The Salience of Future Climate Impacts and the Willingness to Pay for Climate Change Mitigation

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Abstract

Investing in climate change mitigation has substantial benefits, but those benefits unfold over many decades. Economic theory addresses the separation of costs and benefits across time by discounting future benefits according to an appropriate social discount rate. By comparing the upfront cost to a discounted stream of future benefits, we can determine the optimal level of investment. However, we see individuals using implicit discount rates far higher than expected when they make decisions with upfront costs and a flow of benefits over a long time horizon. The mismatch between what economic theory predicts and what we see in actual behavior leads to the question of whether the extended time horizon between the mitigation decision and the benefits of that decision may hinder optimal investment in climate change mitigation in ways that rational choice theory does not predict. The immediate costs of the decision loom large in the decision-maker's mind while the future benefits of the choice have a lower prominence. As a result, climate change mitigation decisions may be prone to a salience heuristic – a cognitive shortcut that substitutes the salience of benefits with the value of benefits. In an online randomized control experiment, I test whether focusing attention on the future risks and challenges of climate change will increase the willingness to pay for climate change mitigation. I also measure whether these treatments shift the decision-maker's implicit discount rate. In an Essay treatment, participants write an essay on the risks and challenges of climate change. In a Letter treatment, participants write a message on the risks and challenges of climate change directed to a particular individual living in the year 2050. I find that compared to a control group, both writing tasks that focus

attention on the future risks and challenges of climate change increase the willingness to donate to climate change mitigation efforts. I also find that the Letter treatment reduces the decision-maker's discount rate, but the finding is only marginally significant. These findings contribute to the understanding of how to bridge the psychological distance between choice and consequence for climate change mitigation. This study also has broader implications for how psychological distance and the salience heuristic may influence a wide range of decisions from personal health choices to retirement savings.

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1 Introduction

> Life can only be understood backwards; but it must be lived forwards.
>
> *Søren Kierkegaard*

When people face decisions that require sacrifice now but hold rewards in the future, they tend to fall short of the behavior that they might, in reflection, deem as optimal. A cheesecake has a certain salience when it sits before you that a potential triple-bypass surgery in thirty years may simply lack. When immediate benefits tempt the decision-maker even though with sufficient forethought or afterthought, the same decision-maker would have chosen a different option, their preferences are said to be time-inconsistent or present-biased (Akerlof 1991; Hoch and Loewenstein 1991; O'Donoghue and Rabin 1999). This problem arises in many contexts. People do not save enough for retirement (Laibson et al. 1998; Thaler and Benartzi 2004), they procrastinate on long-term projects (Fischer 2001; O'Donoghue and Rabin 2008), they spend monthly benefits too quickly (Smith et al. 2016), they invest less and consume more than they should (Liu et al. 2016), and they make unhealthy diet and exercise choices that have major long-term health costs (Fuchs 1982; Dellavigna and Malmendier 2006).

With relevant time horizons spanning centuries, climate change mitigation decisions are highly vulnerable to present-bias (Weber 2010; Pahl et al. 2014; McDonald et al. 2015). Reducing carbon dioxide emissions today does not result in an immediate reduction of climate change impacts. Instead, the benefits are delayed and accrue over the course of decades. Climate change mitigation decisions are intergenerational. Because of the extended time horizon of climate change mitigation, understanding how people evaluate benefits that occur now and in the future is critical to reaching an optimal level of climate change mitigation.

Understanding barriers to optimal decision-making in climate change is of utmost importance. Globally, individuals and policymakers have underinvested in climate change mitigation compared to a likely range of socially optimal carbon reduction pathways (IPCC 2014). The challenge of making decisions where costs and benefits stretch over long time horizons is one of many challenges of achieving optimal investment in climate change mitigation. First and foremost, climate change is a global commons problem. The classic problem of free-riding that complicates the management of open-access resources arises

on a global scale and reaches across generations. Additionally, the substantial uncertainties in both the costs and the benefits of mitigation make it difficult to precisely determine optimal policies and present problems for garnering sufficient political support to address the issue. However, underinvestment in climate change mitigation may also arise because of the disconnection between our choices today and future climate change impacts (Moser 2010).

In this study, I focus on an experimental intervention designed to reduce the psychological gap between today's decisions about climate change mitigation and the future impacts of those decisions. Every climate change mitigation choice made today will incur most of its costs today and most of its benefits in the future. I argue that the time delay in consequences makes them less prominent in people's minds; it reduces the salience of the impacts. In economic decisions, decision attributes that lack salience are given less weight in the decision-making process than attributes with higher salience (Bordalo et al. 2012). I seek to show that by encouraging the decision-maker to think and write about the impacts of climate change, those impacts become more salient and receive more weight in subsequent decisions.

In an online experiment, I utilize a writing exercise with three different narrative frames to vary the salience of the future impacts of climate change. As opposed to using a different type of intervention, the writing task encourages focused attention on the risks and challenges of climate change and to enables each participant to personalize their narrative. In the first treatment, I ask participants to write an essay where they discuss the risks and challenges of climate change. I refer to this as the Essay treatment. In the second treatment, I ask participants to write a letter about the risks and challenges of climate change to a particular individual living in the future. This treatment seeks to make the future impacts even more vivid by writing to someone who would be experiencing the impacts by the time they are reading the letter. For participants with young loved ones, I make this intervention more personally relevant by asking them to address their narrative to their child, grandchild, niece, or nephew. For those without young relatives, they write to an anonymous child born today. I refer to this as the Letter treatment. In the control treatment, I ask participants to write an essay describing their daily routines. I test whether these interventions affect participants' willingness to pay for climate change mitigation by measuring how much of an experimental bonus they choose to donate to carry out a climate change mitigation activity. Additionally, I measure their revealed implicit discount rates using an incentive compatible choice-based measure and test whether the intervention has an impact on this proxy measure of time preference.

Specifically, I test the following hypotheses:

H1: The process of generating a narrative on the risks and challenges of climate change leads to a higher willingness to pay for climate change mitigation.

H2: Addressing the narrative on the risks and challenges of climate change to an individual living in the future will further increase the willingness to pay for climate mitigation.

H3: A future-oriented narrative frame will reduce the revealed implicit discount rate.

In addition to these hypotheses, I explore underlying mechanisms of the treatment effects. First, I explore whether the treatments increase the level of particular "decision factors" that I expect may play a role in a participant's decision to donate to climate change mitigation (e.g., concern for climate change, guilt about one's role in climate change, etc.). Then, I explore whether the treatments change how each decision factor is weighted in the donation decision.

The rest of the paper is organized as follows: in Section 2, I review the literature related to the role of salience in decision-making; in Section 3, I review the economic theory of demand for climate mitigation and donation measures; in Section 4, I detail the methods of the experiment; in Section 5, I describe and discuss the results of the experiment; and in Section 6, I conclude with theoretical and practical implications of this study.

2 Salience and Decision-Making

In a world of perfect information, perfect attention and perfect rationality, the salience of costs and benefits are irrelevant to utility maximization. However, where salience affects decision-making, it is crucial to understand how temporal and social distance affects the demand for climate change mitigation. In this section, I connect salience theory from the economics literature with construal level theory from the psychology literature. I then review studies that point to the role that salience and psychological distance may have in understanding decisions about climate change mitigation.

Recently, theoretical models and applied research have begun to examine the role that salience plays in shaping and potentially biasing economic decisions. In their model of choices over lotteries, Bordalo, Gennaioli, and Shleifer replace objective probabilities of outcomes with decision weights that are biased by the relative salience of lottery payoffs (Bordalo et al. 2012, 2013). When decision weights are biased, decision makers to put too much emphasis on payoffs with

high salience and too little emphasis on payoffs with low salience. Taylor and Thompson's (Taylor and Thompson 1982) definition of salience motivates their salience theory model; it is also the definition I use in this paper: "Salience refers to the phenomenon that when one's attention is differentially directed to one portion of the environment rather than to others, the information contained in that portion will receive disproportionate weighting in subsequent judgments." In a related vein, Koszegi and Szeidl developed a model of overweighting or underweighting attributes by excessive or insufficient focusing on those attributes (Koszegi and Szeidl 2013). Recent empirical research has explored the impact of salience and inattention in many domains (Gabaix and Laibson 2006; Finkelstein 2009; Chetty et al. 2009; Brown et al. 2010; Lacetera et al. 2012; Allcott and Greenstone 2012; Hastings and Shapiro 2013; Busse et al. 2014). I use a modified version of Bordalo, Gennaioli, and Shleifer's salience theory model to explore the role salience of future climate benefits may play in the demand for climate change mitigation.

In this study, I seek to explore how psychological distance affects the salience of the costs and benefits of climate change mitigation decisions. Psychological distance opens up between an individual and an object, person, or event when they are separated by time, physical distance, or social distance (Trope and Liberman 2010). Psychological distance also increases when an event is hypothetical or uncertain (Liberman et al. 2007). In other words, psychological distance arises when a person thinks about an event that they do not directly experience in the present moment. However, people can construct representations of events in their minds. For example, one may imagine an event that will take place in the future or remember an event that occurred in the past (temporal distance). One may visualize their favorite vacation spot while sitting in their office (physical distance). One may try to "put themselves in someone else's shoes" to empathize or gain a new perspective (social distance). Or, one may imagine any number of possible scenarios that may or may not come to pass (hypothetical distance). I argue that as the psychological distance of an event increases, the salience of the attributes of that event decreases.

This connection between psychological distance and salience shares commonalities with Construal Level Theory (CLT), a widely studied theory on psychological distance (Trope and Liberman 2010). In CLT, psychological distance affects the level at which a person construes an event. As the psychological distance increases, the construals become more abstract. As the psychological distance decreases, the construals become more concrete.

Focusing on temporal distance, I review a growing body of research that finds that when decisions have a future-oriented frame, future outcomes have more weight in decisions (Malkoc and Zauberman 2006; Rogers and Bazerman

2008; Hershfield et al. 2011; Radu et al. 2011; Israel et al. 2014). The literature on future-oriented framing of decisions is highly relevant for this study because it lends support to the hypothesis that a writing task that focuses attention on an individual living in the future will lead to the higher willingness to pay to mitigate the future impacts of climate change. A number of these studies rely on construal level theory to explain the effects. However, I posit that the effects align with salience theory where the focus on the future alters the relative salience of costs and benefits that occur in the present and the future. I argue that what construal level theory interprets as "low-level concrete representations" of outcomes or attributes can be thought of equivalently as high salience outcomes or attributes.

By framing choices either as deferred consumption or expedited consumption, Malkoc and Zauberman show that temporal framing affects the level of present bias (2006). When consumers think about deferring consumption, the focus is on a change from the present; when consumers think about expediting consumption, the focus is on a change from the future. In this study, Markov and Zauberman find that focusing on future consumption leads participants to be less present-biased in their choices. The authors attribute the reduction of present bias to the construal-level theory interpretation where a focus on the present leads to more concrete representations of consumption, compared to more abstract representations of future consumption.

However, their results can be reinterpreted through the lenses of prospect theory and salience theory. When a deferral frame anchors consumption on the present, then consumption in the present becomes the reference point from which the decision-maker evaluates potential outcomes. Under prospect theory, loss aversion penalizes delayed consumption while evaluating savings from deferred consumption as a gain. Conversely, the expedited frame anchors consumption in the future. This anchor shifts the reference point to the future consumption event. Thus, expediting consumption is viewed as a gain while the extra cost of expediting is seen as a loss. Malkoc and Zauberman measure the concreteness of representations and find that these measures mediate the effect of the framing on present bias. They argue that this is evidence that the effect is distinct from a loss aversion impact and interpret their results through the lens of construal level theory. I argue that the concrete representation of the consumption event is equivalent to saying that the consumption event is highly salient. The temporal anchor drives salience, and loss aversion drives the differential impact of deferred versus expedited consumption.

Rogers and Bazerman (2008) show that shifting the implementation of a choice or shifting the temporal focus of a decision-maker to the future can increase the likelihood of choosing "should" choices over "want" choices. Closely

related to the climate change focus of this study, Rogers and Bazerman look at experimental participants' willingness to increase the price of gasoline to reduce pollution and climate change. They find that construal level mediates the effect of the support for a policy to increase the price of gasoline either in the immediate future or the distant future. However, against the expectations of construal level theory, the effect on construal level does not hold when the policy under consideration is a decrease in the price of gasoline. This finding presents a puzzle for the construal level theory interpretation.

Once again, salience and loss aversion provide an alternative explanation. If the relationship between the support for a policy to change gas prices and the timing of the implementation of that price change results from differential levels of salience and subsequent weighting in the decision-making process, then the interpretation of the results is as follows. When the price increases, the personal costs of the present implementation are more salient than the personal costs of the future implementation. When the price decreases, the personal savings in the present implementation are more salient than the personal savings in the future implementation. In the experiment, varying the timing of the implementation of a decrease in gas prices did not lead to differences in the level of construal of the policy. These results make sense when interpreted from the perspective of loss aversion and salience. Due to loss aversion, the focus of the decision-maker would shift from the personal savings (i.e., gains) to the negative consequences (i.e., losses) of the policy. The benefits of the gas price policy are diffuse with benefits falling across the population and across time. For that reason, it is reasonable to expect that the salience is not affected by the timing of the implementation within a reasonable timescale such as the four-year delay in the experiment. The salience of these gains is largely the same in both the near and future implementations, so they do not result in differences between the two groups. The overall shift from the focus on personal costs to the focus on social costs when the policy in question is a price decrease rather than a price increase further supports the reinterpretation of these results through the theory of loss aversion.

Studies that do not explicitly address construal level theory, but instead focus on the vividness of future outcomes also align with the hypothesis that the salience of outcomes affects intertemporal choices. Hershfield and co-authors (2011) take the concept of vividness of the future quite literally and use immersive virtual reality to let participants interact with an age-regressed version of themselves. They find that this visualization of oneself at age 65 increases hypothetical retirement savings. Similarly, Israel and co-authors (2014) find that priming participants with pictures of older adults reduces their implicit discount rate.

A simple change in the numeric framing of an intertemporal choice can also affect the vividness of future outcomes. Magen and co-authors (2008) find that an explicit zero framing of intertemporal choices between payouts in the present and payouts in the future can reduce discounting. Asking participants to choose between $5.00 today and $8.20 in 26 days leads to more present biased decisions than asking participants to choose between "$5.00 today and $0.00 in 26 days" and "$0 today and $8.20 in 26 days." Radu and co-authors (2011) explore possible mechanisms for the effect of the explicit zero framing on present bias. In line with a salience interpretation, they find that the frame reduces present bias by shifting attention to the future negative consequences of the present biased option.

There is even evidence that a future-orientated perspective can affect decisions that cross generational boundaries, which is highly relevant for climate mitigation decisions. For example, studies have found that encouraging individuals to consider the perspective of future generations can increase pro-environmental behavior (Pahl and Bauer 2013; Zaval et al. 2015; Arnocky et al. 2014). A growing literature points to the complex role that psychological distance may play in the willingness to undertake socially optimal levels of investment in climate mitigation and adaptation (Newell et al. 2014; Lorenzoni and Pidgeon 2006; McDonald et al. 2015; Weber 2006, 2010). While many researchers conclude that decreasing psychological distance will increase concern and subsequent action on climate change, others call for a more careful examination of the complex interplay of factors (McDonald et al. 2015). Climate change is an issue that involves psychological distance on four dimensions: temporal, geographical, social, and level of uncertainty.

For most people without direct, personal experience, climate change impacts have low salience. Climate change impacts are expected to take place in the future, to affect other people in other places, and have a great deal of uncertainty. When a person directly experiences climate impacts, such as anomalous weather events like Hurricane Sandy, there is no psychological distance between the person and the impacts. As it occurs, the event directly affects the person (no social distance) where they currently reside (no geographical distance) in the present moment (no temporal distance) with complete certainty (no hypothetical distance). However, uncertainty could remain in the causal connection between the event and climate change. Studies have found that personally experiencing anomalous or extreme weather events makes people more concerned about climate change (Akerlof et al. 2013; Donner and Mcdaniels 2013; Li et al. 2011; Joireman et al. 2010; Hamilton and Stampone 2013; Egan and Mullin 2012; Zaval et al. 2014). Weather can even impact major consumer purchases in ways that contradict rational expected utility

theory. For example, the decision to buy a convertible or a four-wheel drive vehicle is significantly influenced by the weather at the time of the purchase (Busse et al. 2014). The authors hypothesize that this effect is due to projection bias and salience.

Experiencing a weather event associated with climate change may change the psychological distance with which one views climate change. However, there is a long time delay between increased atmospheric concentrations of greenhouse gases and the full impacts that will result. Therefore to achieve an optimal climate strategy, we need to align the subjective perception of future impacts with the objective discounted value of those impacts. The cognitive bias that arises from the perceived psychological distance of climate impacts reduces their salience in current decision-making.

3 Willingness to Pay for Climate Change Mitigation and Public Goods Donations

The primary outcome variable in this study is a donation to a charity that helps to sequester carbon and thus mitigate climate change. The donation measure serves as a revealed preference proxy measure for willingness to pay for climate change mitigation. According to basic environmental economics theory, setting the marginal cost of carbon dioxide abatement is equal to the social cost of carbon dioxide will lead to optimal investment in climate change mitigation. With guidance from well-established integrated assessment models, the U.S. government uses a central value of $36 per ton of CO_2 in benefit-cost analyses (Greenstone et al. 2013; Int 2015). With policies such as CAFE standards, renewable portfolio standards, biofuel policies, and regional carbon trading, the economy is operating under a non-zero shadow price for carbon. However, the current global level of climate change mitigation is sub-optimal (Victor et al. 2014). Even new regulations of CO_2 in the United States under the Clean Power Plan will impose a marginal abatement cost of carbon dioxide between $12-$27/ton, well below the estimated social cost of carbon (Burtraw et al. 2014).

The importance of time preference in climate change is evident. The social discount rate, determined in large part by the pure rate of time preference, is one of the most important parameters in economic models of climate change. For example, the social cost of carbon has an average value of $36 with a discount rate of 3%, but the social cost of carbon jumps to $56 with a discount rate of 2.5% and falls to $11 with a discount rate of 5%. A large body of literature in environmental economics details the complex question of what is

the proper social discount rate to use in cost-benefit analyses of climate change (See Arrow et al. 2013 for an overview). In climate change, the benefits of abatement are beset with a broad range of uncertainty and are realized over very long time horizons. As a result of the long time horizons, high discount rates translate to low levels of optimal climate change mitigation (Nordhaus 2007; Arrow et al. 2013, 2014; Weitzman 2001).

Energy efficiency choices are an important area of consumer behavior where time preference affects consumers' climate change impact. There is an active debate over whether there is an "energy efficiency gap" between the optimal and actual investment in energy efficiency (Jaffe and Stavins 1994; Gillingham et al. 2009; Allcott and Greenstone 2012; Gillingham and Palmer 2014; Gerarden et al. 2015). Recent work points to other explanations for this apparent gap (Allcott and Greenstone 2012; Fowlie et al. 2015), but the question of whether myopia contributes to high implicit discount rates merits further study. While some level of discounting is optimal, decision-makers may overweight the present and underweight the future (Akerlof 1991; Zauberman and Lynch Jr. 2006). This study explores whether increasing the salience of future benefits changes the relative weighting of present and future impacts by measuring participants' implicit discount rates after each treatment.

If consumer behavior is suboptimal according to the standard exponential discounting model, then we may look for an explanation from an alternative model of time preference. The hyperbolic discounting model is one of the most robust models in behavioral economics and has contributed a great deal to the understanding of time inconsistencies in time preference (Laibson 1997; Cropper and Laibson 1999). Hyperbolic discounting leads to present bias and a pattern of procrastination where the "right time" to make a costly decision with future benefits never arrives. The collective response to climate change is highly vulnerable to the problem of present bias due to the structure of immediate costs and future benefits for most climate mitigation actions. In this study, I seek to test whether a behavioral intervention reduces myopia by changing the time perspective of the decision-maker.

Individuals who are operating under cognitive bias from the long time horizon of the climate change issue may make two kinds of errors. First, if people are myopic, they may underestimate the current value of the damages of climate change and underinvest in climate change mitigation. For example, an elected representative whose primary decision criterion is maximizing public welfare may fail to do so if she myopically evaluates public policies. She may undervalue policies with long-term benefits by discounting future benefits at a rate higher than the optimal social discount rate. Second, for myopic individuals, facing a carbon price equal to the social cost of carbon may not be

sufficient to achieve optimal change. Increasing the carbon price to account for externalities may still lead to underinvestment in energy efficient technologies due to "internalities" where consumers discount future benefits more than is personally optimal (Allcott et al. 2014). Future utility may be underweighted because it is not salient. Additional policies or information framing strategies may be needed to encourage individuals to give adequate attention to future costs and benefits and reduce these internalities. If myopia plays a role in reducing optimal climate change mitigation through diminished salience of the risks of climate change, then interventions to increase the salience of climate risks may reduce myopia and improve climate mitigation policy choices.

In this study, I utilize voluntary donations in an experimental context to serve as an incentive-compatible, revealed preference proxy measure of willingness to pay for climate change mitigation. After the writing treatments, I explain that all study participants have a 1 in 100 chance of receiving a $20 bonus after the study period ends. I tell them that they may donate part of their bonus to a non-profit organization, Trees for the Future. Their donation would then be used to plant trees that remove carbon dioxide from the atmosphere and thus contribute to climate change mitigation. Then, they choose how much of their $20 bonus to keep for themselves and how much to donate.

Voluntary donations can be made out of a desire to contribute to a public good, like climate change mitigation, and out of a desire to feel good about oneself. A pure altruism model posits that donations are simply made to improve the world around us. The only utility we gain from a donation in a pure altruism model is the utility we derive from our enjoyment of the total level of public goods to which we contribute. An impure altruism donation model allows individuals also to gain utility from feeling good about the act of donating. From the classic impure altruism paper by Andreoni (1990): Individual, i, chooses donation g_i to maximize the following utility function:

$$U_i = U_i(x_i, G, g_i) \tag{1}$$

where G is the total amount of the public good.

Including g_i as a separate argument indicates the "warm glow" gain in utility from the act of donating.

I apply the basic impure altruism model to my donation context with the following parameters:

$$g_i = (\alpha_j + \delta_j)T_j + \gamma X_i \tag{2}$$

α_i: Change in utility weighting of perceived marginal increase in expected future climate stability (altruism, including parental "altruism" towards own

child)
δ_i: Change in marginal warm glow from donation
T_j: Indicator variable for treatment group
X_i: Vector of individual characteristics (including beliefs about the impacts of donation on G)

For a small donation to a global public goods problem like climate change, there is the problem that the marginal effect of a small individual action on climate change is essentially zero, implying that $\alpha_i \to 0$. Nonetheless, individuals make decisions based on their perception of efficacy (Cryder et al. 2013; Erlandsson et al. 2014). Experimental participants may perceive a non-zero efficacy of their donation. Assuming that α_j is the perceived efficacy rather than actual efficacy allows $\alpha_j > \epsilon$. Participants may also donate because it gives them a warm glow. Since I cannot differentiate between α_j & δ_j, I simplify by setting:

$$\beta_j = \alpha_j + \delta_j \tag{3}$$

In this model, I am agnostic on the relative contributions of altruism and warm glow by measuring β_j as $\alpha_j + \delta_j$. While I cannot distinguish between altruistic giving and warm-glow giving, I expect that reducing the psychological distance from the impacts of climate change will increase donations. Salience theory argues that we put more weight on vivid outcomes and less weight on those that are not as clear (Akerlof 1991; Higgins 1996; Bordalo et al. 2012). If the benefits are more vivid when they are psychologically closer, then I hypothesize that they will receive more weight in the decision-making process. More weight on vivid benefits would then, in theory, lead to a higher willingness to pay for climate change mitigation.

4 Methods

The study consists of a pre-experimental survey, a reading task, a randomized writing task, and a post-treatment survey. The primary outcome variables are the willingness to donate to a climate change non-profit and a measure of time preference.

I used a screening survey on Amazon's Mechanical Turk to recruit individuals living in the U.S. who have children under the age of 18. In the screening survey, I collected data on demographics including age, gender, race, ethnicity, education, income, state and zip code. I also asked some political questions including the tendency to vote for Republican or Democratic candidates and concern about climate change (1 to 10 scale). In addition to the variables

of interest, I included decoy questions about concern for illegal immigration, income inequality, and the budget deficit to ensure that participants did not view this as a climate change study which could bias participation in the follow-up study. I ended the screening survey with a question that asked the participant to write 2-3 sentences about an interesting news story they read, listened to, or watched recently as a quality screening mechanism. I excluded participants who wrote fewer than 25 characters from the follow-up study.

Between December 29, 2015, and January 10, 2016, I invited qualified participants to participate in the full study. To establish a minimum level of knowledge and to control for experimenter demand by making it clear to all participants that this study is overtly focused on climate change, participants began by watching a three-minute video explaining the basic science and potential impacts of climate change.[1] Next, they read a series of climate solutions both for broad-scale policy and individual action. The purpose of providing information about solutions is to reduce the level of hopelessness and arousal that some people may feel after watching an educational video that discusses the impacts of climate change. Studies have shown that when people feel hopeless or helpless about a problem, then they respond by disengaging (Rutjens et al. 2010; Moser and Dilling 2011). If learning about climate change puts them in a high stress, high arousal state, then providing concrete solutions may decrease the arousal and stress to a level more conducive for critical thinking (Weick 1984). In this study, it is important that they are aware of the problem of climate change as well as tangible solutions.

The next section varies with treatment group. Each participant is asked to spend five to ten minutes on a writing task. In the Letter treatment, participants are asked to write a message that will be delivered in 35 years. They are asked to write about the risks and challenges of climate change and how they think climate change will affect the lives of people in 2050. For those with a child, grandchild, niece, or nephew, the message is addressed to that individual, and their age in 2050 is given at the beginning of the prompt. For those without a young relative, the message is addressed to an individual born today who will be 35 years old in 2050. In the Essay treatment, participants are asked to discuss the risks and challenges of climate change in an essay. In the control group, participants are asked to write about their daily routines. Participants must spend at least 5 minutes on the writing task and write at least 500 characters. See Appendix 6 for full question texts.

After the writing task, I explain that 1 out of 100 participants will receive

[1]Video from TEDEd: http://ed.ted.com/lessons/climate-change-earth-s-giant-game-of-tetris-joss-fong

an additional bonus of $20 which they may split between themselves and a charity that reduces greenhouse gases in the atmosphere. They then choose among 21 options that divide the $20 between the participant and the donor. In a pilot study, participants were asked to type in the amount they would like to give to the charity and the amount to keep for themselves. The amounts had to add up to $20. While this was, in theory, the best way to elicit a continuous measure of donations, most people chose to donate either $0 (21%), $5 (24%), or $10 (29%). The top half of the distribution was also bimodal at $15 (4%) and $20 (4%). In further testing, providing options that split the money for the participants and allowing them to choose produced donations that more closely approximated a normal distribution.

Next, I use a multiple price list measure of time discounting known as Money-Earlier-or-Later (MEL). I use a choice-based measure based on the finding that choice-based measures are more strongly predictive of real-world behavior than a matching measure, which would have been more efficient to implement (Hardisty et al. 2013). Participants choose between $100 in one month and some amount of money, $X, in four months. The payoff, $X, ranges from $101 and $300. These tradeoffs correspond to a three-month discount rate of 1% and 110%. One participant was randomly chosen, and one of their choices was implemented with a real-world payment. Participants take a short quiz to ensure they understand the procedure.

I structure the choice decision to choose between two future periods, one month and four months, to eliminate the potential effect of present bias. Eliminating the role of present bias simplifies the hyperbolic discounting model to the standard exponential discounting model (Laibson 1997; Frederick et al. 2002). I make this simplification because measuring present bias with monetary rewards in experimental contexts is problematic. Present bias refers to the difference between immediate utility and non-immediate utility. Using monetary rewards to measure present bias requires the assumption that any additional money paid at time zero will be consumed at time zero and will not offset any other consumption. These assumptions do not hold for most people. By utilizing a choice between two future payments, I avoid this confounding issue and achieve a cleaner measure of the implicit discount rate, δ. Additionally, it is important to note the distinction between time preference and time discounting (Frederick et al. 2002). Time preference refers to the relative preference for utility experienced in different time periods, whereas time discounting refers to the lower value of future payments compared to those that occur in the present. Time preference or utility discounting can be measured experimentally by offering tradeoffs between consumption rewards, like food, alcohol, and work (negative reward). While it is possible to employ this paradigm in an online

experiment, it requires retaining participants for a number of weeks and greatly increases the costs of the experiment. I am interested in how time preference is affected by the framing intervention, but in this paper, I seek first to establish a relationship between the treatments and implicit discount rate, which tends to correlate with the underlying time preference. For example, Reuben, Sapienza, and Zingales (2010) find that there is a correlation between the discount rates for monetary rewards and the discount rates for consumption ($R^2 = 0.12$). Further studies will be needed to examine the question in more depth.

In the last section of the experiment, I ask a series of questions that serve as manipulation checks and potential decision factor variables. I ask about legacy motives using a three-question measure that replicates Zaval et al. (2015). I ask about hopefulness about the future, the vividness of the future, ease of hindsight, concern for climate change, and the likelihood that climate change will negatively affect one's child. I also include questions about feelings of altruistic and parental responsibility, the efficacy of personal and global actions, and sense of guilt. In all analyses except the within-subjects change in climate concern, responses to these questions are standardized with a mean of zero and standard deviation equal to one.

To test my first two hypotheses (H1 and H2), I regress donations amounts on indicator variables for both the Essay and Letter treatments. While I expect other covariates to be orthogonal to treatment group due to random assignment, I test the robustness of the treatment effects with two additional specifications. First, I add the measure of prior concern for climate change that was elicited in screening survey. Then, I also add the following demographic variables: parental status (dummy), age (numeric), income (ordinal), education (ordinal), voting preferences (dummies), male (dummy), white (dummy), Hispanic (dummy), and state (dummies). In the full model, I cluster observations at the state level to adjust for correlated errors among individuals within each state. I expect some correlation both due to cultural effects of the state in which a participant lives as well as impacts of recent weather during the study period.

For the full model with treatment groups, dummies and demographic controls, I estimate the following equation using ordinary least squares:

$$y_i = \beta_0 + \beta_1 \mathrm{LT}_i + \beta_2 \mathrm{ET}_i + \beta_3 \mathrm{concern}_i + \gamma X_i + \epsilon_i \tag{4}$$

In this equation, y_i is the donation to a climate change mitigation non-profit, LT_i is an indicator variable for participants in the Letter treatment, ET_i is an indicator variable for participants in the Essay treatment, $\mathrm{concern}_i$ is a baseline concern about climate change, and γ is a vector of control variables.

To assess H1, whether writing a narrative on the risks and challenges of climate change leads to a higher willingness to pay for climate change mitigation,

I test whether $\hat{\beta}_1 > 0$ and $\hat{\beta}_2 > 0$. For H2, that addressing the narrative on the risks and challenges of climate change to an individual living in the future will further increase the willingness to pay for climate mitigation, I test if $\hat{\beta}_1 > \hat{\beta}_2$.

To assess H3, I derive the implicit discount rate from the money-earlier vs. money-later choices and evaluate whether it differs in each treatment group. First, I find the approximate indifference point by looking to where the participant switched from the money earlier payment to the money later payment. If they switched more than once, they are excluded from the sample. I approximate the discount rate by taking the midpoint of the discount rates implied by the monetary tradeoff before the switch and at the switch point. I calculate the discount rate for each point as an exponential rate according to the following equation:

$$r = \ln\left(\frac{x_{t+4}}{x_{t+1}}\right) \tag{5}$$

where periods, t, are measured in months. For those who never switch from earlier payments to later payments or vice versa, the endpoint is used as the implicit discount rate. Using r as the dependent variable, I run the same regression models as I do to analyze donations (Eq. 4). To test H3, that a future-oriented narrative frame will reduce the revealed implicit discount rate, I test whether $\hat{\beta}_1 > 0$. Then I test whether the implicit discount rate mediates the relationship between the Letter treatment and donation amount using the mediation procedure described in the next paragraph.

Using a within-subject, before-and-after measure, I examine the impact of the treatments on climate concern. In the screening survey, I ask participants to rate their level of concern about climate change. After the treatment, I ask them the same question. I apply a difference-in-differences estimation to look at the impact of the Letter and Essay treatments on the change in concern for climate change compared to the change in concern of the control group. The estimated coefficients are defined as:

$$\hat{\beta}_{LT} = \bar{\Delta}y_{LT} - \bar{\Delta}y_C \tag{6}$$

$$\hat{\beta}_{ET} = \bar{\Delta}y_{ET} - \bar{\Delta}y_C \tag{7}$$

Next, I use mediation analysis to investigate pathways of the treatment effects. Mediation analysis attempts to measure whether the treatment changes an intermediary variable which then goes on to affect the outcome variable. Mediation analysis is widely used in psychology. However, generating unbiased estimates of causal mediation effects is very challenging, even in an experimental context. If the treatments affect more than one mediator or if there are heterogeneous impacts of the treatments or the mediator, then the mediation

analysis may be biased (Bullock et al. 2010). It is unlikely that these stringent requirements are met in this study. The analysis is included in this study for two reasons. First, this study serves, in part, as a replication of Zaval et al. (2015) and mediation analysis of the role of legacy in climate change mitigation donations is a central focus in their paper. Second, the mediation analysis is meant to explore potential causal pathways to generate hypotheses for future experiments.

Mediation analysis breaks down the total causal effect, τ_i, of each treatment, t, on the outcome variable of interest, Y_i, into the total indirect effect, $\delta_i(t)$, and the total direct effect, $\zeta_i(1-t)$:

$$\tau_i = \delta_i(t) + \zeta_i(1-t), \tag{8}$$

for $t = 0, 1$. The direct effect is the effect of the treatment on the outcome variable if the mediator, m, were held constant. The indirect effect, or causal mediation effect, is the effect of the treatment on the outcome variable that operates by changing the mediator variable. Figure 1 provides a visual illustration of the theoretical logic of mediation analysis.

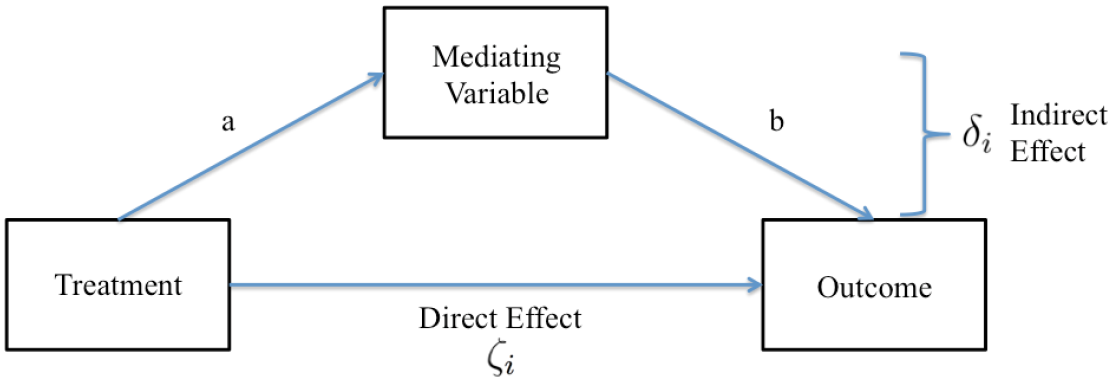

Figure 1: Mediation Analysis

Using a potential outcomes framework, the total treatment effect is defined as the difference in potential outcomes under treatments, $t = 0, 1$:

$$\tau_i \equiv Y_i(1, M_i(1)) - Y_i(0, M_i(0)) \tag{9}$$

The indirect effect is the potential outcome of the treatment, t, with the mediator at the potential value under the treatment minus the potential

outcome of the treatment with the mediator at the potential value under the control:

$$\delta_i(t) \equiv Y_i(t, M_i(1)) - Y_i(t, M_i(0)) \tag{10}$$

I estimate the average indirect effect, $\bar{\delta}_i$, using the R package, 'mediation' which implements the following algorithm (Imai et al. 2010b; Imai and Keele 2010; Imai et al. 2010a):

$$\bar{\delta}(t) = \iint \mathbb{E}(Y_i|M_i = m, T_i = t, X_i = x)\{dF_{M_i|T_i=1,X_i=x}(m) - dF_{M_i|T_i=0,X_i=x}(m)\}dF_{X_i}(x). \tag{11}$$

The algorithm is estimated using a quasi-Bayesian Monte Carlo approximation. The estimates generated by this algorithm are nearly identical to those of the well-known Baron-Kenny procedure (Baron and Kenny 1986; Imai et al. 2010a). The Baron-Kenny procedure calls for three separate regressions to analyze mediation:

$$M_i = \beta_0 + \beta_1 \mathrm{T}_i + \epsilon_i \tag{12}$$

$$Y_i = \beta_0 + \tau \mathrm{T}_i + \epsilon_i \tag{13}$$

$$Y_i = \beta_0 + \delta M_i + \zeta \mathrm{T}_i + \epsilon_i \tag{14}$$

According to Baron and Kenny, $\beta_1 \neq 0$, $\tau \neq 0$, and $\delta \neq 0$ must all hold in the expected directions to indicate mediation. However, more recent work has shown that all of these relationships do not necessarily need to be significant in order to indicate mediation (MacKinnon et al. 2007; Zhao et al. 2010).

The algorithm developed by Imai et al. improves upon the basic Baron-Kenny procedure by generating sensitivity analyses and confidence intervals for hypothesis testing. (Imai et al. 2010a).

I explore mediation effects of the treatments on climate mitigation donations for five climate specific measures: change in climate concern, the belief that climate change will impact on one's children, an altruistic responsibility for climate mitigation, guilt about one's role in climate change, and the efficacy of personal and global mitigation actions on climate change. I also explore mediation effects for five measures of different aspects of time perspective: implicit discount rate, legacy motives, the vividness of the future, hindsight, and hopefulness about the future.

Finally, to measure whether the treatment increases the salience of decision factors, I look to see if decision factors carry different weights in each treatment group by regressing decision factors on donations. In the salience theory model by Bordalo, Gennaioli, and Shleifer (2012), the decision-maker evaluates choices

with risky prospects with as the sum of the value of each outcome weighted by the probability that the outcome will occur if each option is chosen:

$$V(L_i) = \sum_{s \in S} \pi_s v(x_s^i) \tag{15}$$

where π_s is the probability that the state of the world, s, will occur and L_i is the choice or lottery with x_s^i payoffs in each state $s \in S$. If the decision-maker is affected by the salience of particular outcomes, then the objective probability, π_s, is replaced with the decision weight, π_s^i. In other words, aspects of the decision framework that would not affect optimal decision-making in expected utility theory change the weight assigned to each possible outcome in the utility maximization choice.

In their model, salience is defined as specifically related to the ordering and differences between payoffs. In this application of the model, rather than precisely define salience in a modeling context, I test whether the treatments alter the decision weights associated with a decision factor. In this context, I define a decision factor as a potential driver of the willingness to pay for climate change mitigation. For example, if a participant feels that climate change will impact his children, then he may be willing to pay more to mitigate climate change. The outcome of a safer future climate would provide higher utility to him than if he did not anticipate possible negative impacts for his loved ones. Whether each decision factor is affected by the treatment and whether that drives higher donations is examined by the mediation analysis.

To measure the decision weight given to the decision factor, I regress potential decision factors on to the donation amount for each treatment group. Then I compare the decision weights, measured as the regression coefficients, between the treatment groups. The regression for each treatment group answers the question: Holding the values of decision factors constant, how much does each decision factor weigh in a person's willingness to pay for climate change mitigation? Comparing the decision weights between the treatments provides insight on whether the treatment increased the salience of that decision factor.

5 Results

5.1 Revealed Preference: Donation Measure

Participants in both treatment groups donated a larger share of their bonus than those in the control group. The effect sizes in both groups were remarkably similar. In the control group, the average donation was \$6.81. The average

donation in the Letter and Essay treatment groups were $7.54 and $7.56 respectively, an 11% increase for both groups ($p = 0.044$; $p = 0.037$). Including baseline climate concern and demographic control variables in the regression analysis does not significantly affect the donation levels. People with higher baseline concern for climate change donate significantly more than those less concerned, parents donate significantly more than non-parents, and women donate significantly more than men. (See Table 1 for more details.)

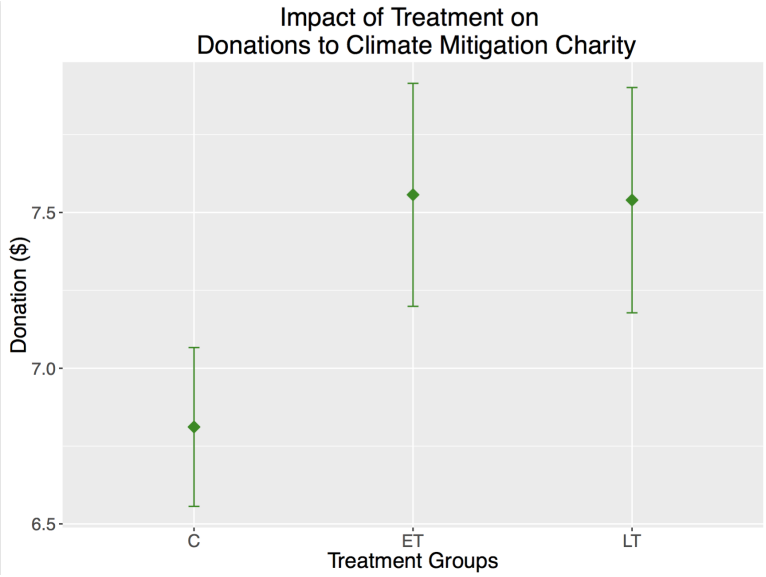

Figure 2: Mean donations of the control group and both treatment groups. Error bars represent standard errors. Difference between control and both treatments are statistically significant.

In Table 2, I detail the results of interaction effects between the treatments and baseline climate concern and other demographic variables on donation levels. I expected that parents would be more strongly impacted by writing a letter to their child than non-parents who wrote to a niece or nephew or an unrelated or anonymous person. Parents overall donated significantly more than non-parents, but the interaction terms between parents and treatment groups are not statistically significant. The same pattern holds for people who had a higher baseline level of concern about climate change. However, when the interaction terms are included, the coefficients on the treatment dummies increase substantially. It is possible that the effects of being a parent and being in the Letter treatment group are simply additive. On the other hand, there may be problems resulting from unbalanced strata. By random chance, parents

Table 1: Donations Analysis

	Dependent variable:		
	Donation to climate change mitigation		
	(1)	(2)	(3)
Letter Treatment D.V.	0.728** (0.362)	0.734** (0.355)	0.670** (0.332)
Essay Treatment D.V.	0.746** (0.358)	0.829** (0.352)	0.750** (0.351)
Baseline Climate Concern		1.292*** (0.144)	1.243*** (0.142)
Parent D.V.			0.786** (0.378)
Age (years)			0.009 (0.017)
Income ($1000's)			0.006 (0.005)
High School D.V.			1.646 (1.301)
Trade School D.V.			1.776 (1.255)
Associate Degree D.V.			1.720 (1.234)
Bachelor Degree D.V.			1.387 (1.258)
Graduate Degree D.V.			1.971 (1.275)
Vote Republican D.V.			−0.986** (0.397)
Vote Democrat D.V			−0.616 (0.439)
Male D.V.			−0.777** (0.337)
White D.V.			−0.398 (0.424)
Hispanic D.V.			0.579 (0.558)
Constant	6.811*** (0.255)	6.772*** (0.251)	4.182*** (1.599)
State Fixed Effects	No	No	Yes
Clustered Standard Errors	No	No	Yes
Observations	1,797	1,784	1,700
R^2	0.003	0.046	0.091

Note: OLS regression. Dependent variable is Donation in $. Income is a numeric variable in $1000's. Dummy variables are included for those who vote mainly or exclusively for Democrats and Republicans. Voters who vote half Republican and half Democrat as well as those who do not vote for either party are the comparison group. Education is a categorical variable split into dummy variables and less than high school education is the comparison group. D.V. indicates binary dummy variables. Baseline climate concern is a 10 point scale measure standardized with mean=0, sd=1. Age is measured is years.
*p<0.1; **p<0.05; ***p<0.01

make up only 68.6% of the Letter treatment group while parents are 75.2% of the Essay treatment group and 72.3% of the control group.

Table 2: Donations Analysis with Treatment Interactions

	Dependent variable:		
	Donation to to climate change mitigation		
	(1)	(2)	(3)
Letter Treatment D.V. (LT)	0.832	0.733**	4.128
	(0.669)	(0.355)	(3.313)
Essay Treatment D.V. (ET)	1.204*	0.828**	5.770*
	(0.684)	(0.352)	(3.265)
Parent D.V.	1.131**		1.128**
	(0.533)		(0.570)
Parent x LT	−0.113		−0.447
	(0.764)		(0.979)
Parent x ET	−0.618		−0.881
	(0.788)		(0.728)
Baseline Climate Concern		1.222***	1.248***
		(0.246)	(0.264)
Baseline CC x LT		0.207	−0.019
		(0.352)	(0.477)
Baseline CC x ET2		0.008	0.032
		(0.351)	(0.356)
Constant	5.980***	6.773***	1.538
	(0.462)	(0.251)	(2.673)
Demographic Controls	*No*	*No*	*Yes*
Dems x Trt Interactions	*No*	*No*	*Yes*
State Fixed Effects	*No*	*No*	*Yes*
Clustered Standard Errors	*No*	*No*	*Yes*
Observations	1,785	1,784	1,700
R^2	0.008	0.047	0.102

Note: OLS Regression. Demographic controls included where indicated are listed in Table 1. Demographic controls are interacted with treatment dummy variables where indicated. State-level fixed effects are not interacted with treatment dummies. *p<0.1; **p<0.05; ***p<0.01

To further explore this question, I separate out average donations by parents

and non-parents in each treatment group in Figure 3. Parents donate more than non-parents in all treatment groups, but the difference is most pronounced in the Letter treatment. Comparing only parents across treatment groups, parents in Letter treatment donate \$0.93 more than parents in the control treatment ($p = 0.032$). Comparing only those in the Letter treatment group, parents donate \$1.37 more than non-parents ($p = 0.018$). The differences between donations from parents and non-parents in the Essay treatment and the Control treatment are not statistically significant.

In the Letter treatment, we ask participants if they have children, grandchildren, nieces and nephews. Participants who report yes then address their letter specifically to one of their younger relatives. Otherwise, they write to an anonymous child. The level of donations among those who wrote a letter to a young person varied based on the closeness of kinship. Grandparents donated the most although there were only thirty-three in the sample. They gave, on average, \$2.23 more than those writing to an anonymous child ($p = 0.087$). Parents writing to their children also donated, on average, \$1.52 more than those writing to an anonymous child ($p = 0.033$). Aunts and uncles gave slightly more (\$0.38) than those writing to an anonymous child, but the difference was not significant ($p = 0.696$). These results are consistent with the theory of social distance: closer social distance between the writer and the recipient magnifies the effect of the treatment.

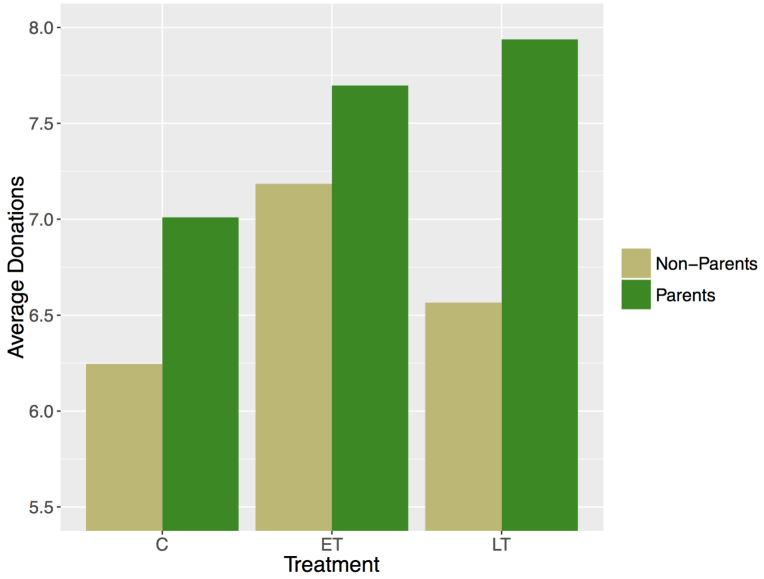

Figure 3: Average donations by parents and non-parents in each treatment group

While both treatments have a similar impact on the average donation, they have different effects on the likelihood of donating (Table 8). Participants in the Letter treatment are no more likely to donate more than $0 of their bonus than participants in the control group. Participants in the Essay treatment, however, are more likely to donate some non-zero amount. In other words, the Letter treatment affects the intensive margin of donations, but not the extensive margin, while the Essay treatment affects both the intensive and extensive margins.

A potential confound of the treatment design is that the Letter treatment asks participants to tell the recipient what actions they have taken or plan to take to reduce their climate change impact. This adds an element that is not controlled in the Essay treatment and could explain why the Letter treatment did not make participants more likely to donate even though it increased the level of donations. According to a theory of moral cleansing or moral licensing, individuals who are motivated by guilt or other negative emotions tend to take a single action to relieve the feeling of guilt and do not take subsequent, similar actions (Weber 2006; Barnes Truelove et al. 2014). Discussing the actions that they are already taking to reduce their climate change impact may minimize the level of guilt that participants feel, leading to a lower donation level. The Letter treatment slightly reduces the level of reported guilt about climate change, but the effect is not significant ($p = 0.296$).

Another potential confound is experimenter demand. The study design attempts to control for experimenter demand by starting the experiment with a video and written information about climate change. It should be obvious to all participants that the study is about climate change. However, without changing the control group to write about climate change, there was no way to reduce experimenter demand entirely. Those in the Essay and Letter treatments may have experienced a stronger experimenter demand effect leading to higher donations than those in the control group.

5.1.1 Mediation Analysis of Donations

Different variables mediate the relationship between treatment and donation for the Letter treatment and the Essay treatment. In the letter treatment, the mediation analysis indicates that focusing on the future consequences of climate change for a single individual may increase legacy motives, which leads to higher donations and may decrease hopefulness about the future, which reduces donations. In the essay treatment, the mediation analysis indicates that focusing generally on the risks and challenges of climate change increases concern about climate change and increases the feeling of personal responsibility

to reduce climate change, both of which increase donations.

Legacy is the primary measure of social distance in this study. Following Zaval, Markowitz, & Weber (2015), I test whether the treatments increase the desire to leave a positive legacy to the future. Compared to the control group, I find that the Letter treatment significantly increases legacy motives ($p = 0.0018$), while the Essay treatment has no effect ($p = 0.173$). I implement the Baron-Kenny procedure to assess whether legacy mediates the relationship between the Letter treatment and willingness to donate (Baron and Kenny 1986; Imai et al. 2010a). A quasi-Bayesian Monte Carlo approximation of the mediation effect finds an average indirect effect of 0.278 (95% CI = [0.11,0.47], p =0.0018, Table 3). Thus, the Letter treatment increases legacy motive which then increases the donation by an average of \$0.28, which accounts for about a third of the total effect of the Letter treatment on the willingness to donate.

In addition to increasing legacy motives, I find that the Letter treatment increased the vividness of the future ($p < 0.001$), a measure of temporal distance. In contrast to legacy motives, the vividness of the future does not increase willingness to donate. Vividness of the future does, however, increase concern about climate change ($p = 0.010$) and it mediates the relationship between the Letter treatment and concern about climate change ($\hat{\beta} = 0.036$, CI= $[0.007, 0.073]$, $p = 0.01$).

The Letter treatment decreases the level of hopefulness participants feel about the future, but the effect is only marginally significant ($p = 0.088$). Feeling hopeful about the future increases donations; a standard deviation increase in hopefulness leads to an average increase in donations of \$0.44 ($p = 0.003$). The average mediation effect of hope on the relationship between the Letter treatment and donations is negative, but only marginally significant ($\hat{\beta} = -0.045$, CI= $[-0.110, 0.006]$, $p = 0.08$).

The Letter treatment does not have a significant impact on any other measured responses to other potential donation decision factors, including self-reported assessments of ease of hind-sight, whether climate change would impact one's children, whether taking action on climate change was part of one's responsibility as a parent or as a person who cares about the welfare of others, guilt about one's own contribution to climate change, and the efficacy of actions taken individually or globally (see Table 10 in Appendix 6 for more details).

The Essay treatment increases the extent to which participants agree that taking action to help reduce climate change is part of their responsibility as a person who cares about the welfare of others ($p = 0.035$). Those who more strongly agree that reducing their impact is part of their altruistic responsibility donate more than those who do not see reducing their impact

Table 3: Mediation Analysis of Donations

Mediation Variable	δ(Letter Treatment)	δ(Essay Treatment)
Implicit Discount Rate	0.0004	-0.0020
	(0.0128)	(0.0153)
Change in Climate Concern	0.0283	0.0718**
	(0.0546)	(0.0392)
Legacy	0.2785***	0.0829
	(0.0934)	(0.0653)
Vividness of Future	0.0456	0.0122
	(0.0497)	(0.0189)
Hindsight	-0.0020	-0.0058
	(0.0216)	(0.0327)
Climate Affects Own Kids	0.0427	0.0589
	(0.1021)	(0.0738)
Mitigation Responsibility	0.0978	0.1651**
	(0.1015)	(0.0788)
Hopeful about Future	-0.0665*	-0.0120
	(0.0445)	(0.0294)
Guilt about Climate Change	-0.0838	0.0454
	(0.0836)	(0.0740)
Efficacy of Climate Action	-0.0216	0.0367
	(0.0977)	(0.0727)

Note: Mediation analysis. Estimation of the treatment effect on donation that operates through the variable in the left-hand column. Estimation models include a dummy variable for the treatment group under examination and an intercept term. Models are estimated on a subset of data that includes the control group and the treatment group under examination. Standard errors are in parentheses. *p<0.1; **p<0.05; ***p<0.01

as part of their responsibility: one standard deviation increase in the feeling of altruistic responsibility correlates with an average increase of donations of \$1.58 ($p < 0.001$). A sense of responsibility to take actions to help reduce climate change mediates the relationship between the Essay treatment and donation ($\hat{\beta} = 0.189$,CI= $[0.018, 0.373]$, $p = 0.03$).

The Essay treatment does not have a significant impact on any other measured responses to other potential donation decision factors (see Table 10 in Appendix 6 for more details).

In summary, I find that writing a letter to a young person living in the future increases legacy motives and the vividness of life in the year 2050. Higher legacy motives lead to increased donations, thus partially mediating the relationship between the Letter treatment and the donation. Writing in about the risks and challenges of climate change in a neutral frame increases the feeling of personal responsibility to mitigate climate change, which partially mediates the relationship between the Essay treatment and the donation.

5.1.2 Salience of Decision Factors for Donations

In the control group, the strongest donation decision factor of those that were measured is guilt about one's own contribution to climate change ($\hat{\beta} = 0.687$, $p = 0.015$, Table 4). Hopefulness about the future and strength of hindsight both have a marginally significant relationship with donations ($\hat{\beta} = 0.503$, $p = 0.062$ and $\hat{\beta} = 0.463$, $p = 0.061$ respectively). The desire to leave a positive legacy is significant at the 10% level ($\hat{\beta} = 0.538$, $p = 0.098$).

In the Essay treatment group where individuals focus on what they know and what they would like to learn about the risks and challenges of climate change, post-treatment concern about climate change was the only statistically significant decision factor ($\hat{\beta} = 0.690$, $p < 0.001$).

In the Letter treatment group, legacy motives had a strong influence on donations ($\hat{\beta} = 0.880$, $p = 0.011$). Post-treatment concern about climate change was also a significant decision factor ($\hat{\beta} = 0.536$, $p = 0.006$).

General concern for climate change is strongly correlated with other decision factors. For this reason, I run a second analysis that excludes general concern about climate change. In the Letter treatment, legacy motives, the belief that climate change will affect one's kids, and the belief in the efficacy of climate change mitigation are all strong, significant donation decision factor (See Table 5).

To make comparisons between the isolated effects of the decision factors on donations, I compare the coefficients from a univariate regression of the decision factor on the donation for each treatment group by running a Z-test of

the null hypothesis that the coefficients in each treatment are equal. I find that the decision weights in the Letter treatment group are significantly higher than those in the control group for climate concern ($p = 0.017$), legacy ($p = 0.058$), efficacy of climate mitigation ($p = 0.029$), and impact on one's own children ($p = 0.013$). The difference between the decision weight on climate concern in the Essay treatment and the control group is not statistically significant ($p = 0.205$), nor are the differences in decision weights on all other variables.

It is striking that weights for multiple decision factors significantly shift when participants write about climate change to an individual living in the future, but they do not shift when an individual simply writes about climate change. The differential impact lends credence to the theory that salience is the causal mechanism by which the exercise of writing a letter to someone living in the future increases the willingness to pay for climate change mitigation. However, it leaves open the question of what is driving increased donations for those who write about climate change in a neutral frame.

5.2 Revealed Preference: Implicit Discount Rate

Time preference measures how much future utility is worth today. The discount rate measures how much future monetary costs and benefits are worth today. Because investment in climate change mitigation yields benefits in the future, the discount rate plays a major role in the expected willingness to pay for climate change mitigation. All else equal, the optimal upfront investment varies considerably depending on the discount rate. I hypothesized that the future-oriented frame of the Letter treatment would shift underlying time preferences. I measured implicit discount rates as a proxy for time preference and found weak evidence supporting this hypothesis.

Participants in the Letter treatment exhibit a lower implicit discount rate, but the effect is marginally significant ($p = 0.065$, Table 6). The effect of the Letter treatment decreases the three-month implicit discount rate by 2.5% from an average rate in the control group of 36.2%. This effect corresponds to an annual discount rate of 10%. However, it is important to keep in mind that the experimental measure across the sample yields annual implicit discount rates between 3% and 330%. This range is well within the norm found using these experimental methods, but it does not correspond directly to discount rates observed in real-world market behavior. Nonetheless, I draw the tentative conclusion that future-oriented writing task increases patience for payoffs in the future.

When treatments are interacted with demographic variables, an especially interesting finding arises. Compared to independents and non-voters in the

Table 4: Salience of Potential Decision Factors Across Treatments

	Dependent variable:		
	Donation to climate change mitigation		
	C	ET	LT
	(1)	(2)	(3)
Climate Concern	0.269	0.690***	0.537***
	(0.181)	(0.187)	(0.195)
Discount Rate	−0.182	−0.672	0.133
	(0.756)	(0.720)	(0.801)
Legacy	0.538*	0.419	0.880**
	(0.324)	(0.344)	(0.345)
Climate Impacts on Kids	0.249	−0.170	0.371
	(0.344)	(0.371)	(0.411)
Vividness of Future	0.228	−0.264	−0.333
	(0.263)	(0.244)	(0.259)
Hindsight	0.463*	0.323	−0.248
	(0.247)	(0.235)	(0.276)
Mitigation Responsibility	0.224	−0.333	−0.077
	(0.438)	(0.437)	(0.422)
Efficacy of Climate Action	−0.247	0.281	0.602
	(0.472)	(0.446)	(0.461)
Hopeful about Future	0.503*	−0.168	−0.149
	(0.270)	(0.267)	(0.272)
Guilt about Climate Change	0.687**	0.488	0.370
	(0.281)	(0.296)	(0.296)
Constant	4.989***	2.606*	3.491**
	(1.365)	(1.433)	(1.482)
Observations	578	600	572
R^2	0.100	0.095	0.164

Notes: OLS regression of measured potential decision factors on donation ($'s) for each treatment group. All covariates are standardized to mean=0, sd=1 across all three treatments. Standard errors are in parentheses. *p<0.1; **p<0.05; ***p<0.01

Table 5: Salience of Potential Decision Factors Across Treatments without General Concern

	Dependent variable:		
	Donation to climate change mitigation		
	C	ET	LT
	(1)	(2)	(3)
Discount Rate	−0.114	−0.718	0.052
	(0.756)	(0.725)	(0.805)
Legacy	0.570*	0.667*	0.992***
	(0.324)	(0.340)	(0.345)
Climate Impacts on Kids	0.459	0.420	0.926**
	(0.315)	(0.339)	(0.360)
Vividness of Future	0.237	−0.177	−0.282
	(0.263)	(0.245)	(0.260)
Hindsight	0.442*	0.328	−0.186
	(0.247)	(0.237)	(0.277)
Mitigation Responsibility	0.377	0.142	0.220
	(0.423)	(0.421)	(0.410)
Efficacy of Climate Action	−0.050	0.589	0.933**
	(0.457)	(0.442)	(0.448)
Hopeful about Future	0.476*	−0.204	−0.156
	(0.269)	(0.269)	(0.274)
Guilt about Climate Change	0.778***	0.664**	0.468
	(0.276)	(0.295)	(0.296)
Constant	6.948***	7.720***	7.437***
	(0.362)	(0.366)	(0.386)
Observations	579	601	572
R^2	0.096	0.074	0.152

Notes: OLS regression of measured potential decision factors on donation ($'s) for each treatment group. All covariates are standardized to mean=0, sd=1 across all three treatments. Standard errors are in parentheses. *p<0.1; **p<0.05; ***p<0.01

Letter treatment, both Democratic and Republican voters respond strongly to the Letter treatment with significant reductions in their implicit discount rates. The Letter treatment reduces the three-month discount rate by 15.1 percentage points for Republican voters ($p = 0.002$) and by 12.4 percentage points for Democratic voters ($p = 0.027$). In this study as in the political sphere, Republicans and Democrats differ sharply on climate change. But they are similar in one dimension: the importance of legacy. On average across the sample, Republican and Democratic voters report higher legacy motives than independent voters and non-voters ($p = 0.036$ and $p = 0.048$ respectively). To find out whether legacy might be the key to the relationship between the Letter treatment and the implicit discount rate, I regress the discount rate on the treatment indicator variables, the legacy measure, and an interaction term. The interaction of the Letter treatment indicator and the legacy motives measure is negative and significant ($p = 0.047$). Taken together, these findings lead to the conclusion that for those who have higher legacy motives, the future-oriented Letter treatment reduces their discount rate and indicates more patient time preference.

While I did not have any prior expectations on this relationship, I find that parents have a significantly higher discount rate when treatment interactions are not taken into account ($p = 0.001$, Table 6). With treatment interactions, I find that parents in both treatment groups have higher discount rates compared to parents in the control group, but the relationship is only significant for the Essay treatment (LT: $p = 0.445$, ET: $p = 0.043$, Table 9). Higher discount rates for parents could arise simply because parents with dependents still in their care may be more budget constrained than those without dependents, all other factors constant. However, the fact that this effect is only seen for parents in the Essay treatment indicates that this may have arisen by chance.

The Letter treatment appears to cause individuals to give more weight to future monetary benefits as shown through the effect of the discount rate. The Letter treatment also increases donations. But the question of whether the Letter treatment creates a shift in time preference which then leads to a higher willingness to pay for climate change mitigation is still open. The mediation analysis does not indicate that the Letter treatment increases donations through lower discount rates. The relationship is extremely small and statistically insignificant ($p = 0.98$). Controlling for demographic variables decreases the noise, but the effect is still small and statistically insignificant with a 95% confidence interval of -$0.02 to $0.07.

A key link in the chain of causality is the link between the implicit discount rate and donations. I find that a lower discount rate correlates with larger donations, but the relationship is not statistically significant even after con-

trolling for other variables ($p = 0.164$, Appendix 6, Table 11). The magnitude of the effect is also quite small with a ten percentage point decrease in the implicit discount rate correlating to a \$0.07 increase in donations.

In analyses of optimal global investment in climate change mitigation, there is a clear and very strong relationship between the discount rate and the optimal investments. This relationship is much weaker in these experimental findings. There are some potential reasons for this effect. First, there are the classic problems of free riding. For a perfectly rational actor without altruism or warm glow donation effects, the optimal personal investment in climate change is zero because it is personally optimal to free ride on others' investments. While it is evident this is not a perfect explanation since most participants chose to donate, this could weaken the link between the discount rate and donations. If the decision to donate were pure warm glow and the warm glow was independent of time preference, then I would expect no relationship between the implicit discount rate and donation. I do not think this tells the full story. Second, the implicit discount rate is an imperfect measure of time preference. We cannot capture present bias for immediate consumption, and we can only measure preference over money earlier or money later, not the more fundamental tradeoff of utility earlier or utility later. Third, the nature of these measures where participants choose between different options for an experimental bonus may simply lead to a noisier relationship than expected because they are imperfectly representative of more fundamental decision processes.

5.3 Impact on Climate Concern

In the screening survey, participants were asked to rate their concern about climate change on a scale from one to ten. In the experiment, after the treatment and donation measure, the same question about concern for climate change is asked again. These two responses provide a clean within-subject pre- and post-treatment measure.

In Table 7, I show the results of the difference-in-difference estimation. The Letter treatment has a small, positive effect that cannot be distinguished from zero. The Essay treatment has a statistically significant, positive effect ($p = 0.0149$). On average, individuals increase their concern for climate change by about one-tenth of a standard deviation after writing an essay about the risks and challenges of climate change. A Wald test shows that the effect sizes of the Letter and Essay treatments are significantly different from one another ($p = 0.038$).

The control group has a significant increase in concern for climate change ($p < 0.001$), likely due to the first part of the experiment which involves

Table 6: Implicit Discount Rate Analysis

	Dependent variable:		
	Implicit discount rate		
	(1)	(2)	(3)
Letter Treatment D.V.	−0.009 (0.020)	−0.010 (0.020)	−0.025* (0.014)
Essay Treatment D.V.	0.016 (0.019)	0.018 (0.019)	−0.005 (0.019)
Baseline Climate Concern		0.008 (0.008)	0.008 (0.008)
Parent D.V.			0.063*** (0.018)
Age (years)			−0.001 (0.001)
Income ($1000's)			−0.001*** (0.0002)
High School D.V.			−0.059 (0.110)
Trade School D.V.			−0.063 (0.118)
Associate Degree D.V.			−0.067 (0.115)
Bachelor Degree D.V.			−0.124 (0.116)
Graduate Degree D.V.			−0.235* (0.124)
Vote Republican D.V.			−0.036 (0.024)
Vote Democrat D.V			−0.028 (0.025)
Male D.V.			−0.014 (0.016)
White D.V.			−0.078*** (0.020)
Hispanic D.V.			0.044 (0.031)
Constant	0.362*** (0.014)	0.362*** (0.014)	0.819*** (0.112)
State Fixed Effects	No	No	Yes
Clustered Standard Errors	No	No	Yes
Observations	1,711	1,700	1,623
R^2	0.001	0.002	0.129

Note: OLS regression. Dependent variable is implicit discount rate. Income is a numeric variable in $1000's. Dummy variables are included for those who vote mainly or exclusively for Democrats and Republicans. Voters who vote half Republican and half Democrat as well as those who do not vote for either party are the comparison group. Education is a categorical variable split into dummy variables and less than high school education is the comparison group. D.V. indicates binary dummy variables. Baseline climate concern is a 10 point scale measure standardized with mean=0, sd=1. Age is measured is years.
*p<0.1; **p<0.05; ***p<0.01

watching a three-minute video about the science and impacts of climate change and reading about climate change mitigation policies and actions.

What is most intriguing about these findings is that the Letter treatment is the only group that does display an increased level of concern. It is possible that an uncontrolled difference in the treatment – where participants were asked to discuss solutions and the personal ways in which they reduced their climate change impact – led to a reduction in concern about climate change. It is also possible that the framing of the letter to an individual led to a more hopeful outlook on the future. These hypotheses should be addressed in future research.

Table 7: Difference-in-Differences Estimation of the Change in Concern for Climate Change

	Dependent variable:
	clim_dif
Letter Treatment (LT)	0.055
	(0.100)
Essay Treatment (ET)	0.241**
	(0.099)
Constant	0.360***
	(0.071)
Observations	1,771
R^2	0.004

Note: OLS regression. Dependent variable is the change in stated concern about climate change before and after treatment measured on a 1-to-10 scale where 1 is labeled as "not at all concerned" and 10 is labeled as "extremely concerned." *p<0.1; **p<0.05; ***p<0.01

6 Conclusions

The long time delay between the mitigation decision and the impacts of that decision hinder optimal investment in climate change mitigation. The extensive

time horizon and social distance from those impacted create psychological distance and make the impacts less salient. In this study, I explore a behavioral intervention in an online experiment that asks participants to write a narrative about the risks and challenges of climate change. In the Essay treatment, the narrative is framed as an essay on the risks and challenges of climate change. In the Letter treatment, the narrative is framed as a message directed to a particular individual living in the year 2050. The control group writes about their daily routine.

Compared to the control, both the Letter and Essay treatments increase the willingness to donate to a charity doing climate change mitigation work. However, the two treatments appear to affect the willingness to donate through different pathways. Writing about the risks and challenges of climate change to an individual living in the future leads to higher donations by increasing the desire to leave a positive legacy and by increasing the salience of climate mitigation benefits for one's children. Writing about the risks and challenges of climate change in an essay leads to higher donations by increasing the sense of individual responsibility to reduce one's impact on climate change.

On the temporal dimension, the Letter treatment increases the vividness of the future and has a negative but marginally significant effect on the implicit discount rate. On the social dimension, the Letter treatment increases the desire to leave a positive legacy. The Letter treatment does not increase the concern that climate change will impact one's own kids, but it causes participants to put more weight on this decision factor in their donation decision.

Returning to the initial hypotheses outlined in the introduction, I will take each in turn and discuss the evidence from this study that supports or does not support each one.

H1: The process of generating a narrative on the risks and challenges of climate change leads to a higher willingness to pay for climate change mitigation.

H1 is strongly supported by the results of this study. Compared to a control group that writes a narrative on an unrelated topic, writing for five minutes about the risks and challenges of climate change leads to a higher willingness to contribute to climate mitigation. I find an effect size of about 11% for both of the treatment groups.

H2: Addressing the narrative on the risks and challenges of climate change to an individual living in the future will further increase the willingness to pay for climate mitigation.

H2 is not supported by the results of this study. The two treatment groups had nearly identical levels of willingness to pay for climate mitigation. However,

mediation analyses suggest that the treatments are operating through different mechanisms. A narrative frame that addresses a discussion of the risks and challenges of climate change to a particular individual living in the future increases the desire to leave a positive legacy, which leads to increased donations. A neutral narrative frame that discusses the risks and challenges of climate change increases the concern about climate change and feeling of responsibility to take action to reduce climate change. The heightened factors then go on to increase average donations. Additionally, the Essay treatment increases the decision weight on concern for climate change has in the donation decision and the Letter treatment significantly increases the decision weight on the belief that climate change will affect one's children, indicating increased salience for those decision factors.

H3: A future-oriented narrative frame will reduce the revealed implicit discount rate.

The null hypothesis of a zero effect cannot be rejected at a significance level of 0.05. The future-oriented framing in writing task where participants write a letter to an individual living in the future correlates with a small, marginally significant reduction in the implicit discount rate ($p = 0.065$). The implicit discount rate weakly predicts donations with lower discount rates correlating with higher donations, however, the effect is not statistically significant ($p = 0.164$).

The similarity in treatment effects points to the possibility that by actively focusing on the problem of climate change leads to higher willingness to pay. This link is a more general hypothesis than H1, but the underlying concept is very similar. A simple experiment that varies how participants focus on a given problem could test whether generating one's own narrative (H1) has a different impact than generally ruminating on the subject. In this experiment, the act of writing a narrative was chosen in part so it could be personalized by addressing it to a particular individual and in part because it requires significant focus. Participants must come up with arguments about the risks and challenges of climate change instead of passively reading or listening to a discussion of the subject. It is possible that the act of coming up with one's own narrative could lead individuals to donate more to climate change mitigation through the mechanism of cognitive dissonance (Festinger 1957). There are many questions and causal mechanisms to explore. This study begins an exploration of the role that salience of climate change risks and mitigation benefits may play in the willingness to pay for climate change mitigation. It is one step forward to understanding a piece of this puzzle, and it raised many questions for further studies to explore.

The results of this study strongly support the conclusions of Zaval, Markowitz, and Weber (Zaval et al. 2015). The study design replicated their survey instruments for both the donation measure and the legacy measures. I improved upon their design by utilizing a tighter control group. While their control group had no writing task, the control group in this study participated in an unrelated writing exercise for the same minimum amount of time. I built upon their findings by testing two different writing prompts that focus specifically on climate change instead of focusing on legacy. The finding that the two narrative frames had a very different impact on legacy motives adds a new insight to this body of inquiry.

Time preference plays a crucial role in climate change mitigation decisions. We do not yet fully understand how time perspective over long time horizon decisions may lead to inefficient choices. This study adds to the scientific understanding by exploring the question of how different narrative frames can shift the willingness to pay for climate change mitigation by altering the social distance across generations and making future climate change mitigation benefits more salient.

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A Appendix: Supplemental Tables

Table 8: Analysis of Extensive Margin of Donations

	Dependent variable:		
	Non-Zero Donation to CO2 mitigation		
	(1)	(2)	(3)
Letter Treatment D.V.	0.0001 (0.143)	−0.011 (0.146)	−0.021 (0.162)
Essay Treatment D.V.	0.218 (0.146)	0.237 (0.149)	0.236* (0.143)
Baseline Climate Concern		0.468*** (0.057)	0.537*** (0.059)
Parent D.V.			0.272* (0.152)
Age (years)			0.001 (0.006)
Income ($1000's)			0.001 (0.002)
High School D.V.			−0.425 (0.721)
Trade School D.V.			−0.437 (0.754)
Associate Degree D.V.			−0.149 (0.712)
Bachelor Degree D.V.			−0.357 (0.742)
Graduate Degree D.V.			−0.475 (0.720)
Vote Republican D.V.			−0.144 (0.152)
Vote Democrat D.V			−0.170 (0.191)
Male D.V.			−0.187 (0.147)
White D.V.			−0.451*** (0.147)
Hispanic D.V.			0.262 (0.233)
Constant	1.258*** (0.101)	1.315*** (0.104)	1.997*** (0.683)
State Fixed Effects	No	No	Yes
Clustered Standard Errors	No	No	Yes
Observations	1,736	1,724	1,645

Note: Logit regression. Dependent variable indicates donation > $0. Income is a numeric variable in $1000's. Dummy variables are included for those who vote mainly or exclusively for Democrats and Republicans. Voters who vote half Republican and half Democrat as well as those who do not vote for either party are the comparison group. Education is a categorical variable split into dummy variables and less than high school education is the comparison group. D.V. indicates binary dummy variables. Baseline climate concern is a 10 point scale measure standardized with mean=0, sd=1. Age is measured is years. *p<0.1; **p<0.05; ***p<0.01

Table 9: Implicit Discount Rate Analysis with Treatment Interactions

	Dependent variable:		
	Implicit Discount Rate		
	(1)	(2)	(3)
Letter Treatment D.V. (LT)	−0.027	−0.009	−0.277
	(0.036)	(0.020)	(0.225)
Essay Treatment D.V. (ET)	−0.060	0.018	−0.245
	(0.037)	(0.019)	(0.232)
Parent D.V.	0.006		0.025
	(0.029)		(0.034)
Parent x LT	0.024		0.028
	(0.041)		(0.041)
Parent x ET	0.103**		0.089
	(0.042)		(0.055)
Baseline Climate Concern		0.017	0.020
		(0.014)	(0.020)
Baseline CC x LT		−0.026	−0.038
		(0.020)	(0.026)
Baseline CC x ET2		−0.003	0.004
		(0.019)	(0.027)
Constant	0.358***	0.362***	0.923***
	(0.025)	(0.014)	(0.195)
Demographic Controls	*No*	*No*	*Yes*
Dems x Trt Interactions	*No*	*No*	*Yes*
State Fixed Effects	*No*	*No*	*Yes*
Clustered Standard Errors	*No*	*No*	*Yes*
Observations	1,701	1,700	1,623
R^2	0.009	0.003	0.153

Note: OLS Regression. Demographic controls included where indicated are listed in Table 6. Demographic controls are interacted with treatment dummy variables where indicated. State-level fixed effects are not interacted with treatment dummies. *p<0.1; **p<0.05; ***p<0.01

Table 10: Impact of Treatment Groups on Decision Factors

	OLS Estimates	
	Letter Treatment	Essay Treatment
Implicit Discount Rate	−0.007	0.017
	(0.019)	(0.019)
Climate Concern	0.028	0.083
	(0.058)	(0.058)
Legacy	0.167***	0.066
	(0.050)	(0.050)
Vividness of Future	0.249***	0.067
	(0.058)	(0.057)
Hindsight	−0.007	−0.011
	(0.058)	(0.058)
Impact on Own Kids	0.024	0.048
	(0.058)	(0.058)
Mitigation Responsibility	0.059	0.122**
	(0.058)	(0.058)
Hope	−0.100*	−0.026
	(0.058)	(0.058)
Guilt	−0.061	0.037
	(0.058)	(0.058)
Efficacy of Climate Action	−0.013	0.026
	(0.054)	(0.050)

Note: Dummy variables for the Letter and Essay treatments are regressed on the dependent variables in the lefthand column. No additional covariates are included in this specification.*p<0.1; **p<0.05; ***p<0.01

Table 11: Relationship Among Decision Factors, Donations and Concern

	Dependent variable:			
	Donation	Donation	Concern	Concern
Implicit Discount Rate	−0.208	−0.568	0.089	−0.179
	(0.454)	(0.477)	(0.175)	(0.123)
Climate Concern	0.803***	0.876***	NA	NA
	(0.058)	(0.093)		
Legacy	1.515***	1.128***	1.161***	0.672***
	(0.168)	(0.179)	(0.060)	(0.044)
Vividness of Future	0.110	0.121	0.146**	0.118***
	(0.148)	(0.150)	(0.057)	(0.039)
Hindsight	0.322**	0.321**	0.173***	0.116***
	(0.147)	(0.149)	(0.057)	(0.038)
Climate Affect Kids	1.569***	1.131***	1.597***	0.846***
	(0.143)	(0.177)	(0.043)	(0.041)
Mitigation Responsibility	1.580***	1.133***	1.753***	1.026***
	(0.143)	(0.182)	(0.039)	(0.040)
Hope	0.437***	0.254*	0.277***	0.191***
	(0.147)	(0.150)	(0.057)	(0.038)
Guilt	1.346***	0.919***	1.197***	0.477***
	(0.144)	(0.166)	(0.049)	(0.042)
Efficacy of Mitigation Action	1.721***	1.297***	1.897***	1.074***
	(0.161)	(0.200)	(0.045)	(0.045)
Demographic Controls	No	Yes	No	Yes
Baseline Concern	No	Yes	No	Yes

Note: The variables listed in the lefthand column are regressed on revealed willingness to donate to climate change mitigation and reported post-treatment concern about climate change on a 1-to-10 scale. Details on demographic controls can be found in Table 1.
*p<0.1; **p<0.05; ***p<0.01

B Appendix: Demographic Characteristics of Study Population

Table 12: Demographics: Linear and Dummy Variables

Statistic	N	Mean	St. Dev.	Min	Max
age	1,713	37.781	11.759	18	76
kids	1,786	0.721	0.449	0	1
white	1,788	0.820	0.384	0	1
hisp	1,788	0.070	0.256	0	1

Table 13: Demographics: Household Income

	Treatment Groups			
Household Income	LT	ET	C	Total
Less than $25,000	99	114	126	339
$25,000-$34,999	94	101	92	287
$35,000-$49,999	97	109	99	305
$50,000-$74,999	127	136	115	378
$75,000-$99,999	85	83	81	249
$100,000-$149,999	71	49	52	172
$150,000-$199,999	9	10	14	33
$200,000 or more	4	8	10	22
Total	586	610	589	1785

Table 14: Demographics: Racial Groups

	Treatment Groups			
	LT	ET	C	Total
American Indian or Alaskan Native	15	15	11	41
Asian	33	37	30	100
Black or African American	53	48	38	139
Native Hawaiian or Other Pacific Islander	0	3	2	5
White	496	510	509	1515
Other	11	16	9	36

Note: Multiracial participants were counted in multiple racial groups.

Table 15: Demographics: Gender

	Treatment Groups			
Gender	LT	ET	C	Total
Male	223	213	200	636
Female	361	397	386	1144
Other	1	0	3	4
Total	585	610	589	1784

Table 16: Demographics: Highest Level of Education Completed

	Treatment Groups			
Level of Education	LT	ET	C	Total
Less than high school diploma or equivalent	3	4	4	11
High school diploma or equivalent	159	171	149	479
Trade school degree or certificate	30	32	31	93
Associate degree	91	116	102	309
Bachelors degree	216	204	201	621
Graduate degree (Masters, PhD, MD, JD, etc)	85	85	101	271
Total	584	612	588	1784

Table 17: Demographics: Voting Preferences

	Treatment Groups			
	ET	LT	C	Total
Nearly always vote for Democrats	154	160	164	478
Vote for Democrats more often than Republicans	132	126	127	385
Half Democrats, half Republicans.	62	71	50	183
Vote for Republicans more often than for Democrats	84	86	97	267
I nearly always vote for Republicans	89	114	85	288
I will not vote for either party	25	16	16	57
I do not vote	40	38	50	128
Total	586	611	589	1786

C Appendix: Survey Instruments

C.1 Essay Prompts by Treatment

C.1.1 Letter Treatment

Pre-essay questions:

- Do you have children, grandchildren, nieces or nephews? ["Yes, I have children", "Yes, I have grandchildren", "I have niece(s) or nephew(s)", "No, I do not have children, grandchildren, nieces or nephews"
- What is the current age of your youngest child [grandchild,niece or nephew]? (in years)

Essay prompts for participants *with* children, grandchildren and/or nieces/nephews

- Imagine it is the year 2050. Your youngest child [grandchild, niece/nephew] is [child's age + 35] years old, working hard, and raising a family of their own. Your child [grandchild, niece/nephew] opens the mailbox and finds a letter from you, written in the year 2015.

  The letter is a message from the past and tells them what you thought about the risks and challenges of climate change and how they might affect the way your child would live their life in 2050. Tell your child [grandchild, niece/nephew] what, if any, actions on climate change you have taken already and what you will take in the next few years.

  Please spend at least 5 minutes writing that letter. At the end of the survey, you will have the option of adding your letter to a long-term archive where your child [grandchild, niece/nephew] can read it in 2050.

  Note: The submit button will appear after the minimum writing time of 5 minutes has elapsed.

Essay Prompts for Participants *without* children, grandchildren and/or nieces/nephews

- Imagine it is the year 2050. A child born today is 35 years old, working hard, and raising a family of their own. They open a time capsule and find a letter from you, written in the year 2015.

  The letter is a message from the past and tells them what you thought about the risks and challenges of climate change and how they might affect the way children in 2015 would live their lives in 2050. Tell this child what, if any, actions on climate change you have taken already and what you will take in the next few years.

  Please spend at least 5 minutes writing that letter. At the end of the survey, you will have the option of adding your letter to a long-term archive where a child born in 2015 can read it in 2050.

  Note: The submit button will appear after the minimum writing time of 5 minutes has elapsed.

C.1.2 Essay Treatment

Essay prompt

- Please spend at least 5 minutes writing about the risks and challenges of climate change. Reflect on what you already know and what you might like to learn more about.

  Note: The submit button will appear after the minimum writing time of 5 minutes has elapsed.

C.1.3 Control

Essay prompt

- Please spend at least 5 minutes writing about your daily routine in the morning after you wake up and in the evening hours before you go to bed.

  Note: The submit button will appear after the minimum writing time of 5 minutes has elapsed.

C.2 Donation

- We will be randomly selecting 1 out of every 100 participants to receive a bonus of $20.

  You have the option to donate part or all of your bonus to Trees for the Future, a non-profit that plants trees that remove carbon dioxide from the atmosphere which helps reduce climate change. You can check out the organization at their website: http://www.treesforthefuture.org/.

  Below, choose how much of the $20 bonus you would like to donate to Trees for the Future and how much you would like to keep for yourself if you win the bonus. ["$20 for Trees for the Future; $0 for myself","$19 for Trees for the Future; $1 for myself",...,"$1 for Trees for the Future; $19 for myself","$0 for Trees for the Future; $20 for myself"]

C.3 Time Discounting

- Now, we will ask you a series of questions where you will choose between two options. Option 1 will have an amount of money to be awarded as a bonus one month from today. Option 2 will have an amount of money awarded as a bonus four months from today.

  You will make 14 of these choices with different amounts of money.

  One of the MTurk workers who completes this survey will be randomly selected. Then, one of the 14 choices will be randomly selected. If that person chose Option 1, then they will receive the Option 1 bonus in one month. If that person chose Option 2, then they will receive the Option 2 bonus in four months.

  Before making your choices over the bonus payments, you will take a short 3 question quiz to be sure that you understand these instructions. You must get all 3 questions correct, but you will have 3 chances to correctly answer the quiz.

- How many people in this survey will receive an MTurk bonus in the amount of one of their choices? ["None","1","2","3"]

- If you are the selected person, how will your bonus be chosen? ["1 of your 14 choices will be randomly selected and rewarded", "An average of your 14 choices will be rewarded", "The study administrator will choose whichever choice she thinks is best"]

- Do each of my choices have an equal chance of being implemented as a MTurk bonus payment? ["Yes","No"]

By random assignment, the following choices were given in either ascending order or descending order:

- Would you rather have $100.00 in one month or $101.00 in four months?
- Would you rather have $100.00 in one month or $102.50 in four months?
- Would you rather have $100.00 in one month or $105.00 in four months?
- Would you rather have $100.00 in one month or $107.50 in four months?
- Would you rather have $100.00 in one month or $110.00 in four months?
- Would you rather have $100.00 in one month or $110.00 in four months?
- Would you rather have $100.00 in one month or $115.00 in four months?
- Would you rather have $100.00 in one month or $120.00 in four months?
- Would you rather have $100.00 in one month or $130.00 in four months?
- Would you rather have $100.00 in one month or $140.00 in four months?
- Would you rather have $100.00 in one month or $150.00 in four months?
- Would you rather have $100.00 in one month or $175.00 in four months?
- Would you rather have $100.00 in one month or $200.00 in four months?
- Would you rather have $100.00 in one month or $250.00 in four months?
- Would you rather have $100.00 in one month or $300.00 in four months?

C.4 Decision Factor Questions

Legacy Motive Questions (Replication of survey instruments from Zaval et al. 2015)

- It is important to me to leave a positive legacy. [1-6 scale: End-points labeled "1 (Not at all)" and "10 (A great amount)"]
- It is important for me to leave a positive mark on society. [1-6 scale: End-points labeled "1 (Not at all)" and "10 (A great amount)"]

- I care about what future generations think of me. [1-6 scale: End-points labeled "1 (Not at all)" and "10 (A great amount)"]
- I feel hopeful about the future. [1-6 scale: End-points labeled "1 (Not at all)" and "10 (A great amount)"]
- On a scale of 1 to 10, how easily does life in the year 2050 come to mind? [1-10 scale: End-points labeled "1 (Not at all easily)" and "10 (Very easily)"]
- On a scale of 1 to 10, how easily can you look back on your actions with the benefit of hindsight? [1-10 scale: End-points labeled "1 (Not at all easily)" and "10 (Very easily)"]
- On a scale of 1 to 10, how concerned are you about climate change? [1-10 scale: End-points labeled "1 (Not at all concerned)" and "10 (Extremely concerned)"]
- On a scale of 1 to 10, how likely is it that climate change will negatively affect your own child? [1-10 scale: End-points labeled "1 (Very Unlikely)" and "10 (Very Likely)"]
- Rate the extent to which you agree or disagree with the following statement: The actions the entire world takes as a whole can make a difference for climate change. ["Strongly Agree", "Agree","Neither Agree nor Disagree", "Disagree","Strongly Disagree"]
- Rate the extent to which you agree or disagree with the following statement: Taking action to help reduce climate change is part of my responsibility as a person who cares about the welfare of others. ["Strongly Agree", "Agree","Neither Agree nor Disagree","Disagree","Strongly Disagree"]
- Rate the extent to which you agree or disagree with the following statement: I feel guilty about my role in contributing to climate change. ["Strongly Agree", "Agree","Neither Agree nor Disagree", "Disagree","Strongly Disagree"]