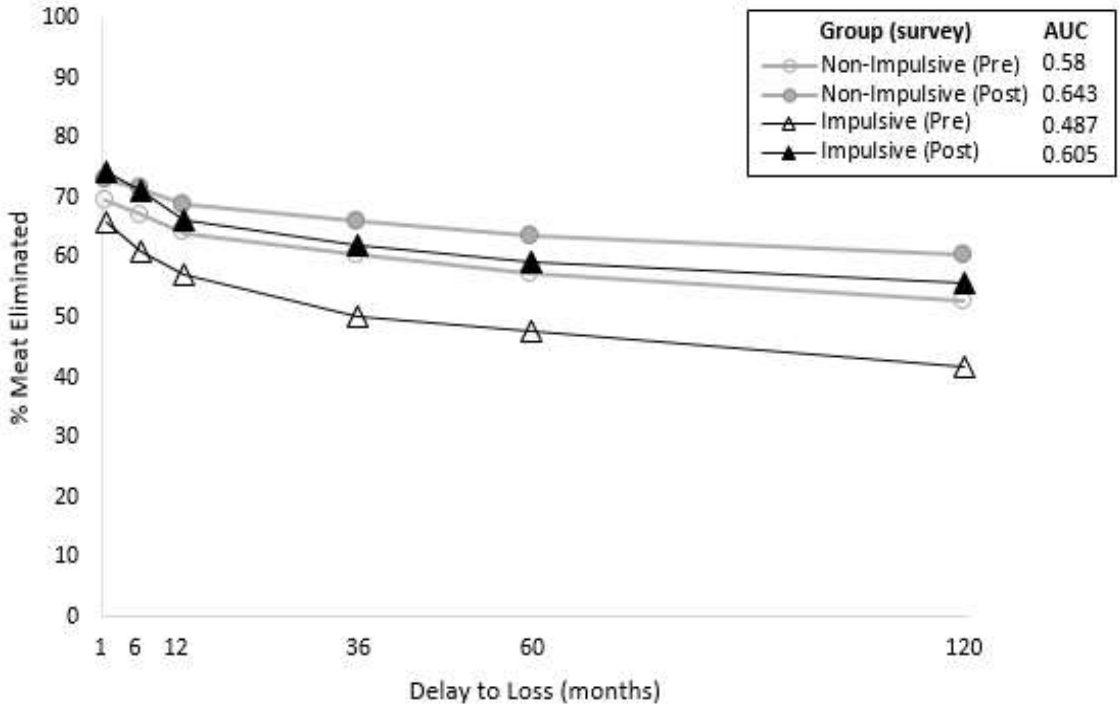

Figure 4. *Mean Percentages of Meat Eliminated as Function of Delay (Median Split).* Line graph displaying the mean percentages of meat that the Non-Impulsive and Impulsive groups chose to eliminate from their diets as a function of the delay to an environmental loss for the pre-survey and post-survey.

Figure 5 displays a comparison of the AUC values from the pre- and post-surveys for the Non-Impulsive and Impulsive groups. For the Non-Impulsive group, average AUC values from the pre-survey (.58, range = 0 to .996, *SD* = .348) and post-survey (.643, range = 0 to .996, *SD* =

.342) were higher (i.e., discounting rates were lower) than those of the Impulsive group (.487, range = 0 to .996, *SD* = .305; and .605, range = 0 to .996, *SD* = .299, respectively), although the Mann-Whitney U test revealed that there was not a statistically significant difference between groups for the pre-survey, $U = 1304$, $p = .1$; and post-survey, $U = 1413.5$, $p = .31$. Just as Figure 4 displayed above, Figure 5 shows that for both the Non-Impulsive and Impulsive groups, the mean AUC values increased from pre-survey to post-survey. The Wilcoxon signed-rank test found the differences from pre- to post-survey statistically significant for both the Non-Impulsive group, $Z = -3.309$, $p = .001$; and for the Impulsive group, $Z = -4.818$, $p < .001$.

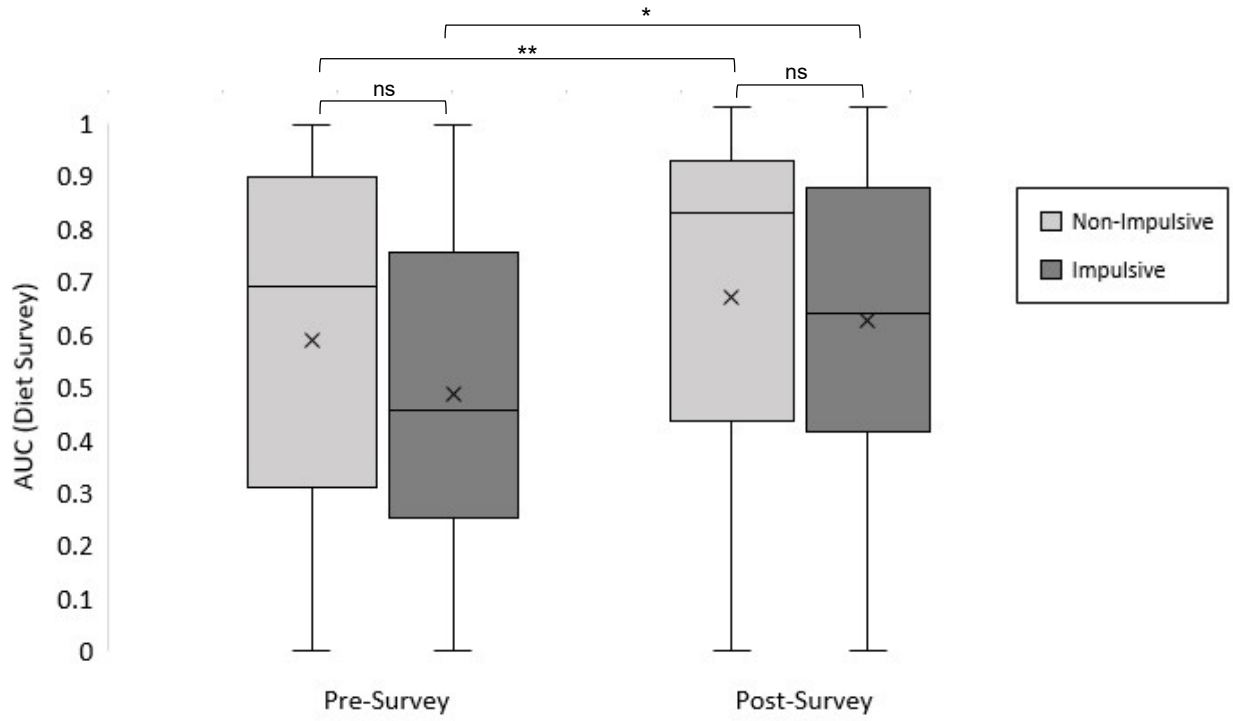

Figure 5. *Boxplot of AUC Values from Pre-Survey and Post-Survey (Median Split).* Boxplot of participants' AUC values by group (Impulsive and Non-Impulsive) from pre-survey (left) and post-survey (right). The *x* and horizontal line in each box represent the mean and median AUC values, respectively. * $p < .001$. ** $p = .001$.

In regard to the MCQ, participants' average *k* value was .017 (*ED*50 = 59 days, range = 0 to .249, *SD* = .035). Because *k* values were not normally distributed, a log10 transformation was performed prior to analysis for Figures 6 and 7. In Figure 6, participants' log *k* values from the

MCQ, and AUC values from the diet survey, are displayed on a scatterplot, showing a negative correlation. This correlation was statistically significant with a Pearson correlation coefficient of $r = -.201$ ($p = .033$).

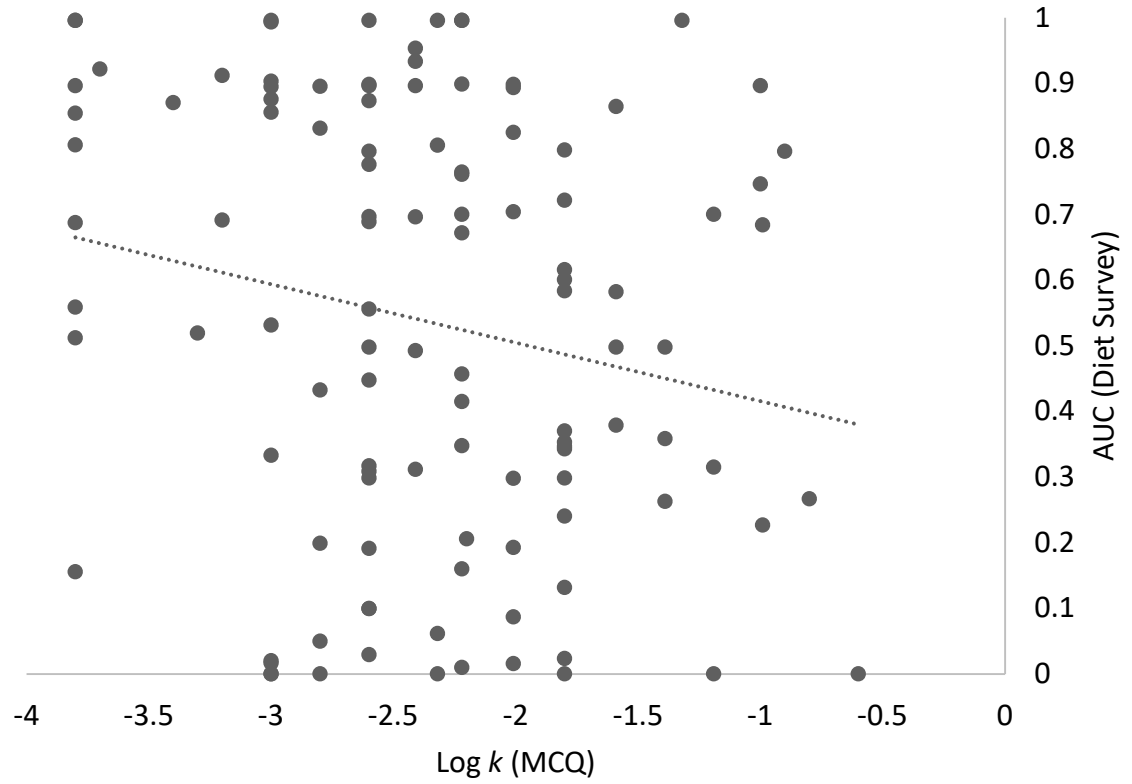

Figure 6. *Scatterplot of AUC and Log k Values.* Scatterplot of log *k* values from MCQ on the *x*-axis and corresponding AUC values on the *y*-axis. The further the log *k* value is to the left, the higher the discount rate. Dotted line represents line of best fit.

Figure 7 presents an alternative comparison, where the difference between participants' pre-survey and post-survey AUC values were calculated, and then those difference values were compared to the same corresponding log *k* values described above. With a Pearson correlation coefficient of $r = .161$, this comparison did not prove to be statistically significant ($p = .089$).

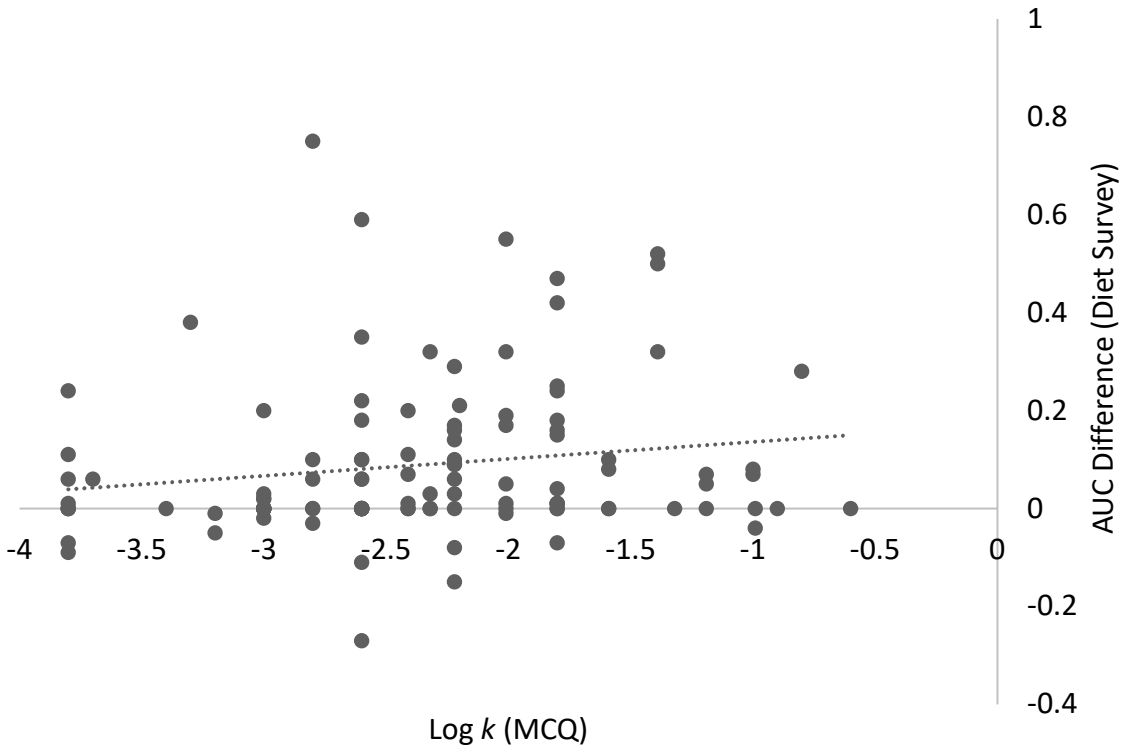

Figure 7. *Scatterplot of AUC Difference Values and Log k Values.* Scatterplot of log *k* values from MCQ on the *x*-axis and corresponding AUC difference values on the *y*-axis. Dotted line represents line of best fit.

CHAPTER 4

DISCUSSION

This study presented meat consumption as an environmentally relevant behavior (ERB) and examined how the delay to an environmental loss might affect peoples' decisions to eat meat. Research has already established a strong correlation between delay discounting and a variety of socially significant behaviors including drug and alcohol addiction (Brody et al., 2014; Phung et al., 2019), diet and exercise (Appelhans et al., 2018; Leahey et al., 2020), gambling (Dixon & Holton, 2009; Shead et al., 2019), etc., and the current study's findings contribute to the expansion of that list via the addition of meat consumption as an ERB.

The results from the environmental discounting survey showed that the average percentage of meat that people chose to eliminate from their diets decreased as a function of the delay to the environmental loss, meaning that the value of preventing flooding as an environmental loss is subject to delay discounting. These findings are in accord with those of Kaplan et al. (2014) when they presented participants with a discounting task involving the effects of wildfires and pollution on local farmland. The results of that study revealed that the amount of time participants were willing to spend on preventing soil pollution was a function of the delay until its occurrence, meaning that the environmental loss was subject to delay discounting. As such, the findings of the present study further support previous research that, like many other socially significant behaviors, ERB is also subject to delay discounting. The fact that climate change outcomes tend to be further delayed would explain why people tend to be less inclined to engage in immediate ERB change.

The commitment and eventual behavior change toward a delayed reward has also been attributed to the underlying process of preference reversal. Rachlin and Greene (1972) first

explored preference reversal when they presented pigeons with a choice between access to grain for two seconds (SIR) or access to grain for four seconds following a four-second delay (LDR). Initially, the pigeons always preferred the SIR; however, when the pigeons were required to wait for a certain period of time before being allowed to choose either option, they reversed their preference and began opting for the LDR. In other words, when an initial delay is required prior to choosing either option, the secondary delay of the LDR becomes less of a deterrent. In terms of the current study, as the delay to the environmental loss would decrease (i.e., flooding gets closer), people who hadn't originally reduced their meat consumption may even do so, exhibiting preference reversal by choosing to eliminate more meat from their diet. None of the scenarios in the present study involved a delay to the SIR (eating meat), which could be another factor contributing to participants' tendency to discount the value of the LDR (preventing flooding).

The results also showed that the informational video that participants watched following the pre-survey did prove to be somewhat effective in influencing responses for the post-survey. From pre-survey to post-survey, the average percentage of meat that participants chose to eliminate from their diets increased, which could mean that many participants were simply unaware of the impact that meat production has on the environment. After watching the video, participants also expressed stronger overall agreement with statements about the relationship between meat production, GHG emissions, and climate change, and the threats they pose to our planet. Furthermore, informal anecdotal data retrieved via comments on social media revealed that several participants were unaware of this environmental impact prior to watching the video.

These findings support previous research on the effects of knowledge and awareness on environmental behavior. For instance, Safari et al. (2018) surveyed 120 managers at a steel company and found that environmental knowledge and awareness had a significant direct effect

on managers' ERB in the workplace (e.g., printing double-sided, taking stairs instead of elevator, turning off lights, etc.), as well as significant indirect effects via self-reported behavioral intentions, environmental attitude, and "green commitment". Similarly, a recent study by Yilmaz and Can (2020) utilized "structural equation modeling (SEM)" to assess the impact of knowledge, concern, and awareness about global warming on ERB and found that as participants' knowledge of climate change increased, their concern and awareness increased and produced indirect effects on environmental behavior.

When participants were split into the Non-Impulsive and Impulsive groups based on their log *k* values, it was interesting to note that while both groups exhibited statistically significant decreases in AUC values after watching the video, the Impulsive group showed a greater difference from pre-survey to post-survey than the Non-Impulsive group. The Non-Impulsive group's overall percentages of meat reduction were still greater than the Impulsive group's percentages, although that difference was not found to be statistically significant. This lack of statistical significance could mean that meat consumption as an ERB is not as strongly tied to impulsivity as other ERBs from the literature, such as those related to air quality (Hardisty & Weber, 2009; discussed below).

Still, when participants' responding in the environmental discounting survey was directly compared to their responding in the MCQ, results did show that those who displayed higher degrees of impulsivity in the MCQ generally exhibited higher degrees of discounting in the diet survey as well. These findings align with the results of the study by Hardisty and Weber (2009) in which 90 individuals completed discounting surveys on both monetary and environmental (air quality) outcomes, and the results showed that participants maintained a similar discount rate for both money and air quality. These results were further supported by a follow-up study which also

compared participants' responses to discounting surveys on money and air quality and, again, found that participants' discounting rates for monetary outcomes were positively and significantly correlated to their discounting rates for environmental outcomes (Berry et al., 2017).

When the difference values from pre-survey to post-survey were compared to MCQ scores, however, there was no significant correlation. One might have initially expected that participants with low discounting rates (i.e., the Non-Impulsive group) in the MCQ would have exhibited larger decreases in meat consumption from pre-survey to post-survey; however, one could also argue that those who are impulsive might be more likely to show a more drastic change from survey to survey, while those who are less impulsive would have more measured, consistent responses from the start, having already applied significant forethought to their choices in the pre-survey.

Limitations

Certain limitations should be considered in the discussion of the present study. First, the individuals who participated in this study were recruited via convenience sampling. Limited to a somewhat narrow pool of contacts, the population surveyed did not end up representing a very demographically diverse group of people. Rather, 80.5% of the participants identified as female, 86.7% identified as white, and 75.2% resided in the Midwest. Therefore, the results of this study are only representative of a specific demographic group within the United States, rather than the broader American population.

It should also be noted that all of the data collected in this study were self-reported and, thus, may have been subject to a variety of biases. Although certain measures were in place to mitigate the presence of invalid or unreliable data, the possibility for dishonesty, exaggeration,

and/or careless responding still remains. Additionally, all questions were based on hypothetical scenarios, so there would be no way to observe or independently verify the accuracy of the reported behavior, and it is possible that even the most honest and careful responder could misjudge the way they would actually behave if any of these scenarios occurred in reality. However, some studies have found that discounting rates remain similar across real and hypothetical rewards (Johnson & Bickel, 2002; Odum, 2011).

Finally, despite the inclusion of a pre- and post-component, a separate control group was not incorporated into this design. If half of the participants were designated as the control group, they would have been presented with a different, nondescript video while the other participants watched the informational video. The changes from pre-survey to post-survey could then be compared between the two groups. If the control group demonstrated little to no change, this would strengthen the claim that any changes which occurred in the intervention group were directly influenced by the informational video rather than any other possible confounding factors, such as testing effects. For example, Sharpe and Gilbert (1998) examined the effects of repeated administration of mood assessments such as the Beck Depression Inventory (BDI) and found that testing effects occurred for several of the measures, meaning that, even without treatment, participants' scores changed as a result of simply retaking the assessment. It should be noted, however, that recent research on the test-retest reliability of delay discounting tasks in particular has shown promising results (Matusiewicz et al., 2013; Weafer et al., 2013; Kuang et al., 2018).

Future Research

Given that the study of PEB in relation to delay discounting has only recently begun, the possibilities for future research are vast. While the addition of a control group to the current

study would be a good start, the exploration of other interventions beyond a simple informational video will also be valuable. There is strong supporting evidence that decisions related to ERB are subject to delay discounting, and now more work is needed on how to effectively influence discounting rates related to those behaviors. Affecting discounting rates associated with ERB is still a fairly new area of study, however plenty of research exists on changing discounting rates related to other behaviors. For example, Yi et al. (2008) found that a contingency management intervention which rewarded smokers with cash for reducing the number of cigarettes they smoked was successful in significantly decreasing participants' discount rates for both money and cigarettes. In another study, Bickel et al. (2011) found that a working memory training which involved exercising memory skills such as recall of auditory and visual words and numbers was successful in significantly reducing monetary discount rates

Additionally, while there is significant empirical evidence that supports the effectiveness of knowledge and awareness interventions, the context in which those interventions are successful may be a determining factor. Skinner (1987) has said that warnings and predictions of aversive outcomes can sometimes have an effect that is opposite to what was intended – creating motivation for individuals to escape or avoid the issue rather than address it. The results of the present study showed that enhancing the knowledge and awareness of the topic was effective in increasing hypothetical PEB, although it is not certain that the same results would be reflected in a real-life scenario. Past research has indicated that humans do not always behave in accordance with their stated intentions and, therefore, knowledge of future aversive consequences does not necessarily lead to adaptive behavior (Hirsh et al., 2015). This is particularly true if reduced meat consumption requires more effort and/or if the individual has no history of reinforcement related to reduced meat consumption.

These confounding factors highlight two main avenues worthy of exploration. First, the issue of discrepancy between one's hypothetical responses and their actual behavior warrants the exploration of methods for strengthening the alignment of an individual's behavior with their intentions. Acceptance and Commitment Therapy (ACT) could be a vital tool in relation to this avenue, as the commitment to values-based action is one of its main components (Hayes et al., 2012). Essentially, in addition to enhancing individuals' knowledge and awareness of the consequences of ERB, future research would do well to analyze the role that verbal behavior plays in ERB by assessing the effects of interventions based on the principles of Relational Frame Theory (RFT), such as those used in ACT (Torneke, 2010).

Second, future research should continue to identify and examine the specific factors related to PEB that reduce individuals' likelihood of aligning their behavior with their intentions (e.g., lack of reinforcement, increased effort due to availability/fewer alternative options, expense, general change in routine, etc.) and then test the effects of eliminating or altering those factors. For example, one might develop scenarios to examine the effects of different types of reinforcement on PEB (e.g., social praise, tangibles). Other scenarios might examine the effects of reducing the prices of meat alternatives, increasing availability in restaurants and/or grocery stores, or even the effects of reducing the response cost through a meal kit subscription service similar to Blue Apron or Hello Fresh. Even if creating a real-life scenario would not be feasible, the analysis of hypothetical scenarios can still provide valuable preliminary information, and enough promising results could even support the justification for funding a more involved study further down the line.

The current study sought to expand environmental discounting research to the topic of meat consumption. The results produced and the associated recommendations for future research

will help inform the ongoing exploration of human behavior as it relates to the environment and climate change. The continued study of the challenges facing large-scale environmentally-relevant behavior change, and the innovative strategies to address and overcome those challenges, will be invaluable not only to the field of behavior analysis, but to essentially all fields of study and domains of life. While the challenges may appear daunting, may the boundless opportunities for research and collaboration provide the encouragement and motivation to continue this necessary work.

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APPENDIX A

DELAY DISCOUNTING SURVEY

Discounting Environmental Loss

Start of Block: 1. Consent/Screener

Q1.1 You are invited to participate in a survey that is being conducted as part of a research project and thesis by Sarah Parkinson, a graduate student at Southern Illinois University Carbondale. This survey will ask you about your preferences regarding the receipt of money, your diet/meat consumption, and your beliefs regarding climate change. The purpose of this study is to analyze variables that affect the decisions people make in regard to the aforementioned topics. You will also be asked to provide demographic information such as age, ethnicity, education level, occupation, etc. Including a brief video, this survey should take about 30 minutes to complete. At the end of the survey, you will have the opportunity to provide your email address in order to opt into a drawing for a $15 Amazon gift card. Participation is limited to those who eat meat and are at least 18 years old. This survey does not pose a risk to participants' physical or emotional well-being. Participants will remain anonymous; your name, specific location, or other identifying information will not be collected over the course of this survey. All information related to this study will be kept password protected, and only the graduate student and faculty advisor will have access to responses to survey questions. Unless you voluntarily provide your email address in order to enter the gift card drawing, your contact information will not be requested, stored, or linked to the survey in any way. Once a winner is selected, the gift card will be sent electronically to the winner's provided email address, and all contact information provided by participants will be erased. All other data from this study will be kept for a minimum of 3 years prior to being destroyed. Your participation is completely voluntary, and consent may be withdrawn at any time without penalty. Completion and submission of this survey indicates voluntary consent to participate in this study. If you have any questions, please feel free to utilize the following contact information: Sarah Parkinson Graduate Student Southern Illinois University Email: sarah.parkinson@siu.edu Ryan Redner, Ph.D., BCBA-D Faculty Advisor Southern Illinois University, Carbondale Email: rredner@siu.edu Phone: (618) 453-8295 Thank you for your consideration. If you would like to participate, please indicate your consent by selecting "yes" below and/or proceeding with the survey. Once you are finished, please submit your answers and close your browser. This project has been reviewed and approved by the SIUC Human Subjects Committee. Questions concerning your rights as a participant in this research may be addressed to the Committee Chairperson, Office of Research Compliance, Southern Illinois University, Carbondale, IL 62901-4709. Phone (618) 453-4534. E-mail siuhsc@siu.edu

- ○ Yes
- ○ No

Skip To: End of Survey If You are invited to participate in a survey that is being conducted as part of a research project... = No

Q1.2 Are you at least 18 years old?

- ○ Yes
- ○ No

Skip To: End of Survey If Are you at least 18 years old? = No

Q1.3 Have you consumed any meat in the last month?

- ○ Yes
- ○ No

Skip To: End of Survey If Have you consumed any meat in the last month? = No

Page Break

End of Block: 1. Consent/Screener

Start of Block: 2. Demographics

Q2.1 Please provide your demographic information below.

Q2.2 Age:

_____

Q2.3 Gender:

- Male
- Female
- Other

Q2.4 Ethnicity (select all applicable):

- [ ] American Indian or Alaska Native
- [ ] Asian
- [ ] Black or African American
- [ ] Hispanic or Latino
- [ ] Native Hawaiian or Other Pacific Islander
- [ ] White

Q2.5 Annual income:

- ○ Less than $25,000
- ○ $25,000 - $44,999
- ○ $45,000 - $64,999
- ○ $65,000 - $84,999
- ○ $85,000 - $104,999
- ○ $105,000 +

Q2.6 Region of residence:

- ○ West
- ○ Midwest
- ○ South
- ○ Northeast

Q2.7 Education:

- ○ High school diploma
- ○ Some post-secondary coursework
- ○ Associate degree
- ○ Bachelor's degree
- ○ Some graduate-level coursework
- ○ Master's degree
- ○ Doctorate

Q2.8 Field of Occupation/Study:

- ○ Agriculture, forestry, fishing, and hunting
- ○ Mining, quarrying, and oil and gas extraction
- ○ Construction
- ○ Manufacturing
- ○ Wholesale and retail trade
- ○ Transportation and utilities
- ○ Information
- ○ Financial activities
- ○ Professional and business services
- ○ Education and health services
- ○ Leisure and hospitality
- ○ Other services (e.g., repair/maintenance, beauty services, religious/social/advocacy organizations, etc.)
- ○ Public administration

Q2.9 Move the marker on the line below to indicate what percentage of your typical diet is made up of meat.

0 10 20 30 40 50 60 70 80 90 100

%

Q2.10 Move the marker on the line below to indicate what percentage of your meals typically contain meat.

0 10 20 30 40 50 60 70 80 90 100

%

Page Break

End of Block: 2. Demographics

Start of Block: 3. MCQ

Q3.1 For each of the following questions, please read carefully and select which of the two options you would most prefer. Although the choices are hypothetical, please answer as though the outcomes were real.

Q3.2 Which would you rather have?

- ○ $54 today
- ○ $55 in 117 days

Q3.3 Which would you rather have?

- ○ $75 in 61 days
- ○ $55 today

Q3.4 Which would you rather have?

- ○ $25 in 53 days
- ○ $19 today

Q3.5 Which would you rather have?

- ○ $31 today
- ○ $85 in 7 days

Q3.6 Which would you rather have?

- ○ $25 in 19 days
- ○ $14 today

Q3.7 Which would you rather have?

- ○ $30 today
- ○ $45 today

Q3.8 Which would you rather have?

- ○ $50 in 160 days
- ○ $47 today

Q3.9 Which would you rather have?

- ○ $35 in 13 days
- ○ $15 today

Q3.10 Which would you rather have?

- ○ $60 in 14 days
- ○ $25 today

Q3.11 Which would you rather have?

- ○ $80 in 162 days
- ○ $78 today

Q3.12 Which would you rather have?

- ○ $55 in 62 days
- ○ $40 today

Q3.13 Which would you rather have?

- ○ $30 in 7 days
- ○ $11 today

Q3.14 Which would you rather have?

- ○ $67 today
- ○ $75 in 119 days

Q3.15 Which would you rather have?

- ○ $35 in 186 days
- ○ $34 today

Q3.16 Which would you rather have?

- ○ $50 in 21 days
- ○ $27 today

Q3.17 Which would you rather have?

- ○ $69 today
- ○ $85 in 91 days

Q3.18 Which would you rather have?

- ○ $49 today
- ○ $60 in 89 days

Q3.19 Which would you rather have?

- ○ $80 today
- ○ $85 in 157 days

Q3.20 Which would you rather have?

- ○ $55 today
- ○ $75 today

Q3.21 Which would you rather have?

- ○ $40 today
- ○ $55 today

Q3.22 Which would you rather have?

- ○ $24 today
- ○ $35 in 29 days

Q3.23 Which would you rather have?

- ○ $33 today
- ○ $80 in 14 days

Q3.24 Which would you rather have?

- ○ $30 in 179 days
- ○ $28 today

Q3.25 Which would you rather have?

- ○ $50 in 30 days
- ○ $34 today

Q3.26 Which would you rather have?

- ○ $30 in 80 days
- ○ $25 today

Q3.27 Which would you rather have?

- ○ $41 today
- ○ $75 in 20 days

Q3.28 Which would you rather have?

- ○ $60 in 111 days
- ○ $54 today

Q3.29 Which would you rather have?

- ○ $54 today
- ○ $80 in 30 days

Q3.30 Which would you rather have?

- ○ $25 in 136 days
- ○ $22 today

Q3.31 Which would you rather have?

- ○ $20 today
- ○ $55 in 7 days

Page Break

End of Block: 3. MCQ

Start of Block: 4. Pre-Agree/Disagree

Q4.1 Indicate how strongly you agree or disagree with the following statements:

Q4.2
Greenhouse gas emissions are producing a serious threat to life on our planet as we know it.

- Strongly agree
- Agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Disagree
- Strongly disagree

Q4.3 Industrial meat production is one of the planet's top contributors to greenhouse gas emissions.

- ○ Strongly agree
- ○ Agree
- ○ Somewhat agree
- ○ Neither agree nor disagree
- ○ Somewhat disagree
- ○ Disagree
- ○ Strongly disagree

Page Break

End of Block: 4. Pre-Agree/Disagree

Start of Block: 5. Pre-Survey

Q5.1 **Imagine you live in a home along the coast and increases in greenhouse gases are causing sea levels to rise. Experts have projected that unless the population reduces industrial meat production/consumption by 90%, coastal neighborhoods will soon be under water. Given this information, please respond to the scenarios below.**
Note: For the purposes of this survey, the term "meat" does not include fish/seafood.

Q5.2
Within one month, rising sea levels will begin reaching the outskirts of your neighborhood, causing some businesses to close and residents to evacuate. Move the marker on the line below to indicate what percentage of meat you will eliminate from your diet.

0 10 20 30 40 50 60 70 80 90 100

%

Q5.3 Within six months, rising sea levels will begin reaching the outskirts of your neighborhood, causing some businesses to close and residents to evacuate. Move the marker on the line below to indicate what percentage of meat you will eliminate from your diet.

0 10 20 30 40 50 60 70 80 90 100

%

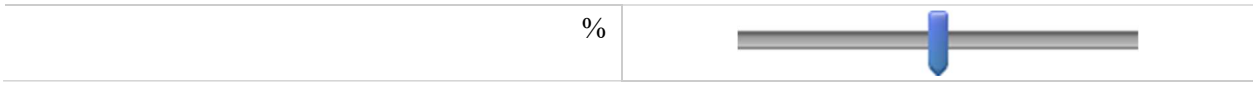
Q5.4 Within one year, rising sea levels will begin reaching the outskirts of your neighborhood, causing some businesses to close and residents to evacuate. Move the marker on the line below to indicate what percentage of meat you will eliminate from your diet.

0 10 20 30 40 50 60 70 80 90 100

%

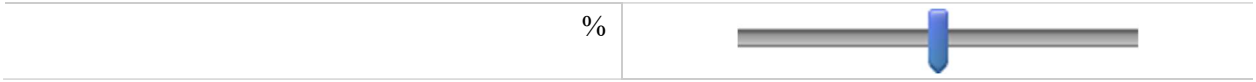
Q5.5 Within three years, rising sea levels will begin reaching the outskirts of your neighborhood, causing some businesses to close and residents to evacuate. Move the marker on the line below to indicate what percentage of meat you will eliminate from your diet.

0 10 20 30 40 50 60 70 80 90 100



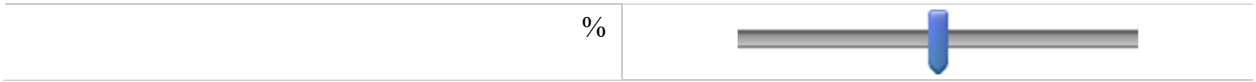
Q5.6 Within five years, rising sea levels will begin reaching the outskirts of your neighborhood, causing some businesses to close and residents to evacuate. Move the marker on the line below to indicate what percentage of meat you will eliminate from your diet.

0 10 20 30 40 50 60 70 80 90 100



Q5.7 Within ten years, rising sea levels will begin reaching the outskirts of your neighborhood, causing some businesses to close and residents to evacuate. Move the marker on the line below to indicate what percentage of meat you will eliminate from your diet.

0 10 20 30 40 50 60 70 80 90 100



Page Break

End of Block: 5. Pre-Survey

Start of Block: 6. Video

Q6.1
Please watch this video and then answer the questions below.

Q6.2 What does the video say about ruminant animals like cows and sheep?

- They're gassy
- They're more intelligent than non-ruminant animals
- They have five stomachs

Q6.3 *Fill in the blank:*
According to the video, switching to a ____diet would significantly reduce our carbon footprint.

- Keto
- Mediterranean
- Nordic

Page Break

End of Block: 6. Video

Start of Block: 7. Post-Agree/Disagree

Q7.1 Indicate how strongly you agree or disagree with the following statements:

Q7.2
Greenhouse gas emissions are producing a serious threat to life on our planet as we know it.

- Strongly agree
- Agree
- Somewhat agree
- Neither agree nor disagree
- Somewhat disagree
- Disagree
- Strongly disagree

Q7.3 Industrial meat production is one of the planet's top contributors to greenhouse gas emissions.

- ○ Strongly agree
- ○ Agree
- ○ Somewhat agree
- ○ Neither agree nor disagree
- ○ Somewhat disagree
- ○ Disagree
- ○ Strongly disagree

Page Break

End of Block: 7. Post-Agree/Disagree

Start of Block: 8. Post-Survey

Q8.1 **Imagine you live in a home along the coast and increases in greenhouse gases are causing sea levels to rise. Experts have projected that unless the population reduces industrial meat production/consumption by 90%, coastal neighborhoods will soon be under water. Given this information, please respond to the scenarios below.**
Note: For the purposes of this survey, the term "meat" does not include fish/seafood.

Q8.2
Within one month, rising sea levels will begin reaching the outskirts of your neighborhood, causing some businesses to close and residents to evacuate. Move the marker on the line below to indicate what percentage of meat you will eliminate from your diet.

0 10 20 30 40 50 60 70 80 90 100

%

Q8.3 Within six months, rising sea levels will begin reaching the outskirts of your neighborhood, causing some businesses to close and residents to evacuate. Move the marker on the line below to indicate what percentage of meat you will eliminate from your diet.

0 10 20 30 40 50 60 70 80 90 100

%

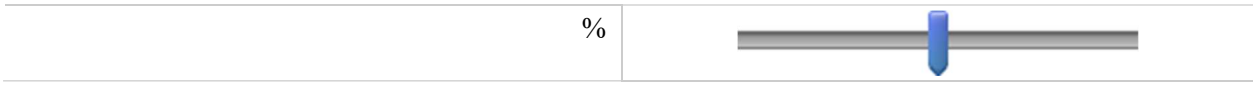
Q8.4 Within one year, rising sea levels will begin reaching the outskirts of your neighborhood, causing some businesses to close and residents to evacuate. Move the marker on the line below to indicate what percentage of meat you will eliminate from your diet.

0 10 20 30 40 50 60 70 80 90 100

%

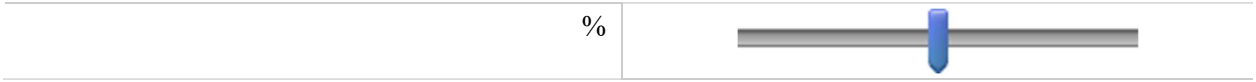
Q8.5 Within three years, rising sea levels will begin reaching the outskirts of your neighborhood, causing some businesses to close and residents to evacuate. Move the marker on the line below to indicate what percentage of meat you will eliminate from your diet.

0 10 20 30 40 50 60 70 80 90 100



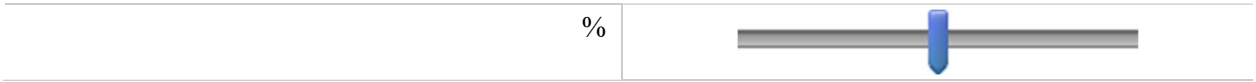
Q8.6 Within five years, rising sea levels will begin reaching the outskirts of your neighborhood, causing some businesses to close and residents to evacuate. Move the marker on the line below to indicate what percentage of meat you will eliminate from your diet.

0 10 20 30 40 50 60 70 80 90 100



Q8.7 Within ten years, rising sea levels will begin reaching the outskirts of your neighborhood, causing some businesses to close and residents to evacuate. Move the marker on the line below to indicate what percentage of meat you will eliminate from your diet.

0 10 20 30 40 50 60 70 80 90 100



Page Break

End of Block: 8. Post-Survey

Start of Block: 9. Gift Card

Q9.1 Thank you for participating in this survey! Would you like to be entered into the drawing for a $15 Amazon gift card?

- Yes
- No

Skip To: End of Survey If Thank you for participating in this survey! Would you like to be entered into the drawing for a $... = No

Q9.2 To be entered into the drawing for the drawing to win a $15 Amazon gift card, please provide your email address in the space below. By September 1st, 2020, an email will be sent to the winner's provided email address. Upon confirmation, the $15 Amazon gift card will be sent to the winner electronically. If the winner does not reply to the email notification within seven days, a new winner will be selected and notified. Once the gift card has been sent, all provided email addresses will be erased.

_____

End of Block: 9. Gift Card

VITA

Graduate School
Southern Illinois University

Sarah Parkinson

Sarah216lynn@gmail.com

Loyola University Chicago
Bachelor of Science, Bilingual/Bicultural Education, December 2010

Special Honors and Awards:
Magna Cum Laude

Thesis Paper Title:
An Examination of Reduced Meat Consumption as a Pro-Environmental Behavior and its Weak Correlation to Delay Discounting

Major Professor: Dr. Ryan Redner