Honors College Thesis

Submitted in partial fulfillment of the requirements for

graduation from the Honors College

Effects of Episodic Future Thinking and Perspective Taking

on Climate Change Risk Perception and Action

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May 2, 2025

Abstract

Previous studies have found that pre-experiencing future climate events using episodic future thinking (EFT) can increase climate change risk perception and action. Perspective taking (PT) with individuals being affected by climate change can do the same. Here we tested if combining EFT and PT would be more effective than EFT alone in altering self-reported climate change risk perception and action. Climate action was defined as the amount of money participants chose to donate to a climate change charity in a modified dictator game. 259 participants recruited through Prolific were randomly assigned to one of three groups: EFT+PT, which involved reading a vignette about a young friend or relative enduring a devastating future storm; EFT, where participants read the same vignette but about a generic person; or a control condition, where participants read climate change facts. Climate change risk perception increased overall after reading the vignettes, but, surprisingly, this change was only significant within the control group. There was no effect of our manipulation on the proportion of charitable choices made. However, in the EFT+PT group, participants who reported feeling closer to the friend or relative that they imagined in the vignette donated more money to charity. In a follow-up study, we obtained ratings of all of the vignettes from an independent group of 50 participants. The vignette in the control condition was rated as more likely to occur than the EFT+PT and EFT vignettes, which could explain why that vignette elicited the biggest increase in climate change risk perception. Meanwhile, the EFT+PT vignette was rated as the most motivating for climate action. Together, these results suggest that perspective taking with *close* others may encourage climate action, even if individuals' climate change risk perception is not affected.

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Background

The Problem of Climate Change Inaction

The current era people live in has been referred to as the Anthropocene (Bai et al., 2016; Bonneuil and Fressoz, 2016). This era is defined by human-driven climate change. Climate change is a result of fossil fuels being burnt and increasing greenhouse gases like carbon dioxide in the atmosphere (Zandalinas et al., 2021). This traps heat in the atmosphere, leading to temperature increases that affect weather and temperature patterns in the long run. Climate change refers to these long-term changes that are caused by global warming. Although climate change is an issue that defines the present, it has resulted from an accumulation of past decisions, and it has dire implications for the future.

Climate change is a testament to the complexities of human progress. While the past few centuries have seen an explosion in economic growth, a variety of unintended environmental consequences have arisen (Bai et al., 2016; Lewis and Maslin, 2015). For example, since the Industrial Revolution, atmospheric carbon levels have increased, leading global temperatures to warm and water acidity to increase (Lewis and Maslin, 2015). There is potential for hundreds of millions of people to experience water scarcity, which will also constrain food production (Bradley, 2019). With unstable food and water sources could come mass migrations and increases in disease**.** Therefore, the more the planet warms, the more severe the effects will be not just on the environment, but on human society as well.

Although climate change is quite widely accepted to be a serious issue (Sawe and Chawla, 2021), people often fail to take pro-climate action. This has been proposed due to borders – both physical and figurative – that prevent people from feeling obligated to take climate action. On one hand, physical borders may distance people from climate change because

it is a *global*, rather than a local, issue (Duke and Holt, 2016). Our world is split into various

countries and states, and each nation has its own policies that people must abide by. Therefore,

an issue like climate change that affects the whole world rather than confining to man-made

divisions, is not compatible with the nature of the policies we have in place (Ghosh, 2016). This

makes it difficult to grasp the span of the crisis.

Our society has also created figurative borders (Ghosh, 2016). These have developed as a

consequence of how we experience time (Bastian, 2012; Bradley, 2019). Environmental issues

tend to occur slowly over time, rather than becoming immediately apparent (Boomsma et al.,

2016; Bradley, 2019; Uhl-Haedicke et al., 2019). The root of the crisis occurred in the past and

affects us today, and the actions we take today will impact the future. However, these events

across time are more interconnected than people are equipped to realize (Bradley, 2019; Ghosh,

2016). People tend to focus on optimizing their material well-being in the short term

(Charbonnier, 2021). Accordingly, climate change can be hard for people to grasp. Our

perception of time has created figurative borders that are incompatible with the long-term

gradual nature of this crisis (Ghosh, 2016).

These figurative borders may exacerbate people's psychological distance from the future

(Duke and Holt, 2016). Psychological distance refers to the idea that events happening in

faraway places, distant time periods, and to socially distant individuals may not be perceived as

threatening or urgent (Pahl and Bauer, 2011). Since climate change involves long term changes

in weather and temperature, future generations will face the consequences of today's

unsustainable behavior (Guizar et al., 2022). This makes climate change an intergroup issue in

which people in the present must take action to benefit people in the future (Guizar et al., 2022;

Meleady and Crisp, 2017). However, just as people are more willing to help those whom they are

emotionally close to (Jones and Rachlin, 2006), people are also more willing to help those they are temporally close to. Future generations are perceived as outgroups due to their temporal distance from the present (Meleady and Crisp, 2017). This leads people to prioritize current generations over future ones. By isolating people in the present, our figurative borders have strengthened this bias, creating an obstacle towards mitigating climate change.

   Consequently, challenging people's time perspectives may allow them to gain a better grasp of climate change and feel more urgency to take climate action. Therefore, the current study will focus on challenging people's time perspectives to decrease their psychological distance from the future affected by climate change.

The Role of Mechanical Time and Capitalism in Presentism

   A lack of connection to the past and future may prohibit climate action, so it is important to outline how concepts of time have transformed (Bastian, 2012; Ghosh, 2016). The rise and impacts of capitalist mechanical time can help us to gain insight into the root of the climate crisis. Mechanical time differs from the organic form of time, which can be thought of as a qualitative state of time (Stahel, 1999). Organic time can be looked at as a natural accumulation of events, including processes that cannot be sped up or slowed down (Bastian, 2012; *On Time*, 2017). For instance, time could be thought of in terms of the changing of the days and seasons, or by biological cycles driving one to eat and sleep (Mumford, 2010; Johncock, 2019). This demonstrates that organic time contains patterns, but it lacks complete precision and regularity.

   Contrarily, mechanical time is an abstract quantitative form of time that is displayed using the clock (Mumford, 2010; Stahel, 1999). In this case, time can be thought of as a collection of hours, minutes, and seconds that simplify the complexities of life into precise

statistical measurements. The beginning of the Anthropocene is often related to the Industrial Revolution (Lewis and Maslin, 2015). Although the steam engine is typically thought of as being the most important invention of the Industrial Revolution, the clock can be thought of as having a larger impact. One cannot speed up or slow down the passing of seasons or rising of the sun. However, quantifying time allows people to measure their output during a given period. Then, people may aim to increase the amount of work they complete in this period of time (Mumford, 2010). Therefore, without clock time, there would be no need to come up with advanced technology such as the steam engine to speed up production and enhance output.

Although mechanical clock time was used since the 14th century, this form of time was universalized under the capitalist system (Martineau, 2012). Multiple scholars indicate that in the capitalist market, mechanical time contributed to the commodification of resources and labor (Martineau, 2012; Mehnert, 2016). As the intrinsic value of resources diminished, they became increasingly valued in terms of how much profit they would yield once transformed into products (Mehnert, 2016). Therefore, labor time, or the amount of mechanical time spent to create a product, became an important tool to determine the prices of products (Stahel, 1999).

The universalization of mechanical time was useful for building a strong capitalist economy, but it also resulted in large scale environmental degradation. This form of time is external to the human being, meaning clock time can be used to coordinate schedules. By creating a concrete work schedule, people could complete their work and achieve profit more easily (Bastian, 2012; Johncock, 2019). However, capitalism also transformed human relationships with nature and time. People were encouraged to exploit the resources at their disposal for profit, and there were unintended consequences surrounding this commodification (Charbonnier, 2021; Gifford, 2011; Mumford, 2010; Stahel, 1999). This led to unsustainable

resource use and a huge increase in pollution. This demonstrates that the popularization of capitalism can be tied to the root of the climate crisis.

Additionally, this system created a sharp divide between natural and cultural time. Using clock time, each day is defined by the same cycle going from 12:00 am to 11:59 pm regardless of the events that fill it (Bastian, 2012). While clock time allows for coordination of human society, it gives no insight into the progress of environmental changes, like the timing of glacial melting or sea level rising. This highlights that this form of time has helped advance industrial societies, but it has detached people from the environment (Bastian, 2012; Johncock, 2019). Mechanical clock time is completely regular, but not every process abides by this. Therefore, there is potential for the development of a myth of regularity (Ghosh, 2016). The everyday work routine in the capitalist system is so predictable that it may cause people to dismiss climate disasters as fantastical or unrealistic. People go on with business as usual every day because climate crises do not fit into the economic and social paradigms enforced by capitalism. However, these events are already happening, and they are likely to get worse.

The capitalist system also encourages values and skills that are incompatible with those needed to combat climate change. One of these values is presentism. On one hand, environmental degradation takes place in the long term, which makes it hard to grasp when focusing on the present (Boomsa et al., 2016; Uhl-Haedicke et al., 2019). This was not necessarily an issue in older economic systems. As a byproduct of their small scale, non-industrialized agricultural systems were relatively sustainable. They used the resources at their disposal to feed the population, but there were still resources left for future use as well (Charbonnier, 2021).

In contrast, under capitalism, there is an unlimited pursuit of   short-term material growth. Unlike humans who must make short-term sacrifices to ensure they have adequate resources available in the long term, businesses can only survive if they prioritize short-term economic growth (Angus, 2008). If corporations do not take the opportunity to maximize profit, they will be beaten out by competition and driven out of business. Therefore, capitalists are essentially forced to value presentism (Charbonnier, 2021). They are willing to endure environmental issues in favor of large fast returns. If we continue on this path of economic growth, resources could become depleted, and eventually this model of business may not be able to function. The values this system imposes could result in its own demise. Therefore, climate change is a threat to human society and not just the natural world.

Psychological Evidence for the Role of Presentism in Climate Change Inaction

The consequences of these values have been displayed in neuroscience and psychology studies. Although it is known that presentism can lead people to allocate fewer resources to their future selves (Critchfield & Kollins, 2001), the current study will only discuss a particular kind of presentism: people's unwillingness to sacrifice to share resources with other people in the future. Various researchers have found that people are not willing to sacrifice present gain to aid future generations (Langenbach et al., 2022; Pei et al., 2022). For example, Langenbach et al. (2022) reported that participants who had to extract fish to receive monetary rewards surpassed the intergenerational sustainability limit. This means they took more rewards for themselves at the expense of reducing payoff for future generations. This finding highlights that presentism inhibits people from caring about how their actions will affect other people in the future. Additionally, multiple survey studies found complementary results. Higher levels of altruism and

consideration of future consequences were both found to be associated with higher levels of environmental concern (Arnocky et al., 2014; Milfont et al., 2014). This suggests that valuing immediate gratification can limit one's consideration of long-term environmental problems.

A disregard for future consequences is not necessarily rooted in denial of fact; it may instead stem from a feeling of despair about the future relating to climate change (Bradley, 2021; Franzen, 2019). Although high climate change risk perception is correlated with an increase in climate action (Lee et al., 2018; Wang et al., 2021), it does not always motivate people to act. Researchers have pointed out that feeling doomed can spur inaction (Sawe and Chawla, 2021). For instance, both Sawe and Chawla (2021) and Weber and Constantino (2023) highlight that dread can make people hopeless about the future, discouraging future-oriented climate action. This is relevant considering that themes of doom and catastrophe are common in Western environmental narratives (Bettini, 2019). Therefore, both fear and desire for immediate gratification have caused people to develop borders between the present and future (Ghosh, 2016).

By focusing so much on the present, people have also become detached from the past. If people cannot reflect on the causes of the climate crisis, they cannot be expected to combat it moving forward (Bonneuil and Fressoz, 2016). Scholars have pointed out that people tend to rely on technological innovation to solve their problems, hence the creation of fertilizers and steam engines to enhance production (Tainter, 2000; Mumford, 2010). However, these innovations have largely contributed to the greenhouse gas emissions associated with climate change. Accordingly, innovation can be seen as a cause of the climate crisis (Bonneuil and Fresssoz, 2016). The more that people are driven to maximize short-term growth, the more rapidly the negative effects of climate change accumulate (Charbonnier, 2021). This highlights why it would

be harmful for people to continue to rely on short-term technological fixes without looking back or trying to foresee the consequences. Consequently, it is essential to challenge the borders established by our concepts of time.

Psychological Evidence for the Role of Individualism in Climate Change Inaction

People have also developed psychological borders between themselves and others in the present. Climate change is an issue that will require cooperative worldwide efforts to mitigate (Duke and Holt, 2016; Lewis and Maslin, 2015). One obstacle to this in Western societies is that they tend to be highly individualistic (Charbonnier, 2021). The negative effects of individualism have been demonstrated in various controlled experiments. Multiple researchers found that intergenerational discounting prevented participants from cooperating (Jacquet et al., 2013; Langenbach et al., 2022). For example, Jacquet et al. (2013) found that participants were unable to reach the target number of investments when their reward came in the form of trees being planted for the next generation. This suggests that people have trouble making sacrifices when they are not receiving the benefits of those decisions. Considering we live in a system that rewards selfish behavior, it will be hard to increase climate action unless we can override this individualistic programming (Franzen, 2019; Jacquet et al., 2013).

This emphasis on individualism also seems to promote climate change inaction. Multiple psychology studies have found a link between individualistic values and anti-climate attitudes (Leiserowitz, 2006; Xiang et al., 2019). For example, Leiserowitz (2006) found that opposing pro-climate policies was associated with greater support for individualism and social hierarchies. Similarly, Xiang et al. (2019) found that more individualistic participants were more likely to believe that the climate crisis was out of their control and were also less likely to take climate

action. This indicates that individualist values are associated with disregarding the well-being of others (Kimmerer, 2015). Given that climate change is an issue requiring collective, other-oriented action, individualist values pose challenges towards mitigating climate change.

Psychological Solutions to the Climate Change Inaction Problem

Despite these challenges, neuroscientists and psychologists have successfully challenged these borders by projecting people into the future and connecting them with others. One way that researchers have lowered psychological distance is by encouraging people to engage in episodic future thinking. Episodic future thinking refers to the "pre-experiencing" of potential future events using one's imagination (Lee et al., 2018). This technique is known to lead to more future-oriented decisions (Bromberg et al., 2017; Rösch et al., 2022). In the context of climate change, lowering this psychological distance from the future can increase climate change risk perception (Duke and Holt, 2016; Lee et al., 2018). Lee et al. (2018) found that imagining future negative climate events led participants to show higher climate change risk perception. This result suggests that imagination can make people feel more threatened, which then motivates people to act in the present for an issue that mostly impacts the future. By pre-experiencing the future in the present, people can break free of their psychological borders (Bradley, 2019).

In addition to increasing climate change risk perception, episodic future thinking has also been shown to increase sustainable decision making (Lee et al., 2018; Nakagawa and Saijo, 2021). For example, after reading about some negative impacts of climate change in Taiwan, Lee et al. (2018) had participants list some climate events they thought would be possible in the future. However, only half of the participants were asked to engage in future thinking by vividly imagining these events. These participants who engaged in future thinking were then more likely

to sign up for beach cleaning. This shows that future thinking increased climate action. Similarly, Nakagawa and Saijo (2021) developed a visual narrative about the future generations' concerns about climate change. They reported that people who were able to use this story to imagine the future were more likely to support sustainable government policies. This suggests that by decreasing psychological distance from the climate change-ridden future, people may gain a better grasp of the issue. Then, they feel more motivated to act.

However, episodic future thinking has not always produced successful results. For example, Bo and Wolff (2020) found that episodic future thinking was ineffective at increasing climate change risk perception. Perhaps the success of episodic future thinking may depend on how personally connected people feel with the future as opposed to imagining a general climate event (Meleady and Crisp, 2017). Although episodic future thinking involves changing one's perspective from a present-oriented one to a future-oriented one, it does not necessarily emotionally connect people with specific individuals who are being affected. Multiple studies have found that increasing connection between present and future generations can increase climate action (Baumgartner et al., 2023; Meleady and Crisp, 2017). Therefore, it is important to increase consideration for individuals who will reap the benefits of today's climate action (Guizar et al., 2022), perhaps through taking the perspective of another individual.

Previous research has shown that perspective taking with individuals in the future increases pro-environmental behavior (Langenbach et al., 2022; Pahl and Bauer, 2011). During perspective-taking interventions, participants are typically asked to listen to the experience of hypothetical people experiencing the effects of climate change. Then, they are told to consider how that person feels or how they would feel in that position, to increase empathy (Pahl and Bauer, 2011; Uhl-Haedicke et al., 2019). For example, Uhl-Haedicke et al. (2019) and Pahl and

Bauer (2011) demonstrated this on the behavioral level. They found that taking the perspective of individuals experiencing the negative effects of climate change made people spend more time reading environmental pamphlets. This suggests that connecting people with those who will be most impacted by climate change motivates them to act.

Neuroscience of Episodic Future Thinking and Perspective Taking

There are multiple shared neural correlates of episodic future thinking and perspective taking. These regions overlap with a system in the brain known as the Default Mode Network (DMN). The DMN is a set of brain regions that are activated when an individual is not focused on their external environment or a goal-oriented task (Li et al., 2014; Menon, 2023). Originally, researchers proposed that this network was activated whenever someone was at rest. However, more recent work suggests that the DMN is actively involved in a variety of internally-focused functions including social cognition, episodic memory, mind wandering, and reflecting on experiences. There are many brain regions that enable these functions including the posterior cingulate cortex, the inferior parietal lobule, the medial prefrontal cortex, the medial temporal lobe, the temporoparietal junction, and the anterior cingulate cortex (Menon, 2023).

Two of the most important functions of the DMN, and the ones that are most relevant to this study, are episodic future thinking and perspective taking of others (Li et al., 2014; Menon, 2023). Episodic future thinking engages the medial prefrontal cortex as well as various regions of the medial temporal lobe (Li et al., 2014). Additionally, a subsystem of the DMN that includes regions like the temporoparietal junction (TPJ) and the dorsomedial prefrontal cortex (dmPFC), is activated when considering others' mental states (Li et al., 2014). Multiple studies have shown that inhibiting the TPJ region using transcranial magnetic stimulation has led to deficits in

perspective taking (Costa et al., 2008; Soutschek et al., 2016). This shows that the TPJ helps people to gain insight into others' points of view and to understand them better (Li et al., 2014; Smith et al., 2014; Wever et al. 2021).

Activity in this region may be dependent on social distance. For instance, Wever et al. (2021) found that the TPJ was more active when people imagined the suffering of their own child than an unfamiliar child. However, when the TPJ was inhibited with transcranial magnetic stimulation, participants were unable to differentiate how they treated people based on social distance (Brethel-Haurwitz et al., 2021). This demonstrates that the TPJ is sensitive to differences in how close people are.

The TPJ can also be used to modulate presentism and egocentrism. This is important considering that climate action involves making sacrifices in the present, like utilizing fewer natural resources, to aid the future (Guizar et al., 2022). Various studies have found that the TPJ is helpful in controlling egocentric bias, or self-centeredness (O'Connell et al., 2017; Soutschek et al., 2020). Egocentric bias has temporal and social aspects. It makes people prioritize their current selves over their future selves, and it makes people prioritize themselves over others.

The TPJ can help individuals become less selfish (Kwon et al., 2023; Morishima et al., 2012). First, structural variations in this region are associated with different levels of selfish behavior. In particular, individuals with larger gray matter volume and activity in the TPJ show higher levels of altruism (Morishima et al., 2012; Park et al., 2017). This is consistent with other work that reported the role of the TPJ in charitable decision making, such as donating money to others (Kwon et al., 2023; Smith et al., 2014; Strombach et al., 2015). This demonstrates that the TPJ is involved in social decision making when evaluating how one's actions can impact others.

However, the TPJ does not act alone. The functional connectivity of the TPJ with prefrontal regions of the DMN impact social decision making (Smith et al., 2014; Strombach et al., 2015). For example, the TPJ can modulate activity of the ventromedial prefrontal cortex (vmPFC). The activity in the vmPFC is known to track the subjective value of stimuli including money, food, or social stimuli like evaluating other people (Rhoads et al., 2023; Smith et al., 2014). When faced with temptations to be selfish, the TPJ can selectively increase activity in the vmPFC (Strombach et al., 2015). This means that the TPJ can magnify the value of others' welfare, encouraging generous decision making (Rhoads, 2023; Smith et al., 2014). This is important, considering that people receive short-term gains in our economic system for exhibiting selfish behavior (Angus, 2008; Jacquet et al., 2013). Therefore, perspective taking with others can increase selflessness and help overcome egocentric bias.

By controlling egocentric bias, the TPJ can motivate other-oriented action (O'Connell et al., 2017). For example, both Park et al. (2017) as well as Strombach et al. (2015) found that participants who showed greater TPJ activity were more likely to make generous decisions when choosing how to split money between themselves and others of varying social distance. For Strombach et al. (2015), the greater the temptation was to be selfish, the greater the functional connectivity was between the TPJ and the vmPFC. Individuals are known to favor members of their social ingroup who they strongly identify with (Meleady and Crisp, 2017; Zhao et al., 2024). Therefore, the TPJ is an important brain region to utilize for encouraging climate action despite the temporal and social distance that separates individuals in the present from those who will be most affected (Guizar et al., 2022).

Furthermore, by increasing consideration of future others, TPJ activity can encourage pro-climate decision making (Baumgartner et al., 2023; Guizar et al., 2022; Langenbach et al.,

2022). Multiple studies showed that perspective taking with the future was associated with sustainable decision making. For instance, Langenbach et al. (2022) found that stimulating the TPJ with transcranial magnetic stimulation caused participants to adhere more strictly to intergenerational sustainability thresholds in a paradigm where they received money for extracting fish. Similarly, Baumgartner et al. (2023) used a paradigm where participants were put in groups of four and told that if they extracted more than 40 points collectively, the payoff for future groups would be reduced. They found that sustainable participants, who extracted under ten points, were more likely than unsustainable participants, who extracted over 10 points, to take the perspective of future generations. Although both groups showed similar levels of TPJ activity, only the sustainable participants thought about the future. This highlights the importance of perspective taking with future individuals who will face the consequences of today's decisions.

The Current Study

Previous studies have successfully used either perspective taking or episodic future thinking to increase climate change risk perception and action. However, studies thus far have not investigated the role of perspective taking in conjunction with episodic future thinking. Therefore, to bridge this gap, we will have participants take the perspective of a young relative or friend in the future in a climate change-related vignette. By allowing participants to feel more connected to the future using an individual they already care about, they should be able to both have a more vivid mental image of the future (Lee et al., 2018) and to feel more connected to those most impacted (Pahl and Bauer, 2011). Thus, this intervention simultaneously challenges presentism and individualism. Therefore, it may encourage pro-climate attitudes and actions.

By engaging the brain's perspective-taking system, we may be able to encourage pro-climate action. If participants do perspective taking with close others in the future, the TPJ may activate (Wever et al., 2021). If the TPJ is already active when we test participants' generous decision making, then it may be easier to modulate activity of other regions and decrease egocentric bias (O'Connell et al., 2017; Strombach et al., 2015). This is relevant to climate action which involves prioritizing others more than oneself. Kwon et al. (2023) found an increase in activity in the TPJ while people were donating money to a variety of charities. Therefore, we may be able to encourage climate action in the form of donations to climate charity by utilizing the perspective taking system.

By changing the way that people perceive time, by having them "pre-experience" a future event about a close individual in the present, we may be able to challenge some of the biases preventing climate action. Although short-term growth is championed, this might allow participants to experience events over time as being interconnected. If people agree to take action today that benefits the future, they can challenge individualism and presentism (Ghosh, 2016; Mehnert, 2016), values that are incompatible with those linked to climate action (Cho et al., 2013; Xiang et al., 2019).

Participants of this study were broken into three groups to monitor the effects of perspective taking and episodic future thinking on climate change risk perception and action. One group did episodic future thinking and perspective taking by reading a climate change vignette about a specific person they know under the age of 18. This allowed the target person to serve as a representation of the future. The next group did episodic future thinking only. This group read the same climate change vignette, but it was about a generic future individual. While this group may have engaged in future thinking as well, they were not instructed to think about a

close other. If they merely thought about a stranger, this may not have engaged the TPJ as much as the group that did perspective taking with close others (Wever et al., 2021). The last group was a control group that read facts about what the future could look like if people do not take significant climate action.

We hypothesized that taking the perspective of a young relative or friend in the future would increase climate change risk perception and lead to a higher number of pro-climate charitable choices.

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Study 1 Methods

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Participants

Three hundred participants were recruited online via Prolific to do a Qualtrics survey, but after exclusions, the final sample included 259 participants. The final sample was 49.0% female (*n*=127), 46.3% male (*n*=120), 4.2% non-binary (*n*=11), and 0.4% who preferred not to say (*n*= 1). The sample was 67.2% White (*n*= 174), 21.2% Black or African American (*n*= 55), 4.2% mixed race (*n*= 11), 3.9% Asian (*n*= 10), 1.5% American Indian or Alaska Native (*n*= 4), 1.2% who preferred not to say (*n*= 3), 0.4% Native Hawaiian or other Pacific Islander (*n*= 1), and 0.4% Other/Unknown (*n*= 1), with a median age of 33 (SD = 12.5; range: 18 - 78). The study's procedure, sample size, hypotheses, and analysis plan were all pre-registered on the Open Science Framework: https://doi.org/10.17605/OSF.IO/DUAR8.

Forty-one participants were excluded from analysis. The study contained four attention check questions, two during the intertemporal choice task and two during the modified dictator game task. Based on our pre-registered exclusion criteria, participants were excluded for: completing the study in under 10 minutes (*n* = 5), taking over one hour to complete the study (*n* = 13), missing two or more of the attention check questions (*n* = 8), failing to name a target

person in the episodic future thinking + perspective taking group only ($n = 7$), or naming

someone over 18 in that condition ($n = 8$).

Prolific is a service that automatically yields a data set that does not include identifying

information. Prolific pre-screens participants so that they fulfill the inclusion criteria. Those

participants then choose whether to participate, based on a study description. The inclusion

criteria were that all participants had to be from the United States, using a computer, and over the

age of 18. They also had to be fluent English speakers and to have a Prolific approval rate of

>90%. Participants were notified that they would be filling out questionnaires to assess their

opinions on climate change. They were also told that they would be making decisions about

money and answering demographic questions. Participants were compensated for their time by

being paid $6 for this 30-minute study. Additionally, participants had the chance to earn a bonus

of up to $45. Specifically, one out of every 50 participants received a bonus based on their

choices in the intertemporal choice task, and one out of every 10 participants received a bonus

based on their choices in the modified dictator game task (more detail on these tasks follows

below).

Study Flow

Participants began the study by filling out some surveys so we could assess their climate

change risk perception (Fig. 1). Afterwards, participants were split into three groups to read

climate change-related vignettes. Then, they completed a climate change related decision-

making task in the form of a modified dictator game. Lastly, before completing the study,

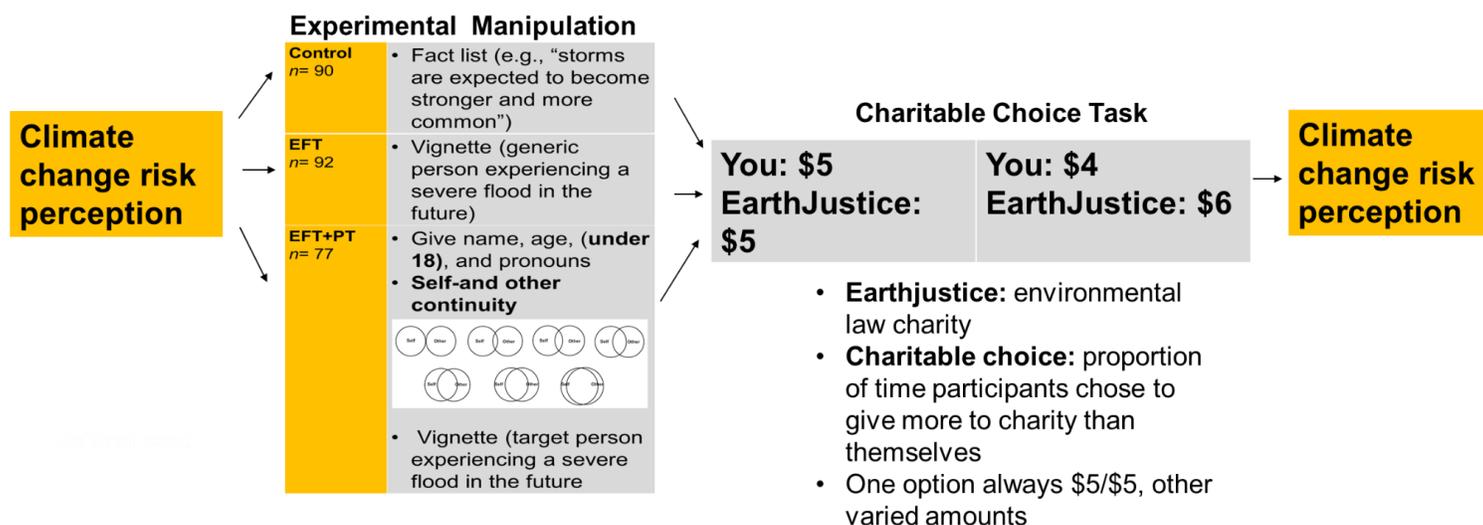participants filled out some more surveys and a demographic questionnaire.

Figure 1. Layout of the experimental procedure. All participants began by filling out a climate change risk perception survey. Then, participants were randomly assigned to one of three groups: Control, EFT, or EFT+PT. Each group read a vignette that differed according to what condition they were in. Next, all participants completed a modified dictator game where they chose how to split $10 between themselves and a charity called EarthJustice. Lastly, participants retook the climate change risk perception survey from the beginning of the study.

Climate Change Risk Perception

Once participants provided informed consent, they began the study by filling out two surveys to assess their climate change risk perception. The first survey was taken from van der Linden (2015). This survey included eight questions all measured on a seven-point Likert scale (e.g., how often do you worry about the negative consequences of climate change? 1=very rarely, 7= very frequently). This survey was given to all participants twice, once at the beginning of the study and again after reading the vignettes. This survey assessed how concerned participants were with climate change and how much of a threat they believed it to be to themselves and the United States. The overall score on this survey was our primary measure of climate change risk perception. Then, participants filled out another climate change risk perception survey taken from Leiserowitz (2006). This survey was only completed once at the beginning of the study. This survey assessed how serious people believed the effects of climate change to be. This survey was included for exploratory purposes.

Intertemporal Choice Task

Participants completed a standard intertemporal choice task (Lempert et al., 2020) where they were asked to choose between smaller amounts of money they could have today (e.g., $10 today) and larger amounts they could have later (e.g., $20 in 30 days). This task allows us to assess individual differences in temporal discounting rate, which is the extent to which people overvalue immediate outcomes relative to delayed outcomes. Participants had the chance to earn a bonus of up to $35. Specifically, one out of every 50 participants received a bonus based on their choice in a randomly selected trial of the intertemporal choice task. We included this task for exploratory analyses that we will not discuss here.

During the intertemporal choice task, we included one question that gave participants the option between $10 now or $9 in 180 days, and another question that gave them the option between $28 now or $26 in 100 days. These were considered attention check questions because no one who is paying attention would prefer less money in the future to more money now.

Experimental Manipulation

Next, participants were randomly assigned to one of three groups. One did episodic future thinking and perspective taking (EFT +PT), another did episodic future thinking only (EFT), and the last was a control group. If participants were assigned to the EFT+PT condition, they were asked to name a relative or friend under the age of 18. They had to indicate this person's age and preferred pronouns, which were piped into the vignettes they read afterward. They were also asked how close they consider themselves to be with this person. To assess this, we used the Inclusion of Other in Self Scale (Aron, 1991) which asks participants how much they feel that they overlap with the target person.

Afterward, participants completed the main task of the experiment. This consisted of reading a climate change-related vignette. We generated our vignette by asking ChatGPT to write about a person in the future experiencing a flood caused by climate change. Participants were each given a minimum of one minute to read the vignette, which detailed what the future may look like without significant climate action. The vignettes differed depending on which group the participants were assigned to (see Appendix for full text for vignettes). If participants were in the EFT+PT group, the vignette described a specific story about the target person they named in the future. This person was experiencing a storm caused by decades of climate inaction. Participants in the EFT-only group read the same story, but it was about a generic

future individual rather than a specific person of their choosing. Finally, participants in the control group read some facts about what the future may look like without climate action including the rising sea levels and increasing frequency of storms. We expected that this condition would not induce either episodic future thinking or perspective taking.

Modified Dictator Game

All participants completed a modified version of the dictator game adapted from Kobayashi et al. (2022). Participants were asked for their preference on how to split $10 between themselves and a climate change charity called EarthJustice. EarthJustice is an environmental law organization that advocates for climate change action. They are committed to fighting for cleaner air and water to protect the environment itself and the people that inhabit it. In this version of the dictator game, participants always had the choice to split the money evenly ($5 for self / $5 for charity). This choice always appeared on the left side of the screen. However, the other option was an uneven split of the $10. The options were to keep $6 for themselves and donate $4 to charity, keep $7 for themselves and donate $3 to charity, keep $8 for themselves and donate $2 to charity, keep $9 for themselves and donate $1 to charity, keep $10 for themselves and donate $0 to charity, keep $4 for themselves and donate $6 to charity, keep $3 for themselves and donate $7 to charity, keep $2 for themselves and donate $8 to charity, keep $1 for themselves and donate $9 to charity, or keep $0 for themselves and donate $10 to charity. Thus, there were 10 trials, each displayed twice for a total of 20 trials. Participants had the chance to earn a bonus of up to $10. Specifically, one out of every 10 participants received a bonus based on their choices in a random trial of the modified dictator game, and EarthJustice received money as well based on the participant's choice. The proportion

of trials in which participants chose to give more money to EarthJustice than to themselves was our measure of climate change action.

In the modified dictator game, we included one question in which participants chose between giving $5 to themselves and $5 to EarthJustice, or $3 to themselves and $3 to EarthJustice. There was also a question that asked participants to choose between giving $5 to themselves and $5 to EarthJustice, or $2 to themselves and $2 to EarthJustice. These were considered attention check questions since the $3/$3 and $2/$2 options led to a lower payout for all parties; therefore, anyone who is paying attention would select $5/$5 on these questions.

Future Self Continuity

After the decision-making task, participants took a different version of the Inclusion of Other in Self Scale in which they were asked how much overlap they felt between their present and future selves (Ersner-Hershfield et al., 2009). This is a measure of self-continuity that we included for exploratory purposes, and it will not be discussed further here.

Vividness of Visual Imagery Questionnaire

To assess mental imagery, the Vividness of Visual Imagery Questionnaire (VVIQ; Marks, 1973) was used. The VVIQ contains a series of 16 questions in which participants rated how clearly they could picture various images in their head. They indicated their responses via multiple choice questions ranging from "No image at all" (only "knowing" that you are thinking of the object) to "Perfectly clear and as vivid as normal vision."

Interpersonal Reactivity Index

To assess perspective taking, the Interpersonal Reactivity Index (IRI; Davis 1980) was

used. The IRI contains a series of 28 questions to assess participants' ability to empathize and take others' point of view. There are four subscales of the IRI. The first is the Perspective Taking (PT) scale. This scale assesses participants' tendencies to consider the point of view of others. Next is the Fantasy (FS) scale. This scale assesses participants' tendencies to immerse themselves in works of fiction. Then, the Empathic Concern (EC) scale assesses participants' sympathy and consideration of others. Lastly, the Personal Distress (PD) scale measures participants' anxiety in social contexts. Each question was measured on a 5-point Likert scale with answers ranging from 1 (does not describe me well) to 5 (describes me very well).

Demographics and experimenter demand question

Before leaving the study, participants filled out some demographic questions to indicate their age, race, nationality, gender, education level, political orientation, and socioeconomic status. They were also asked if they suspected that we were trying to change their climate change risk perception by showing them the vignettes. They were asked to be honest and told that their answer would not affect their pay. They were assigned a 1 if they said yes and a 0 otherwise.

Analysis

First, we ran a series of one-way ANOVAs because we wanted to ensure that our groups did not differ with respect to variables such as: age, political orientation, and baseline climate change risk perception. We also ran two chi-square tests to ensure that there were no significant differences between groups in gender or experimenter demand.

To see if our experimental manipulation affected climate change action, we ran a

one-way ANOVA on charitable choices in the modified dictator game. The independent variable was group, and there were three levels (EFT+PT, EFT, control). The dependent variable was the proportion of charitable choices. This was determined by calculating the number of times participants selected the higher amount for the charity divided by the total number of trials. We expected to find a significant main effect of Group, with the EFT+PT group making the most charitable choices.

To see if our experimental manipulation led to changes in climate change risk perception, we ran a repeated-measures ANOVA. In this case, the between-subjects independent variable was group (EFT+PT, EFT, control). Since participants took a climate change risk perception survey at the beginning of the study and again after reading the vignettes, the within-subjects independent variable was Time. Time 1 referred to before participants read the vignettes, and Time 2 referred to after participants read the vignettes. The dependent variable was their score on the climate change risk perception index. We expected to see a main effect of Time, with all groups showing an increase in climate change risk perception from before to after the manipulation. We also expected to find a significant interaction between Group and Time, with the EFT+PT group showing the greatest increase in climate change risk perception.

We also ran exploratory correlational analyses to examine associations among: the four subscales of the IRI, political orientation, climate change risk perception at the beginning of the study, climate change risk perception after the experimental manipulation, and the change in climate change risk perception (after minus before).

Study 1 Results

Demographics

Our results indicated that there were no between-groups differences in a variety of demographic variables, including age, F(2, 167)= 1.60, *p*= .205, political orientation, F(2,166)= 0.06, *p*= .945, experimenter demand, χ^2 (2, 259)= 1.52, *p*= .467, baseline climate change risk perception, F(2,167)= 1.05, *p*= .351, or gender, χ^2 (6, 259)= 4.48, *p*= .613.

Climate Change Action Results

First, our hypothesis concerning charitable choices was not supported. After completing a one-way ANOVA, we found no significant difference between groups in terms of the number of charitable choices made, F(2, 165) = 1.16, *p* = .316. In other words, charitable choices were similar, whether people were assigned to the EFT+PT group (M = .368, SD = .315), the EFT group (M= .316, SD= .269), or the control group (M= .297, SD= .292). Therefore, taking the perspective of a relative in the future did not make people more likely to donate money to charity.

Although there was no significant effect of Group on charitable choice overall, we ran a post-hoc exploratory analysis to see if self-reported closeness to the other in the future would be associated with charitable choice. Indeed, we found a significant correlation between self-other continuity and the proportion of charitable choices made within the EFT+PT group, r(75)= .309, *p* < .01 (Fig. 2). This suggests that, in the group that took the perspective of a person of their choosing in a vignette, the closer participants felt to the target person they named, the more times they chose to give more money to charity rather than to themselves. In fact, a follow-up ANOVA suggested that when including only those participants in the EFT+PT group who scored above

the median on self-other continuity, there was a significant group effect on charitable choice,
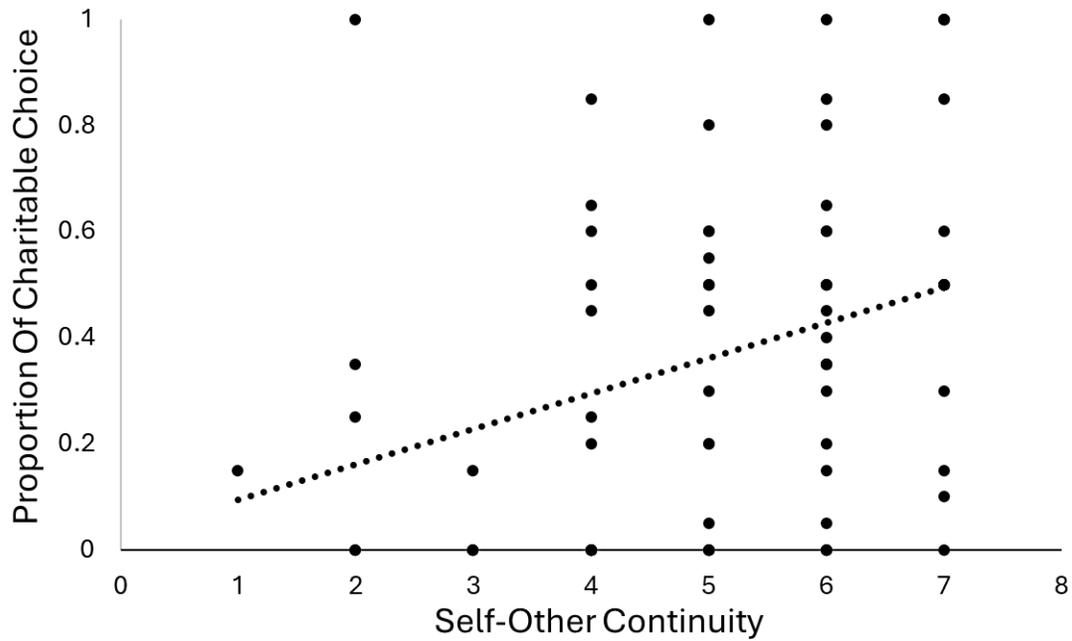
$F(2, 96.6)= 3.53$, $p< .05$.

Figure 2. Relationship between scores on the Self-other continuity scale and proportion of charitable choices made in the modified dictator game. A charitable choice was defined by a participant choosing to split $10 such that the charity EarthJustice got more than they did. Pearson's r= 0.309.

Climate Change Risk Perception Results

Next, our hypotheses concerning climate change risk perception were partially supported by the data. We found that there was a significant main effect of time (pre vs. post vignette), $F(1,255)= 6.84$, $p< .01$, on climate change risk perception (Fig. 3). The mean score for Risk Perception at Time 1 across groups was 42.2 (SD=10.5). The mean Risk Perception score at Time 2 was 42.8 (SD=11.2). When running a post-hoc paired-samples t-test looking across all groups, there was a significant increase in climate change risk perception from Time 1 to Time 2, $t(258) = -2.73$, $p < .01$. There was no significant effect of group assignment on climate change risk perception, however, $F(2,256) = .683$, $p = 0.51$. Finally, the interaction between group and time was significant, $F(2,256)= 3.78$, $p<.05$. This means that the effect of the vignette on risk perception depended on which group participants belonged to.

Contrary to our hypothesis, however, this interaction effect seemed to be driven by a change in climate change risk perception in the control group. To understand the interaction effect further, we conducted a series of post-hoc paired-samples t-tests, to compare the Time 1 risk perception scores to the Time 2 risk perception scores within each group. In the EFT+PT group, there was no difference in risk perception between Time 1 (M=43.6, SD = 11.0) and Time 2 (M=43.6, SD= 11.6; $t(76) = 0.095$; $p = 0.924$). The same was true for the EFT group (Time 1 M=41.6, SD= 10.2; Time 2 M=41.9, SD= 11.1; $t(91)= -1.10$; $p =.276$). However, in the control group, climate change risk perception significantly increased from before the vignette (M=41.5, SD= 10.5) to after the vignette (M=42.9, SD= 11.1; $t(89)= -3.46$, $p < .001$; Fig. 2). In

particular, there was a significant change in participants responses for questions that referred to how personally threatened they felt. For example, risk perception increased for the question "In your judgment, how likely are you, sometime during your life, to experience serious threats to your health or overall well-being, as a result of climate change?", between Time 1, before reading the facts, (M= 4.66, SD= 1.63) and Time 2, after reading the facts (M=5.07, SD=1.65; t(89)= -3.72, p< .001). Therefore, the participants who read facts about climate change showed higher climate change risk perception after reading the facts than they did before reading them.
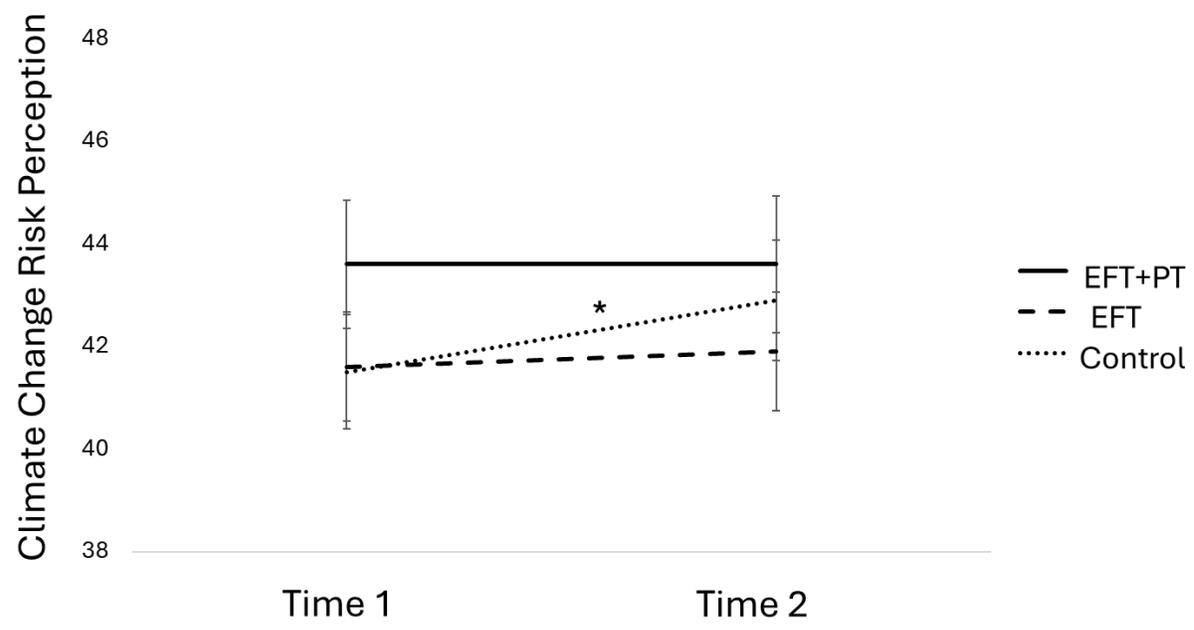
Figure 3. Average climate change risk perception scores for the EFT+PT, EFT, and control groups at Time 1, before the participants read the vignettes, and Time 2, after the participants read the vignettes. There was a main effect of Time, suggesting that risk perception went up overall, but this increase was only significant within the control group. Error bars represent standard error. *p<0.05.

Exploratory Correlational Analyses

We observed several significant correlations in our exploratory analyses (Table 1.). First, we found that there was a significant correlation between political orientation and climate change risk perception both at Time 1, $r(257)= -.369$, $p< .001$, and Time 2, $r(257)= -.382$, $p< .001$. The more liberal participants reported that they were, the higher their climate change risk perception was. Political views were also significantly associated with empathic concern, $r(257)= -.211$, $p< .001$, and the fantasy scale of the IRI $r(257)= -.141$, $p<.05$, such that more liberal participants reported more empathic concern and greater tendencies toward fantasizing. Across groups, higher baseline climate change risk perception scores were positively associated with the IRI perspective-taking subscale, $r(257)= .148$, $p< .05$. The fantasy scale of the IRI was also significantly positively correlated with baseline climate change risk perception $(257)= .141$, $p<.05$ as well as changes in climate change risk perception from Time 1 to Time 2 $r(257)= .144$, $p< .05$. Upon further inspection, we found that these correlations were driven by the EFT group, as they were the only group to show a significant positive correlation between scores on the fantasy scale and baseline climate change risk perception $r(90)= .206$, $p< .05$, and changes in climate change risk perception from Time 1 to Time 2 $r(90)= .306$, $p< .01$.

Table 1. Correlation Matrix for Study 1

Variable	IRI-EC	IRI-FS	IRI-PT	IRI-PD	Political Orientation	Risk Perception Time 1	Risk Perception Time 2	Change in Risk Perception
IRI-EC	____							
IRI-FS	0.263***	____						
IRI-PT	0.572***	0.206***	____					
IRI-PD	0.061	0.192**	-0.165**	_____				
Political orientation	-0.211***	-0.141***	0.011	-0.069	_____			
Risk Perception Time 1	0.339***	0.141*	0.148*	0.152*	-0.369***	_____		
Risk Perception Time 2	0.345***	0.178*	0.153*	0.171**	-0.382***	0.947***	_____	
Change in Risk Perception	0.084	0.144*	0.043	0.088	-0.111	0.027	0.348***	_____

Note. IRI = Interpersonal Reactivity Index. EC= Empathic Concern. FS= Fantasy Scale. PT=

Perspective Taking. PD= Personal Distress. ***p<0.001. **p<0.01. *p<0.05.

Study 1 Discussion

Our results did not support the hypothesis that combining episodic future thinking and perspective taking would alter climate change risk perception. The EFT+PT group did not show a significant increase in climate change risk perception from Time 1, before reading the vignettes, to Time 2, after reading the vignettes. However, the control group did show a significant increase in climate change risk perception. In particular, this seemed to be driven by participants feeling more personally threatened by climate change. Given that there was no significant difference in demand effect between the three groups, the behavior of the control group cannot be attributed to increased experimenter demand in that condition. This demonstrates that there must have been a different factor driving this increase in climate change risk perception.

We also found that doing episodic future thinking and perspective taking together did not result in taking more charitable choices than other groups. However, given the previous research showing the association between connecting to the future and pro-climate action, we ran other analyses to understand the behavior of the EFT+PT group. We then found that the higher the self-other continuity was, the higher the proportion of charitable choices were. This suggests that perspective taking with *close* others is associated with other-oriented choices. Incidentally, the greater the difference in age between participants in the EFT+PT group and the target person they named, the higher the reported self-other continuity was, r(76)= .155, *p*< .05. This correlation suggests that some participants might have been taking the perspective of their child or grandchild, and this close bond motivated more climate action.

Given that our hypotheses were not supported, we wanted to collect more data to clarify these results. We wanted to understand the different mechanisms driving increases in climate

change risk perception and climate action. Therefore, we ran a modified version of the study with 50 more people.

Study 2 Methods

Participants

Fifty participants were recruited from the Adelphi University's SONA research system. This system allows students to participate in surveys in exchange for class credit. Participants were rewarded with one credit for participation in the 20-minute study. The final sample of $n= 50$ participants was 76% female ($n= 38$), 20% male ($n= 10$), 2% non-binary ($n= 1$), and 2% who preferred not to say ($n= 1$) with a median age of 18 (SD= 1.20; range: 18-23).

Procedure

Once participants provided informed consent, they began the study by filling out a survey to assess their climate change risk perception. We used the same survey as our initial study from van der Linden (2015). This survey included eight questions all measured on a seven-point Likert scale (e.g., how often do you worry about the negative consequences of climate change? 1=very rarely, 7= very frequently). This survey assessed how concerned participants were with climate change and how much of a threat they believed it to be to themselves and the United States. However, in this case, we only assessed climate change risk perception once.

Next, we had participants read all three of the vignettes from our initial study. Just as in Study 1, before reading the EFT+PT vignette, participants were asked to name a relative or friend under the age of 18 and to indicate the person's age and pronouns. They also filled out the Inclusion of Other in Self Scale (Aron, 1991), which asks participants

how much they feel that they overlap with the target person. The EFT+PT vignette always came last to make sure that participants were not perspective taking with the individual they named the whole time. The order of the control and EFT vignettes were randomized between participants.

After reading each vignette, participants had to answer a series of questions concerning their thoughts about the vignettes and climate change in general. First, we asked participants (1) how realistic the vignette seemed (realism), (2) how worried they felt after reading the vignette (worry), (3) how likely the event(s) in the vignette seemed to occur to the world, a future individual, or the person they named (corresponding to the control, EFT, and EFT+PT vignettes respectively; this was our measure of the perceived likelihood of the vignette event, (4) how likely they think they are to experience an event like that described in the vignette (personal likelihood), (5) how much hope they felt towards the future after reading the vignette (hope), (6) how motivated they felt to take climate action after reading the vignette (motivation), (7) and how much control they felt they had over the future of climate change after reading the vignette (perceived control)? Each question was assessed on a seven-point Likert scale with one being the lowest (e.g., very unhopeful towards the future) and seven being the highest (e.g., very hopeful towards the future).

Finally, we completed the survey by asking participants which vignette they thought would be most effective in increasing climate change risk perception, and in a separate question, which one would be the most effective in increasing climate action. Before the end of the survey, we had participants fill out some standard demographic information including their age, gender, income, and political views.

Analysis

To analyze the data, we ran a series of repeated-measures ANOVAs with the vignette as the within-subjects factor, and the score on each of the seven questions described above (worry, realism, perceived likelihood of vignette event, personal likelihood, hope, motivation, and perceived control) as the dependent variable. When we found significant results in our repeated-measures ANOVA, we also ran a series of post-hoc *t*-tests to clarify which vignettes had responses that were significantly different from each other.

Once again, we also conducted exploratory correlational analyses on the following measures: the four subscales of the IRI, political views, and climate change risk perception.

Study 2 Results

We compared responses to the vignettes on a few characteristics in order to better understand mechanisms underlying climate change risk perception and action. Here we report only significant differences. We found that the EFT+PT vignette was rated as significantly less likely to occur than either the control, t(49)= -4.96, *p*<.001, or the EFT vignette, t(49)= -5.99, *p*<.001 (Fig 4a.). This indicates that participants felt it was more likely for the world to experience the effects of climate change (including rising sea levels and more storms) than it was for their friend or relative to experience a climate-related flood. Since the participants thought the control list of facts seemed more likely to occur, this could explain why people in the original study felt more threatened after reading it.

Additionally, we found that participants reported feeling significantly more motivated to act after reading the EFT+PT vignette than either the control, $t(49)= 5.11$, $p<.001$, or the EFT vignette, $t(49)= 5.09$, $p<.001$ (Fig 4b.). This demonstrates that there is a relationship between connecting to a loved one in the future and feeling encouraged to take pro-climate action, which is consistent with results from our original study.

Other results concerning climate action and connecting to the future were replicated in this study as well. In the original study, participants in the EFT+PT group who had higher self-other continuity also made more charitable choices. In this study, we similarly found a significant positive correlation between self-other continuity with motivation to act after participants read the EFT+PT vignette, $r(48)= .295$, $p<.05$.

Next, we also replicated some of the exploratory results from the original study (Table 2.). Like in the first study, there was a significant positive correlation between scores on the fantasy scale of the IRI and climate change risk perception, $r(48)= .431$, $p<.01$. Therefore, participants who had an easier time transporting themselves into works of fiction were more likely to feel threatened by climate change. Consistent with our first study, we also found a significant negative correlation between political views and climate change risk perception, $r(46)= -.496$, $p< .001$, meaning that more liberal participants had higher climate change risk perception, and more conservative participants had lower climate change risk perception.

Interestingly, all three vignettes appeared to evoke more worry (M= 4.95; SD = 1.43) than hope (M= 3.51; SD = 1.29) or perceived control M=3.05; SD = 1.52).
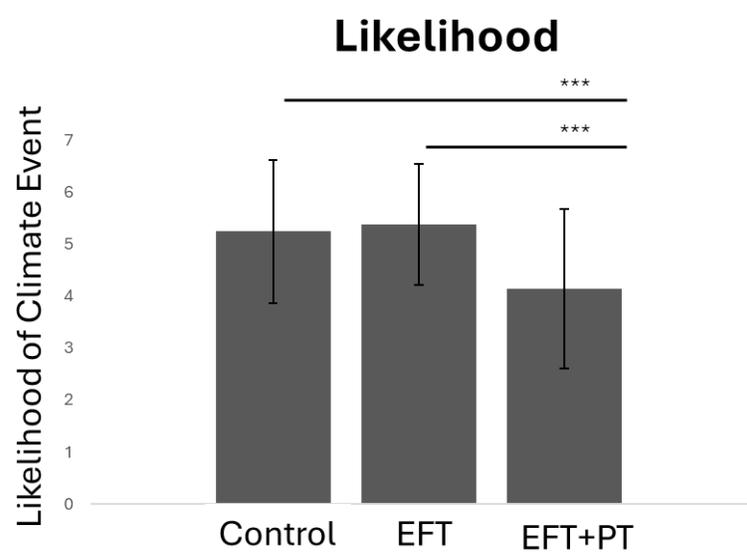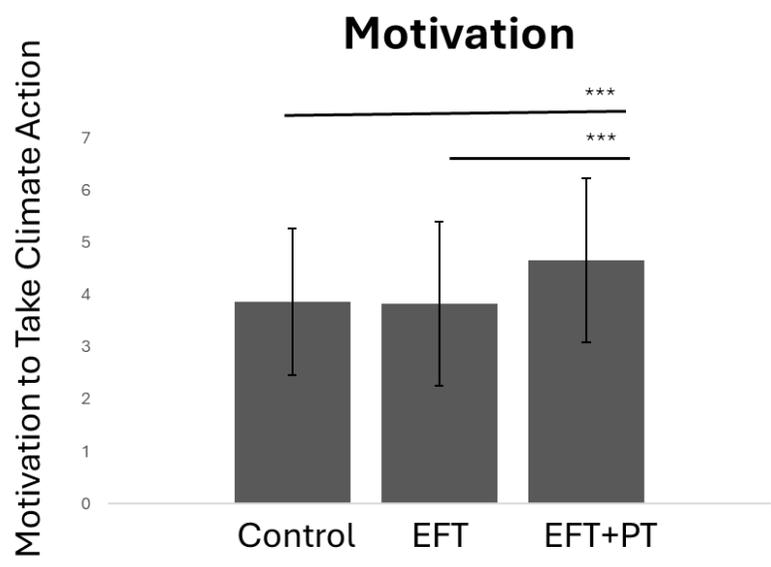
a.
b.

Figure 4. Study 2 results. (a) The mean score for likelihood that the event from the vignette or list will occur for the control list of facts, the EFT vignette, and the EFT+PT vignette. (b) The mean score for how motivated participants felt to take climate action after reading the control list of facts, the EFT vignette, and the EFT+PT vignette. Error bars represent standard errors. ***p<0.001.

Table 2. Correlation Matrix for Study 2

Variable	IRI-EC	IRI-FS	IRI-PT	IRI-PD	Political orientation	Climate Change Risk Perception
IRI-EC	____					
IRI-FS	0.320*	____				
IRI-PT	0.212	-0.057	____			
IRI-PD	0.320*	0.459***	-0.175	_____		
Political orientation	0.007	-0.132*	0.001	0.059	_____	
Climate Change Risk Perception	0.193	0.431**	0.054	0.099	-0.496***	_____

Note. IRI = Interpersonal Reactivity Index. EC= Empathic Concern. FS= Fantasy. PT= Perspective Taking. PD= Personal Distress. ***p<0.001. **p<0.01. *p<0.05.

Study 2 Discussion

We found that participants felt significantly more motivated to act after reading the EFT+PT vignette than either the EFT vignette or the control list of facts, but they also indicated that the EFT+PT vignette seemed significantly less likely to occur than either the EFT vignette or the control list of facts. These findings may help explain why there are inconsistencies between participants in Study 1 who showed an increase in climate change risk perception versus those who took a significant amount of climate action.

In our original study, we did not observe a significant increase in climate change risk perception in the EFT+PT group as expected. According to Study 2, this may be explained by the fact that this vignette seemed less likely to occur than the control one. This could explain why the control group from Study 1 felt more threatened by climate change after reading the vignette. Additionally, many of the questions from the climate change risk perception survey referred to the threat of climate change to oneself, but the EFT+PT group was specifically instructed to imagine the effects of climate change on someone else. This would explain why this group did not feel more threatened by climate change after reading the vignette.

On the other hand, in Study 1, we saw that the subset of the EFT+PT group who did perspective taking with close others took more climate action than other participants. According to Study 2, this could be because connecting to the future makes participants feel more motivated to act. By connecting to the future, participants may reduce their psychological distance from climate change and then perceive climate action as more urgent (Duke and Holt, 2016). Therefore, there may be different mechanisms that drive increases in climate change risk perception and climate action, and connecting with the future may be more important for encouraging people to act.

It seems especially important to connect with the future given that participants showed a higher mean level of worry than hope or perceived control. It is possible that despite feeling threatened, many participants in our original study did not feel the issue was in their control or thought they had little control over the future. This may explain why we saw generally low levels of climate action, emphasizing the need to take the perspective of close others in the future.

General Discussion

We found that perspective taking with close individuals in the future did not increase climate change risk perception. In contrast, reading facts about a future without climate action did. This may have been driven by a low perceived likelihood of the event occurring in the EFT+PT group. However, we also found that perspective taking with close others was associated with high levels of climate action in the form of charitable choices. This may be explained by an increase in motivation to act that people feel when they connect with someone they are close to going through a climate change-related event in the future. This highlights the importance of connecting present and future generations to decrease psychological distance between them and motivate climate action.

Climate Change Risk Perception

Contrary to our predictions, the EFT+PT group did not show a significant increase in climate change risk perception from before reading the vignettes to after reading the vignettes. However, the control group showed a significant increase in climate change risk perception. However, they did not follow through by taking more climate action than the other groups. This is consistent with previous research that found discrepancies between pro-climate attitudes and pro-climate action (Cho et al., 2013; Meleady and Crisp, 2017).

One explanation for this discrepancy may relate to participants' perceived control over climate change. Across all three vignettes, participants in Study 2 reported feeling significantly more worried about climate change than in control. If people feel threatened but lack perceived control over the issue, this could partly explain their lack of climate action. While it is possible that these results occurred because the vignette was negative and stressful, it may speak to people's attitudes towards climate change. These findings are consistent with previous literature. For example, multiple studies have found that people try harder to solve problems, including climate change, when they have a sense of control over the problems (Chan and Mukhopadhyay, 2010; Xiang et al., 2019). Since climate change is a long-term global issue, many people feel there is nothing they can do about it (Gifford, 2011). They may be more likely to feel powerless in this situation, which could inhibit them from taking action (Aitken et al., 2011).

Next, after reading all three vignettes in Study 2, participants reported feeling more worry than hope towards the future of climate change. This lack of hope may explain why people fail to act despite feeling threatened by climate change. Several scholars have explained that feeling excessively threatened can lead people to neglect the future (Bradley, 2019; Slavec et al., 2023). Particularly, if people feel there is nothing they can do about the problem, they may feel helpless (Aitken et al., 2011; Wilson, 2021). Given that much of the climate disaster has already been determined by the past, doom and gloom narratives have become common (Sawe and Chawla, 2021). Since people feel we are unlikely to avoid tragedy, they may feel hopeless. In contrast, hope can motivate people to take future-oriented action, even when their likelihood of success is low (Bury et al., 2020; Weber and Constantino, 2023). Therefore, if people lack hope, they may fail to take climate action despite feeling concerned about the issue.

Climate Action

In Study 1, we found that there were no significant differences between groups in terms of charitable choices. However, we found that the higher self-other continuity was in the EFT+PT group, the greater the number of charitable choices that were made. Furthermore, when a filter was applied to the group such that it only included those who rated self-other continuity as six or seven (i.e., above the median score of 5), then this subgroup made a significantly higher proportion of charitable choices than the EFT or control groups. This indicates that perspective taking with close others is associated with taking small-scale climate action.

This may be explained by the high level of motivation people experience after perspective taking with close others. In Study 2, the higher the self-other continuity was, the more motivated participants felt to take climate action after reading the EFT+PT vignette. We know that an obstacle inhibiting climate action is the preference people have for helping others in their temporal ingroup (Guizar et al., 2022; Meleady and Crisp, 2017). Therefore, people are psychologically distant from the individuals who will be most impacted by climate change, and they do not perceive climate action as urgent (Duke and Holt, 2016; Pahl and Bauer, 2011). By making people feel more connected to the future, they may feel more motivated to take climate action.

These results are consistent with previous research showing the connection between mentalizing with someone in the future and taking climate action. In our study, participants who imagined someone they were close to going through a climate change event were more likely to take climate action than those who did perspective taking with distant others or those who did not do perspective taking. Similarly, both Langenbach et al. (2022) and Baumgartner et al. (2023) found that participants who took the perspective of future generations were more likely to

make sustainable decisions in an economic fishing task. Also, Meleady and Crisp (2017) found that people who were asked to come up with similarities between themselves and future generations were more likely to choose sustainable items in a product choice task. This shows that increasing peoples' connections with the future can help decrease psychological distance despite the temporal distance between generations (Pahl and Bauer, 2011).

Furthermore, based on previous research, it is possible that TPJ activity differed between participants depending on self-other continuity. The TPJ is involved with general perspective taking, but it is also involved in discriminating between socially close and distant others (Menon, 2013). For example, Wever et al. (2021) found that participants who imagined the suffering of their own child showed greater TPJ activity than while imagining the suffering of an unfamiliar child. This highlights that TPJ activity is dependent on closeness between people. This was supported by other studies where people failed to vary their treatment of others of varying social distances when the TPJ was inhibited (Brethel-Haurwitz et al., 2021). These studies indicate that the closer individuals in the EFT+PT group were to their target person, the greater the TPJ activity may have been.

The mechanism by which perspective taking with close others leads to climate action may involve interactions between TPJ and frontal regions of the brain (Strombach et al. 2015). The dorsal medial prefrontal cortex (dmPFC) interacts with TPJ and is also important for understanding the mental states of others (Li et al., 2014). For instance, Wever et al. (2021) found that participants experienced heightened TPJ-dmPFC connectivity while imagining others suffering. Participants in our study, particularly in the EFT+PT group, may have had the same pattern of neural activity since the vignette described a relative/friend experiencing a stressful climate change event. Additionally, the functional connectivity between the TPJ and the

ventromedial prefrontal cortex (vmPFC) can encourage generous decision making. The vmPFC is known to be involved in calculating the subjective value of various stimuli (Smith et al., 2014). When temptations to be selfish are high, the TPJ can modulate signals in the vmPFC to encourage generous decisions (Rhoads et al., 2023; Strombach et al., 2015). By upregulating certain signals, the TPJ can help people to care more about how others are impacted by their decisions (Kwon et al., 2023).

Although certain participants did perspective taking with close others, they were willing to make donations that did not go directly to this person. This is consistent with a finding reported by Zhao et al. (2024) where the more participants tried to understand others, the greater the TPJ-mPFC connectivity was, and the more willing participants were to help strangers. This could explain why we saw an increase in charitable choices made after perspective taking with close others even though the donations were for EarthJustice. While the TPJ tends to activate more for perspective taking with close others (Wever et al., 2021), TPJ-mPFC connectivity may increase willingness to help others regardless of how well they are known.

Putting these findings together, it seems that generous pro-climate action may be encouraged by engaging the brain's perspective-taking system. It is possible that the subset of the EFT+PT group that did perspective taking with close others may have experienced a higher level of TPJ activity than the other participants (Wever et al., 2021). If this region was active from perspective taking, particularly with an individual in a negative stressful situation, then it may have been easier for this group to control their egocentric bias. The stronger the TPJ activity is, the more the activity in the vmPFC can be modulated to upregulate the value of others' well-being (Rhoads et al., 2023; Strombach et al., 2015). Therefore, these participants could have

possibly had an easier time overcoming egocentric bias, leading them to take more action for the benefit of others in the future.

While it may seem plausible that the EFT group also did perspective taking by imagining someone in place of the generic individual, they may not have activated the TPJ to the same extent as the EFT+PT group. The TPJ plays a role in perspective taking with close others (Wever et al., 2021). However, future thinking is known to be a self-focused internal process, and it involves prefrontal regions like the medial prefrontal cortex (Cona et al., 2023; Menon, 2023). Since the EFT+PT group was instructed to do perspective taking with a close other, they may have experienced greater levels of TPJ activity than the EFT group. The heightened TPJ activity in the EFT+PT group may account for these behavioral differences between groups.

Climate Change, Time's Arrow, and Time's Cycle

Our results seem to provide a promising mechanism for encouraging climate action. However, on a daily basis, people are not encouraged to consider others in the future. People in our follow-up study reported feeling significantly higher levels of worry than hope or control over climate change. If our sample is representative of the broader population, then this may explain why people are reluctant to try to mitigate the climate crisis. It is important to remember what is at stake if we do not prioritize climate action.

Societies typically rely on technology to solve problems (Tainter, 2020). However, when technology was used in the past to solve problems, major unintended consequences arose. During the Industrial Revolution, the clock enforced the idea that people in the capitalist system needed to make as much profit in as little time as possible (Mumford, 2010; Stahel, 1999). However, this led to inventions like the steam engine which caused a massive increase in carbon

emissions. Therefore, while technology helps people be more efficient in the short term, it can make problems larger and more complex in the long run.

The Anthropocene can largely be thought of as a crisis of time conceptions (Bastian, 2012). Our capitalist system has enforced an idea of regularity that is inconsistent with extreme climate events (Bastian, 2012; Martineau, 2012). The universalization of clock time allowed people to regulate and coordinate their work schedules. It guarantees that each day will consist of an identical number of hours and minutes. Therefore, this system created an illusion of life having complete regularity (Ghosh, 2019). However, natural events, like rising sea levels that lead to large storms such as the one mentioned in our vignettes, do not occur on such a precise scale (Bastian, 2012). Something this extreme does not align with how we are taught to experience time. However, events like this are already happening and expected to get worse. Therefore, the more we latch on to these illusions of regularity, the more we may dismiss climate change as an issue, and the less likely people may be to act.

Also, when the issue of climate change is recognized, our conceptions of time may lead us to neglect valuable lessons about innovation from the past. For example, one way to view time would be as an arrow, where events looked at as unidirectional and isolated from one another (Gould, 1987). This aligns with our societal conceptions of time since our focus on the short term detaches us from the past and future (Ghosh, 2016). Contrarily, another way to view time would be as a cycle, where events over time are connected and occur in patterns. Understanding how events connect requires people to think in the long term. It makes sense then, that we would have difficulties reflecting on the past given that we are socialized to value the short term (Boomsma et al., 2016; Duke and Holt, 2016).

If we fail to recognize time's cycle, we may repeat the mistake of assuming that innovation can be a simple fix for our problems. Therefore, we could end up increasing the complexity of the climate crisis. When people feel an issue is out of their control, they agree to give up their individual agency and depend on others to solve the problem (Gorz, 1975). In the case of climate change, people tend to assume that scientists will be able to develop some type of technology that will "save" us from this crisis (Aitken et al., 2013; Bonneuil and Fressoz, 2016). However, this is dangerous given the role that innovation played in initiating the climate crisis. The more we rely on man-made inventions to battle climate change, the further detached we become from nature itself (Bonneuil and Fressoz, 2016). Furthermore, while depending on others to figure out solutions to the crisis, most people will be isolated from the decision-making process. This could in turn make people even more dependent on others, making individuals helpless to mitigate climate change (Gorz, 1975).

Some people think we are already past a point of return with climate change. Given that it is a long-term issue, so much of the future has already been determined by the past (Boomsma et al., 2016; Uhl-Haedicke et al., 2019). Although the climate crisis has the potential to worsen, there is still potential for us to mitigate its effects. For instance, while warming of the planet by two degrees will likely cause catastrophic effects including extreme weather events and water scarcity, these effects can be reduced if the planet warms by half a degree less (Bradley, 2019). If the planet only warms by one and a half degrees, there will be less food and water scarcity, and the planet will be livable. This highlights the necessity of connecting people with future generations. Despite feeling significantly more worry than hope or control, participants in Study 1 and Study 2 both demonstrated motivation to take climate action after perspective taking with a close individual in the future. This shows that it may be possible the overcome the social and

temporal barriers between present and future generations. By connecting people with future

generations, we may be able to lower psychological distance from climate change and motivate

people to act (Meleady and Crisp, 2017; Pahl and Bauer, 2011).

Individual Differences in Climate Change Risk Perception

Some of our exploratory results may also help explain why people vary in how much

they care about climate change. In study 1, in the EFT group, there were significant correlations

between scores on the fantasy scale of the Interpersonal Reactivity Index (IRI) and both baseline

climate change risk perception and change in climate change risk perception from Time 1 to

Time 2. This suggests that people who like to engage their imaginative abilities more (e.g., by

immersing themselves in fiction) also feel more threatened by climate change. This is consistent

with the idea that psychologically distant events – like the extreme climate events predicted for

the future - can sometimes seem like fantasy or fiction. The finding that IRI fantasy scale scores

were also associated with the *change* in risk perception in the EFT-only group suggests that

people who were more inclined toward fantasizing might have felt closer to the generic

individual described in the vignette. While it is unfortunate that some elements of the climate

crisis might seem like fantasy, this link between imagination and climate change risk perception

suggests that making climate change narratives more engaging (e.g., through TV and movies)

may be an effective tool to combat indifference toward climate change.

Overcoming Individualism and Presentism

Despite these findings, it is worthy of noting that the proportion of charitable choices

were generally quite low across all groups. None of the participants chose the more charitable

option in the dictator game more than 40% of the time. This relates to the values, namely individualism and presentism, that are imposed by our economic system. While climate change is about long-term survival of the collective, our society prioritizes short-term growth for individuals (Angus, 2008). The goal is an endless pursuit of material wealth, so people are encouraged to be selfish and greedy (Charbonnier, 2021; Jacquet et al., 2021). For example, in a different study, people failed to reach a collective investment target for climate change when they were not repaid for their sacrifice (Jacquet et al., 2013). This suggests that people were more focused on individual gain than how their actions would benefit the collective. While it is possible that many participants in our study were using this as an opportunity to earn a little extra money to support themselves, they may have had a hard time overcoming their capitalist programming for the sake of the study.

Our study emphasizes the barrier that individualism poses towards mitigating climate change. The capitalist system has encouraged an insatiable desire for economic growth (Charbonnier, 2021). People want as much money for themselves as possible. Psychology studies show that people who are more individualistic are less likely to take climate action (Leiserowitz, 2006; Xiang et al., 2019). In contrast, collectivist attitudes are associated with environmental concern (Cho et al., 2013). This may be because people who are more individualistic are more likely to feel they cannot make an impact on climate change (Xiang et al., 2019), whereas people with more collectivist values may be more confident that others will take action as well (Cho et al., 2019). This demonstrates how our economic system is inadvertently discouraging climate action.

Our results indicate that we may have been able to challenge this bias. Given that we had participants read about close others experiencing the effects of climate change, we may have

encouraged collectivist values. If participants had greater environmental concern after increasing their consideration of others, this could explain why a subset of the EFT+PT group made more charitable choices. This suggests that individualism was minimal in certain participants.

Additionally, rather than aiming to keep the population fed in the long term, this the capitalist model essentially forces businesses to value short term growth (Angus, 2008). This ensures that they are not beaten by competition. Therefore, this system encourages presentism. Psychology studies point out that having high consideration of future consequences is associated with having higher environmental concern (Arnocky et al., 2014). Since we had participants read vignettes of people experiencing the negative effects of climate change in the future, it is possible we increased their consideration of the future, thus increasing their environmental concern and their motivation to act. This suggests that we may have challenged presentism bias.

By encouraging consideration of others, specifically in the future, we have the potential to counteract capitalist programming and encourage climate action. This is important because it shows that uprooting the entire system may not be necessary. Connecting to the future can challenge both presentism and individualism.

Strengths and Limitations

Our results indicate that perspective taking with close others can motivate climate action. There are several strengths of the current study. One strength is that all hypotheses and methods for Study 1 were preregistered on Open Science Framework as we wanted to be transparent about our research process. Another strength is our large sample size, which gave us power to detect even small effects of our manipulation. Finally, we provided real incentives for participants to express their true preferences in the decision-making tasks. We included a real

charity, EarthJustice, in our charitable choice task, and some payments were actualized. This gave participants an opportunity to actually participate in a form of climate action rather than reporting their intentions.

However, the study also has some limitations. To collect a large sample size, the data had to be collected online. Since the study was not conducted in person, we were unable to properly monitor participants. It is possible that some participants did not read the vignettes closely, or that they were distracted by other tasks during the study. Another limitation with the sample was the uneven distribution of participants in each group. We had to exclude more participants from the EFT+PT group than the control or the EFT group since some participants neglected to write a name down or chose someone over the age of 18. Therefore, the results of the study could have been stronger if all groups had the same number of participants.

Next, although we found a connection between perspective taking with close others and climate action, we did not ask about relationships. It could have been helpful to have the EFT+PT group state what their relationship was to their target person. Given that we found a positive correlation between age difference and self-other continuity, we assume that these participants named children or grandchildren rather than friends or peers. However, we do not know this for sure. While this is a limitation, it also supports our hypothesis that connecting to the future motivates action. This may indicate that closeness between people matters more than what their relationship is.

Along the lines of perspective taking, it is possible that the three groups were not as distinct as they were planned to be. Those in the EFT group may have also engaged in perspective taking. They could have imagined either a stranger or someone they knew while reading about a generic individual. Even if this was the case, this vignette likely did not engage

the perspective taking system as much as the EFT+PT vignette did. The TPJ increases in activation the closer one is to the person they are taking the perspective of (Wever et al., 2021). Since only the EFT+PT group was instructed to read about a close other, the TPJ may have been more active in this group. This may have created a more robust effect on account of strong upregulation of the vmPFC (Strombach et al., 2015). This would explain why a subset of the EFT+PT group took more climate action than other participants.

Although it was a strength that participants had the opportunity to take real climate action in our study, one limitation of this approach is that monetary donations are not the only form of climate action. Some people are suspicious of charities in general. Some participants expressed this in the feedback section at the end of the study. Accordingly, it is possible that these participants would engage in other forms of climate action like reducing electricity use or helping clean up beaches, but this was not reflected in our study. Despite this, choosing a monetary task allowed us to obtain quantitative data and compare the groups easily, but in the future, it would be interesting to assess what people think about different forms of collective climate action.

While assessing climate action was an important part of our study, we also looked at how reading vignettes would alter climate change risk perception. One limitation here was that there was quite a large demand effect, as approximately half of all participants reported that they knew we were trying to change their climate change risk perception, and this could have impacted the results. However, even if people felt obligated to increase their risk perception, we only saw significant changes for questions pertaining to personal risk perception and no change for how concerned people were about the environment. This still provides insight into how people are affected by climate change. Furthermore, we were interested in climate change risk perception,

but attitudes towards climate change do not necessarily map onto actions (Meleady and Crisp, 2017). Therefore, we were more interested in how we could encourage climate action, and people seemed to be less aware of what the charitable choice task was trying to measure.

Lastly, while the results of our study may indicate various neural implications regarding the TPJ and mPFC, we did not actually collect neuroimaging data. Therefore, in the future, we are interested in using a similar task while using neuroimaging to measure neural activity throughout the study. This could be important in showing how the perspective taking system can be utilized to decrease selfish behavior and motivate climate action.

Conclusion

The gradual nature of climate change makes it hard for people to grasp (Boomsma et al. 2016). This leads people to become psychologically distant from the issue, lowering their sense of urgency to take action (Duke and Holt, 2016). We attempted to minimize psychological distance from climate change by having participants take the perspective of a loved one in the future experiencing a climate change induced flood. We found that while this did not increase climate change risk perception, doing perspective taking with *close* others in the future was associated with taking more climate action in the form of charitable donations. Our second study indicates that while this vignette may have seemed relatively unlikely to occur, it still made people feel motivated to take climate action. This highlights the importance of challenging individualism and presentism by connecting people with individuals who will be most impacted by climate change. This may lower psychological distance from the crisis and get people to take climate action.

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Appendix

Figure A1.

Perspective Taking and Episodic Future Thinking Group (blank spaces will be filled in with the name of the target person the subject names):

Imagine that the year is 2070, and _____ lives in a coastal town. _____ faced an imminent threat: a massive hurricane was on its way. As the storm approached, _____ prepared as best (he/she/they) could, boarding up windows and gathering supplies.

But despite their efforts, the hurricane brought more than just wind and rain. As it made landfall, the waters surged, flooding streets and homes alike. _____ watched helplessly as (his/her/their) neighborhood was swallowed by the rising tide.

Figure A2.

Episodic Future Thinking ONLY group

Imagine that the year is 2070, someone lives in a coastal town. They faced an imminent threat: a massive hurricane was on its way. As the storm approached, they prepared as best they could, boarding up windows and gathering supplies.

But despite their efforts, the hurricane brought more than just wind and rain. As it made landfall, the waters surged, flooding streets and homes alike. This person watched helplessly as their neighborhood was swallowed by the rising tide.

Sitting in their attic, they waited for the waters to recede. But when dawn broke, the damage was devastating. This person's home faced significant damage. Many of their possessions like photos and furniture were destroyed due to the floodwaters.

As they surveyed the wreckage, they knew they faced a long road ahead. Years of

people neglecting to take climate action had led to this moment. Climate change has made storms like this more frequent and more destructive, leaving this person vulnerable and uncertain about the future.

Figure A3.

Active Control

Without significant climate action, there will be dire effects in the future. First, the rising emissions of greenhouse gases like carbon dioxide and methane in the air will continue to warm the globe. This can alter levels of rainfall and cause sea levels to rise.

Storms are expected to become stronger and more common in the future. This could pose significant threats to human lives by increasing the spread of disease and injury. Floods will likely become heavy. However, droughts will be an issue as well which may pose challenges to farming and agriculture.

The various effects of climate change pose a threat to biodiversity. There is potential for many marine species to be wiped out as sea levels rise, become more acidic, and become warmer. Entire ecosystems can be offset by these effects.

Food availability will also become an issue. As storms become more frequent and severe, crops could be wiped out. On the other hand, droughts could also prohibit many crops from growing which could lead to global food scarcity. Therefore, climate change has the potential to cause major disruptions.