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Published in:
Global Environmental Change

DOI:
10.1016/j.gloenvcha.2019.102008

Global Environmental Change 60 (2020) 102008

Contents lists available at ScienceDirect

Global Environmental Change

journal homepage: www.elsevier.com/locate/gloenvcha

Activating the legacy motive mitigates intergenerational discounting in the climate game

Mark J. Hurlstone*,[1,a], Annabel Price[a], Susie Wang[a,b], Zoe Leviston[c], Iain Walker[d]

[a] School of Psychological Science, University of Western Australia, Crawley 6009 WA, Australia
[b] Department of Social Psychology, University of Groningen, The Netherlands
[c] School of Arts & Humanities, Edith Cowan University, Joondalup, Australia
[d] School of Psychology and Counselling, University of Canberra, Canberra, Australia

ARTICLE INFO

Keywords:
Climate change
Cooperation
Intergenerational discounting
Legacy motive
Tragedy of the commons
Tragedy of the horizon

ABSTRACT

Climate change will have dangerous impacts on future generations. Accordingly, people in the present have an obligation to make sacrifices for the benefit of future others. However, research on temporal and social discounting shows that people are short-sighted and selfish—they prefer immediate over delayed benefits, and they prefer benefits for themselves over others. Discounting over long-term time horizons is known as intergenerational discounting, and is a major obstacle to climate action. Here, we examine whether persuasive messages that activate the legacy motive—the desire to build a positive legacy—can increase the willingness of current actors to make sacrifices for future generations. Using a climate change public goods game, we find that when the benefits of cooperation accrue to decision makers in the present, high levels of cooperation are sustained, whereas when the benefits accrue to future generations, intergenerational discounting makes cooperation elusive. Crucially, when the legacy motive is activated—by promoting death awareness, feelings of power asymmetry, and intergenerational reciprocity—intergenerational discounting is attenuated, and cooperation is restored. Our results suggest climate action can be fostered by framing climate change as an intergenerational dilemma, and by crafting persuasive messages that activate people's drive to leave a positive legacy.

1. Introduction

Preventing dangerous climate change is perhaps the greatest collective action problem ever (Dreber and Nowak, 2008). It is a tale of two tragedies. The first tragedy—the *tragedy of the commons* (Hardin, 1968)—is that climate change is a social dilemma entailing a conflict between individual and collective interests. All countries benefit from the protection of the global climate, but because climate protection requires costly emission abatement this creates the incentive for each country to free ride on the emission reductions of cooperating countries. Thus, what is best for the group is if all countries cooperate, but defection is individually profitable, as a country can reap the benefits of climate protection without paying the associated costs. The second tragedy—the *tragedy of the horizon* (Carney, 2015; Hurlstone et al., 2017)—is that climate change is an intergenerational dilemma entailing a conflict between the interests of current and future generations. The current generation either incurs the costly burden of managing the climate change problem and the benefits are passed on to future generations, or the current generation reaps the benefits of inaction and the cost of managing this burden is imposed on future generations.

The two tragedies combine to make climate change prone to *intergenerational discounting*—the tendency for people to prefer smaller benefits for themselves now, rather than larger benefits for future others (Wade-Benzoni, 2008; Wade-Benzoni and Tost, 2009). There are at least two components to intergenerational discounting (Wade-Benzoni and Tost, 2009). The first is *temporal discounting*, the tendency for individuals to prefer smaller benefits for themselves in the present than larger benefits for themselves in the future (Frederick et al., 2002). The second is *social discounting*, the tendency for individuals to prefer to give greater benefits to socially close others, compared to socially distant others (Jones and Rachlin, 2006; 2009; Rachlin and Jones, 2008). For both components, the degree of discounting increases as a function of distance—for the first component, the temporal distance between the decision and the consequence of that

* Corresponding author.
E-mail address: mark.hurlstone@uwa.edu.au (M.J. Hurlstone).

[1] All raw data associated with this study have been deposited in a publicly accessible repository at: https://github.com/mark-hurlstone/Hurlstone-Price-Wang-Leviston-Walker-2019.

https://doi.org/10.1016/j.gloenvcha.2019.102008
Received 25 June 2019; Received in revised form 25 October 2019; Accepted 6 November 2019
Available online 25 December 2019
0959-3780/

decision, and for the second component, the social distance between the self and another person (Wade-Benzoni, 2008). Intergenerational discounting therefore emerges as the combined action of temporal and social discounting, creating fertile conditions for self-interested behaviour to flourish.

Intergenerational discounting is typically studied in the laboratory by asking participants to decide how much of a resource to allocate to oneself versus others in the future (Wade-Benzoni, 2008; Wade-Benzoni et al., 2012; Zaval et al., 2015). The results of such studies show that intergenerational resource allocations exhibit a self-serving bias that increases as a function of temporal and social distance. For example, Wade-Benzoni (2008) gave staff from a U.S. university $7 and asked them to decide how much to keep for themselves and how much to allocate to another participant (i.e., generation) who they were told would complete the experiment either on the same day (low temporal distance) or in 6 months (high temporal distance). They knew the amount they left for the next person would be increased by 50%. Social distance was also manipulated by telling some people that the participant they would be allocating the money to was a member of staff from the same university (low social distance), whereas others were informed the participant was a student from a different university (high social distance). Results revealed that allocations to the next person decreased with both increasing temporal and social distance.

Research has shown that intergenerational discounting is a major obstacle to individual and collective climate action (Jacquet et al., 2013; Spence et al., 2012; Weber, 2006; 2010). Accordingly, this might lead one to expect that in the absence of material or economic incentives, the prospect of persuading citizens and countries to make sacrifices for future generations is bleak. However, research in the organisational and social psychology literatures suggests that willingness to make sacrifices for future generations can be catalysed by framing such intergenerationally beneficent behaviour as an opportunity to build an enduring positive legacy that will extend into the future (Fox et al., 2010; Wade-Benzoni, 2019; Wade-Benzoni and Tost, 2009). This so-called *legacy motive* reflects an inherent drive for one's life to have a meaningful impact that continues in some symbolic form after one's physical existence has ceased. By promoting an awareness that after one's death one's legacy will extend into the future to affect the lives of socially distant others, the legacy motive reduces distance along the temporal and social distance dimensions—it provides a bridge between current and future generations, such that their interests become aligned (Fox et al., 2010).

Several variables have been shown to activate the legacy motive (Fox et al., 2010; Wade-Benzoni, 2019; Wade-Benzoni and Tost, 2009). First, the legacy motive can be induced by making salient an individual's own mortality via a process known as *mortality salience*. Experiencing death awareness reminds an individual of the inevitability of their own death and their desire to live, which triggers legacy building needs. In support of this view, it has been shown that the negative impact of intergenerational discounting on the allocation of benefits by current actors to other people in the future can be mitigated by implicitly priming them with thoughts of death (Wade-Benzoni, 2002). Second, the legacy motive can be induced by drawing individuals' attention to the inherent *power asymmetry* that exists between current and future generations—the current generation has complete decision making power over future generations who have no voice in the decision making process (Tost et al., 2008). Although power asymmetry can promote selfish behaviour (Handgraaf et al., 2008), when this asymmetry is extreme it makes salient the vulnerability and exploitability of future generations, making intergenerational resource allocations a moral dilemma (Wade-Benzoni, 2019). This, in turn, makes people more conscious about behaving ethically and socially responsibly toward future others, which promotes intergenerational beneficence (Tost et al., 2015; Wade-Benzoni, 2008). Third, the legacy motive can be induced through *intergenerational reciprocity* by linking the past to the future. The norm of reciprocity—which obliges us to repay others for what we have received from them—is one of the most powerful forces in human culture (Gouldner, 1960). Accordingly, if a past generation has acted in a way that benefits the current generation, this creates a strong desire to reciprocate the kindness of that past generation. However, sometimes direct reciprocity is not possible because the previous generation no longer exist. Under these circumstances, the norm of reciprocity can induce a strong drive to pay forward the benefits provided by past benefactors to future generations (Bang et al., 2017). Thus, thinking about the sacrifices past generations have made for the present generation can induce current actors to think about the legacy they would like to leave for future generations (Wade-Benzoni, 2019).

These results provide tantalising evidence that legacy motivations may be a key tool for minimising the two tragedies of climate change. In support of this claim, it has been shown that activating the legacy motive can promote individual action on climate change (Wade-Benzoni et al., 2010; Zaval et al., 2015). However, what remains unclear is whether legacy motivations can overcome the barriers to intergenerational beneficence in the context of collective action on climate change. Using a group-based decision-making situation, the aim of the current study is to establish whether persuasive messages that activate the legacy motive can increase the willingness of current actors to forego short-term economic incentives in order to confer longer-term climate protection benefits on future generations. As a vehicle to pursue this goal, we employ a climate change public goods game known as the *intergenerational collective-risk social dilemma* (Jacquet et al., 2013; Milinski et al., 2008) (Fig. 1) that mimics the two tragedies of climate change. The game involves groups of six players. Each is given an operating fund of $40 that they can choose to spend, and an endowment of $45 that they can potentially lose, depending on the gameplay. The players must decide whether to contribute $0, $2, or $4 from their operating fund in each of 10 rounds to a climate account without communicating. At the end of each round, the contributions of each group member are made public. If by the end of the game a collective target of $120 has been invested in the climate account, then 'dangerous climate change' is averted with certainty (Fig. 1a), whereas if the collective target is missed then each player's $45 endowment is lost with a 90% probability (Fig. 1b). Regardless of whether the collective target is reached or missed, players are paid the leftovers of their personal operating funds in cash at the end of the game.

The critical comparison in this game is between two different conditions—short-delay and intergenerational. In the short-delay condition, players are informed at the outset that if their group successfully averts 'dangerous climate change', then they will be paid their $45 endowment in cash the next day. By contrast, in the intergenerational condition players are informed that their $45 endowment will be invested in the planting of trees which will sequester carbon and therefore provide the greatest benefit to future generations. Thus, in the latter condition the beneficiaries of the provision of the public good are other people who are temporally and socially distant from the players themselves, which should foster intergenerational discounting. This is what Jacquet et al. (2013) observed—total group contributions were markedly higher in the short-delay than the intergenerational condition, with fair-share ($2) investments dominating over selfish ($0) and altruistic ($4) investments in the short-delay condition, whereas selfish investments dominated over fair-share and altruistic investments in the intergenerational condition. Critically, the collective target was reached 70% of the time by groups in the short-delay condition, whereas it was never reached in the intergenerational condition—a compelling demonstration of the unwillingness of current actors to cooperate with the future.

The results of Jacquet et al. (2013) paint a bleak picture of the climate cooperation challenge. However, to date no study has examined whether legacy-enacting messages can stave off the impediment of intergenerational discounting in a group setting. To plug this gap, in the current study, we added a third condition known as the legacy induction condition. This condition was procedurally identical to the

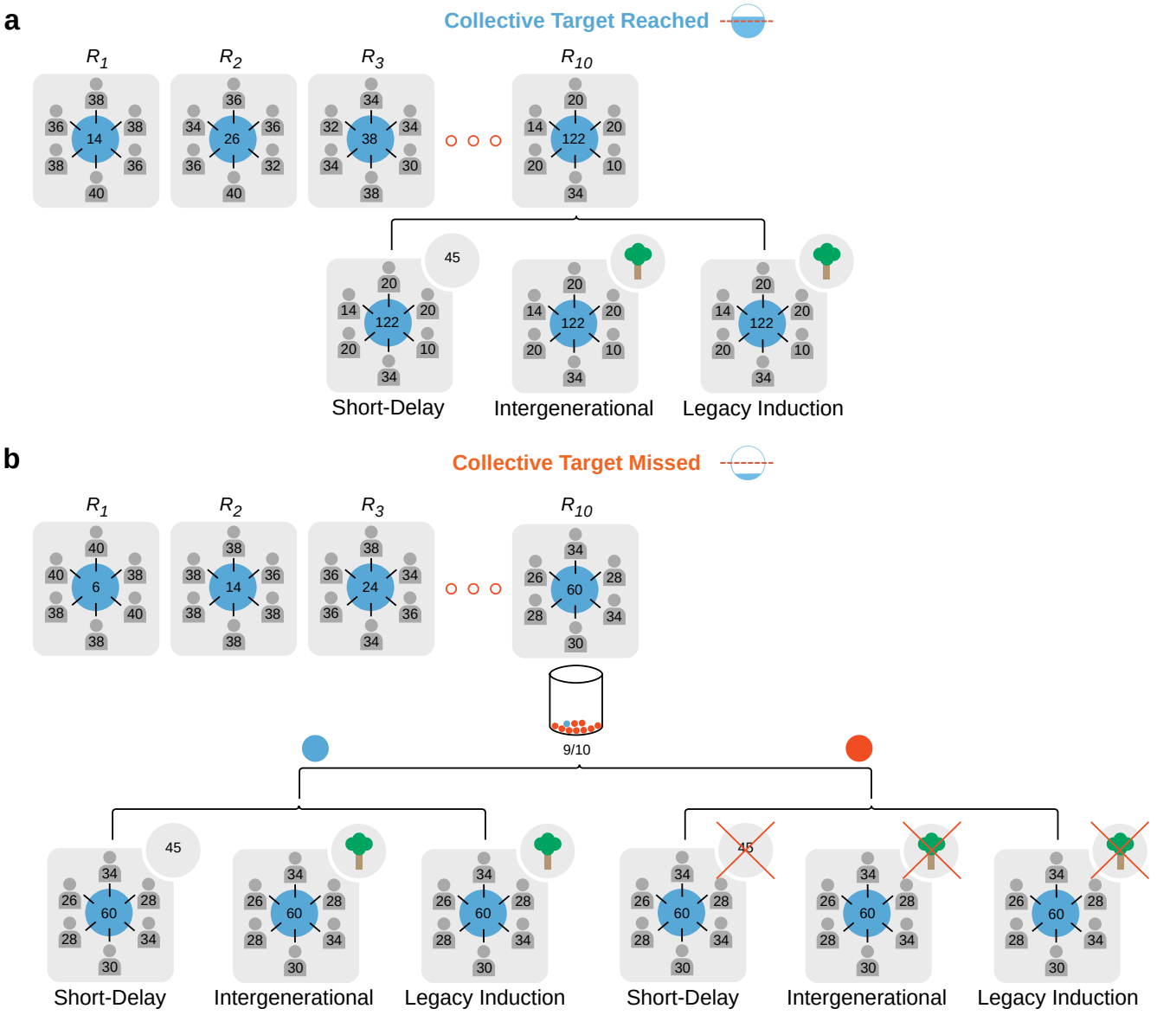

Fig. 1. An illustration of the structure of the climate change game. **a,** On each of 10 rounds, players ($N = 6$) invest \$0, \$2, or \$4 from a \$40 personal operating fund into an account for climate protection. If the total amount in the climate account by the end of game reaches the collective target of \$120, then 'dangerous climate change' is averted and players in the short-delay condition are paid their \$45 personal endowments in cash the next day, whereas these endowments are invested in the planting of trees for players in the intergenerational and legacy induction conditions. **b,** If the \$120 collective target is missed, then the personal endowments are lost with a probability of 90% and retained with a probability of 10%, as determined by a random draw from a uniform distribution. Irrespective of whether the collective target is reached or missed, players are paid the leftovers of their personal operating funds in cash at the end of the game.

intergenerational condition, except that players were exposed to three persuasive messages prior to their investment decisions on rounds 1, 4, and 7 of the public goods game. The three persuasive messages made salient the legacy motive via the previously described mechanisms of mortality salience, power asymmetry, and intergenerational reciprocity. We expected to replicate the pattern of results reported by Jacquet et al. (2013) with regards the short-delay and intergenerational conditions. However, we anticipated that intergenerational discounting would be mitigated in the legacy induction condition, such that total group investments and the percentage of groups reaching the collective target would be higher in the legacy induction condition than the intergenerational condition. We also anticipated that the distribution of selfish, fair-share, and altruistic investments in the legacy induction condition would mimic that observed in the short-delay condition, with fair-share investments dominating over selfish and altruistic investments.

2. Methods

2.1. Experimental games

Ethical approval to conduct the experiment was granted by the Human Ethics office at the University of Western Australia (UWA) (RA/4/1/6996). One hundred and eighty members of the campus community at UWA participated in the experiment (92 female, 86 male, 2 unspecified age 17–57 years, $M = 21$ years, $s = 5.55$ years). Participants were recruited using the Online Recruitment System for Experimental Economics (ORSEE), an open source web-based recruitment platform used by the Behavioural Economics Laboratory (http://bel-uwa.github.io) at UWA. The ORSEE database contains a pool of over 1500 UWA staff and students from a range of academic disciplines. Participants were recruited by issuing electronic invitations to randomly selected individuals in the ORSEE database to attend the experimental sessions.

Table 1
The mortality salience, power asymmetry, and intergenerational reciprocity text passages used in the legacy induction condition.

	Passage name		
	Mortality salience	Power asymmetry	Intergenerational reciprocity
Description	Induced a state of death awareness by drawing attention to the inevitability of death. It then highlighted the potential for our actions to leave 'footprints' on the world that outlive this mortality, and remain as a gift or a burden for future generations.	Underscored the imbalance of power between current and future generations and contrasted the absolute decision-making power of the present generation with the voicelessness and powerlessness of future generations.	Sought to enhance participants' connection with future generations through identification with a specific past generation whose actions created a legacy that benefits us today. It further emphasised the opportunity for indirect reciprocation by "paying it forward".
Title	Leaving a Positive Legacy	The Helpless Nature of Future Generations	We Are One With Future Generations
Passage	Whether in months, years or decades, we all face the same fate as human beings. Death is certain, and life is short, even though family, friendships, and career all feel as though they will last forever. Before we know it, we will reach a point of reflection rather than action. We will be in the position of passing the places and objects in our lives on to new generations.	It is easy to think our decisions shaped what our world looks like today. However, the world as we know it is largely a reflection of the past. Previous generations of people made the decisions that moulded our communities, laws, culture, environment, and economy into what they are today. Almost every aspect of our society is the result of other generation's decisions, whether 50 or 200 years ago, and what they decided on, we have inherited, for better or worse.	Humans have always faced great trials and adversity. Our parents and grandparents have faced many challenges, which have tested their personal strength and courage. Each generation has been burdened with problems in some shape or form, from the small to the seemingly insurmountable. And for each problem overcome by one generation, another arises to confront the next.
	We all leave footprints on the world. Some are fleeting, like a smile to lift someone's day, and some are more enduring. Even though we cannot live forever, our actions will live on long after we do. These actions can be a benefit or burden to future generations, and they dictate how our time on this planet will be remembered.	We are completely powerless in receiving what past generations left to us. They had no obligation to care about us, but they did so nevertheless. Now, we are in that same position of absolute power: what we decide now will dictate what future generations will receive from us. Everything that we do now will affect them, but nothing they can do will affect us.	More than 70 years ago, the greatest problem of members of that generation's time was achieving world peace by winning World War II. Millions of war veterans from many countries fought and died for the Allied forces to protect our lands, rights, and freedoms, so that we could inherit a peaceful and just world. In the darkness of war they were confronted with unimaginable horrors and seemingly impossible challenges, but their strength and bravery shone through. They achieved their goal of peace and freedom, and today we honour and remember them for giving us the world we inherited.
	As the current stewards of the Earth, we have a responsibility to behave in ways that do not create burdens for future generations. Behaving without regard to the life and environment of future generations is unethical in a civilized society. If we fail to take action on climate change, it will have disastrous consequences for our grandchildren and great-grandchildren. However, by engaging in behaviours that protect the climate, we can help to shield our descendants from harm. By doing what is morally right, we can ensure that we are remembered positively by future generations.	Climate change might not seem like a present danger. However, its effects will worsen with time, meaning that future generations will experience catastrophic consequences if we do not tackle this burden for them now. Whether or not we decide to act, future generations are voiceless in the matter. They cannot negotiate their needs and rights to land and life. They are completely helpless and at our mercy. Accordingly, we have a responsibility to speak and act on their behalf.	Climate change is the greatest problem of our time. If we fail to act, there will be disastrous consequences for future generations, placing our grandchildren and great-grandchildren at risk of great personal hardship. But like our ancestors before us, this problem is an opportunity for us to demonstrate our own willingness to shape a better world for future others. It is our chance to ensure that our descendants remember us as a generation that did not shirk their responsibility to protect them from harm. Just as past generations have taken actions to benefit us, so too must we for generations to come.

The experiment employed a 3 (condition: short-delay vs. intergenerational vs. legacy induction) × 10 (round: 1–10) mixed design: condition was a between-groups factor, whereas round was a within-groups factor. Participants were tested in groups of six players, with each group randomly allocated to one of the three levels of the condition factor (i.e., ten groups per condition).

Three text passages were crafted that were designed to activate the legacy motive either through the mechanism of mortality salience, power asymmetry, or intergenerational reciprocity (Fox et al., 2010; Wade-Benzoni, 2019). The text passages (Table 1) contained three paragraphs, were approximately 250 words in length, and were accompanied by an image and short caption to reinforce their central theme (Fig. 2).

The mortality salience passage, entitled "Leaving a Positive Legacy", centred on the theme of creating a positive enduring legacy. The passage sought to induce a state of death awareness by drawing attention to the inevitability of death. It then underscored the potential for our actions to leave 'footprints' on the world that outlive this mortality, and remain as a gift or a burden for future generations. The corresponding image showed a line of footprints in sand, and was captioned "Our footprints on the world remain long after we are gone" (Fig. 2a).

The power asymmetry passage, entitled "The Helpless Nature of Future Generations", underscored the imbalance of power between current and future generations. The passage contrasted the absolute decision-making power of the present generation with the voicelessness and powerlessness of future generations who bear the consequences of their decisions. The accompanying image depicted one hand reaching out to another, and was captioned "We have a responsibility to help powerless future generations" (Fig. 2b).

The intergenerational reciprocity passage, entitled "We Are One With Future Generations", sought to enhance participants' connection with future generations through identification with a specific past generation whose actions created a legacy that benefits us today. The passage centred on the theme of sacrifice, using the example of World

Fig. 2. Images and captions conveyed following the second paragraph of the **a,** mortality salience, **b,** power asymmetry, and **c,** intergenerational reciprocity text passages in the legacy induction condition.

War II soldiers—a group that many members of the current generation feel a strong connection toward—to illustrate the sacrifices of a past generation for the sake of the present generation. It further emphasised the opportunity for indirect reciprocation by "paying it forward". The passage was accompanied by an image of a chain, captioned "We are one link in a chain connecting us with past and future generations" (Fig. 2c).

Participants were tested in groups of six members. Sessions took place in the Behavioural Economics Laboratory at UWA, a computerised experimental laboratory for running economic experiments. At the start of a session, participants were randomly seated at interconnected computer terminals running the Zurich Toolbox for Readymade Economic Experiments (z-Tree; Fischbacher, 2007), which was used to register and communicate their investment decisions during the experiment. They were separated by privacy blinds to prevent participant collusion. Participants read an information sheet and provided informed consent initially, after which they read the electronic instructions and answered a series of control questions to ensure that they understood the rules of play (Supplementary Instructions and Control Questions). To ensure anonymity, each participant was assigned a pseudonym before the game commenced (Carpo, Galatea, Leda, Portia, Sinope, or Triton).

At the start of the game, each participant received a $40 operating fund. On each of ten subsequent climate rounds, participants decided simultaneously and independently whether to contribute $0, $2, or $4 of their operating fund into a 'climate account'. Participants in the legacy induction condition were required to read one of the three text passages prior to registering their investment decisions on rounds 1, 4, and 7, with the order of presentation of the passages being counterbalanced across groups, such that each group read all three passages but in different orders. Participants in the short-delay and intergenerational conditions did not read any text passages prior to these (or any) rounds. At the end of each of the 10 climate rounds, the investment decisions of all six participants were displayed on all computers simultaneously under their designated pseudonyms. The total investments on the current round and the cumulative sum of investments across all rounds played so far was also displayed to participants.

Participants knew that any money invested in the climate account would be used to fund an advertisement on climate protection in a large daily newspaper, and that the leftovers of their operating fund would be paid to them in cash at the end of the session. Participants in the short-delay condition were told at the outset that if the total amount invested in the climate account by the end of round 10 was equal to at least $120, then in addition to keeping the leftovers of their operating funds they would each receive a $45 monetary endowment in cash the next day. By contrast, participants in the intergenerational and legacy induction conditions were told that their $45 endowment would be invested in planting 72 trees (12 trees per player) which would benefit future generations by capturing and storing CO_2 for 80 years to help mitigate climate change. They were also given a signed letter from the chief investigator (Supplementary Tree Planting Pledge) assuring them that if their group reached the $120 investment target then their endowments would be donated to the Carbon Neutral Charitable Fund—a carbon offsetting charity based in Perth, Western Australia—for reforestation upon publication of the present study.

At the end of the game (i.e., after ten climate rounds), participants completed a brief questionnaire (Supplementary Ex Post Questionnaire) after which they were paid what remained of their operating fund—anonymously and in cash—irrespective of the amount of money they invested in the climate account. Additionally, if the total investments in the climate account were equal to or greater than $120, 'dangerous climate change' was averted with certainty and participants were awarded their $45 endowment. By contrast, if total investments in the climate account were less than $120, 'dangerous climate change' was simulated, with a 90% probability that all participants' $45 endowments would be lost. This outcome was determined by drawing a random number $r \in (0, 1)$ from a uniform distribution. If $r \leq 0.9$, then 'dangerous climate change' occurred, whereas if $r > 0.9$ then 'dangerous climate change' was averted and the endowments were awarded, despite the failure of the group to reach the $120 threshold. Participants were informed about all of these consequences at the outset of the experiment. Successful group members in the short-delay condition returned to the laboratory the next day to receive their monetary endowment in cash, whereas participants in the intergenerational and legacy induction conditions were given information about the reforestation charity to which their endowments would be invested as they left the laboratory (Supplementary Receipt for Planting of Trees).

2.2. Equilibria

The climate change game is a coordination game—where players must coordinate strategies for their mutual benefit—with two symmetrical pure strategy Nash equilibria. One is a "cooperative" equilibrium in which each player contributes $20 and the collective target is reached, whereas the other is a "noncooperative" equilibrium in which each player contributes $0 and the collective target is missed (there are also several "cooperative" asymmetric pure strategy Nash equilibria where different players contribute different amounts). In the short-delay condition, the cooperative equilibrium yields a total payoff of $65—each player receives the uninvested $20 from his or her operating fund, plus his or her $45 endowment. By contrast, the noncooperative equilibrium yields a total payoff of $40—each player receives his or her $40 operating fund in full, but his or her $45 endowment is lost with near certainty. Evidently, the cooperative equilibrium yields a higher

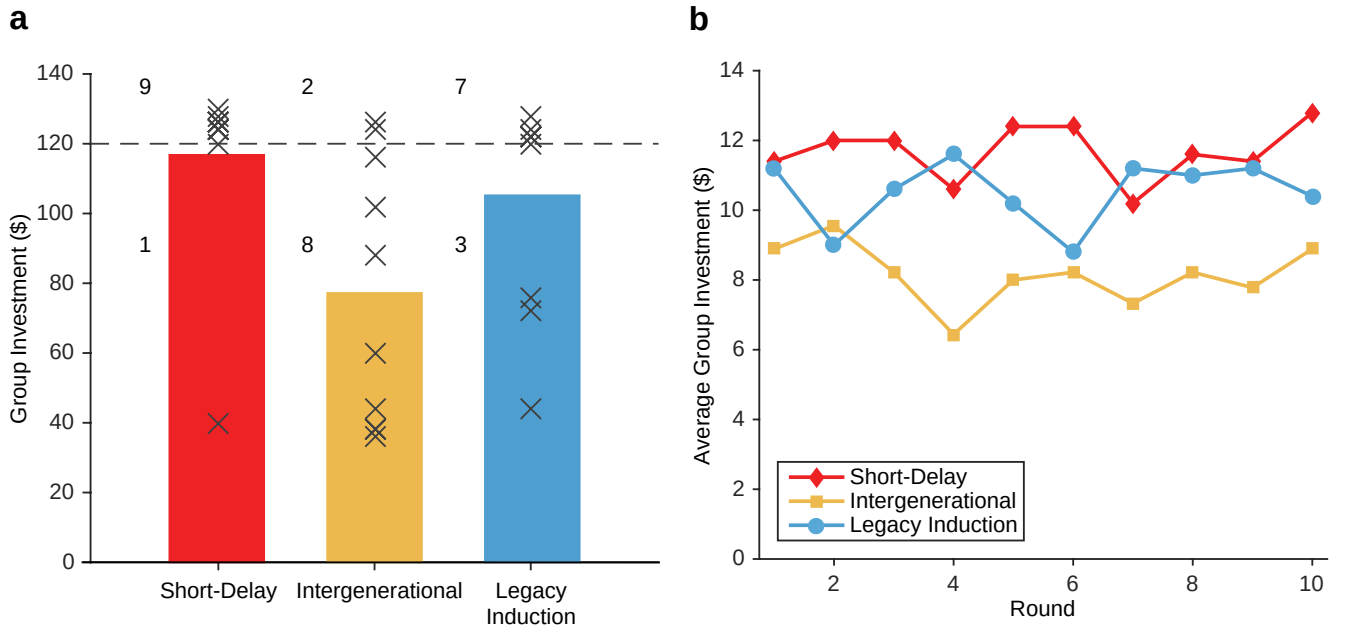

Fig. 3. Measures of cooperation across the three conditions. **a,** Total investments per group (denoted by the crosses) and average group investments per condition (denoted by the bars). The hatched horizontal line represents the $120 investment target, with the values above and beneath this line representing the number of groups that reached and missed the target, respectively. **b,** Average group investments on each round of the climate change game.

payoff than the noncooperative equilibrium, and for this reason the cooperative equilibrium is most salient in the short-delay condition.

However, in the intergenerational and legacy induction conditions, the payoffs and preferences over these equilibria change. Bearing in mind that a rational and purely self-interested player will disregard the endowment to future generations, now the cooperative equilibrium yields a total payoff of $20—each player receives the uninvested $20 from his or her operating fund. By contrast, the noncooperative equilibrium yields a total payoff of $40—each player receives his or her $40 operating fund in full. Evidently, the noncooperative equilibrium yields a higher payoff than the cooperative equilibrium, and for this reason the noncooperative equilibrium is most salient in the intergenerational and legacy induction conditions.

On this rational analysis, the prognosis for the intergenerational and legacy induction conditions is bleak—short-term self interest should lead to universal defection across all groups. However, the strong prediction of complete noncooperation was not borne out in the study by Jacquet et al. (2013)—all groups in the intergenerational condition invested something in the public good.

3. Results

3.1. Success at reaching collective target

For data analysis, we first examined success at reaching the collective target. Fig. 3a shows that the number of groups that successfully reached the $120 collective target varied according to condition. Of the ten groups in each condition, nine in the short-delay (90%), two in the intergenerational (20%), and seven in the legacy induction condition (70%) reached the collective target. The data were analysed via logistic regression with the group outcome (target reached vs. target missed) as the dependent variable, and the dummy coded main effect of condition as a predictor, with the intergenerational condition as the reference category. The resulting model provided a significantly better fit to the data than a constant only model, χ^2 (27) = 11.66, p = 0.003. The difference between the number of successful groups was significant for the short-delay and intergenerational conditions, β = 3.58, SE = 1.32, z = 2.72 p = 0.007, reflecting the strong negative impact of intergenerational discounting in the latter condition. However, and critically, the number of successful groups was significantly higher in the legacy induction condition than the intergenerational condition, β = 2.23, SE = 1.04, z = 2.13 p = 0.033.

3.2. Group investments

Turning to the group investments in the climate account, the data are portrayed first in general form—Fig. 3a shows the total amount invested by each group, and the average of these quantities for each condition. Group investments (M ± SEM) in the short-delay condition ($116.80 ± 8.58) were on average 51% higher than investments in the intergenerational condition ($77.20 ± 12.01), which, in turn, were 36% lower than investments in the legacy induction condition ($105.20 ± 9.38). To examine the data further, Fig. 3b shows the average amount invested, per group, across the ten climate rounds. Although investments are higher in the short-delay and legacy induction conditions compared to the intergenerational condition, the average investments are more or less constant over rounds for all three conditions. We conducted a 3 (condition: short-delay vs. intergenerational vs. legacy induction) × 10 (round: 1–10) Analysis of Variance (ANOVA) on the group investments. As expected, there was a significant main effect of condition, F(2,27) = 4.07, p = 0.029, but no significant main effect of round, F(9,243) = 0.35, p = 0.959, and no significant interaction, F(18,243) = 1.02, p = 0.434.

3.3. Player investment strategies

We next examined the frequency of selfish ($0), fair-share ($2), and altruistic ($4) investment strategies, which are shown graphically by round in Fig. 4a–c and in general form in Fig. 4d. It is apparent from inspection of Fig. 4a–c that on the first round of the three conditions the distribution of selfish, fair-share, and altruistic investments is quite similar. However, as the rounds progress the dynamics of investment strategies changes across conditions. In the short-delay condition, fair-share investments come to dominate, although the frequency of these investments decreases gradually over rounds. In the intergenerational condition, there is a crossover point after the third round where fair-

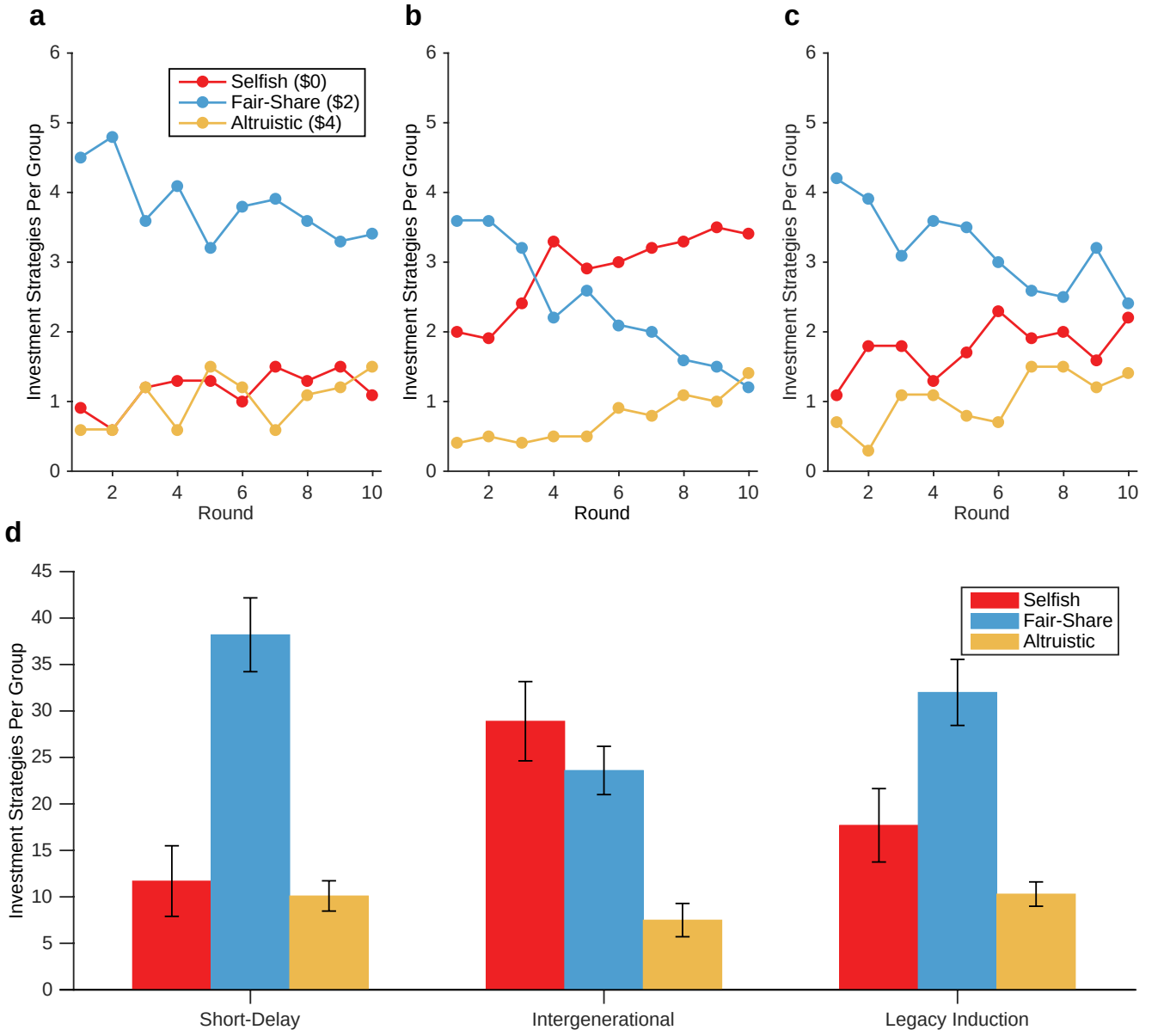

Fig. 4. Frequency of selfish ($0), fair-share ($2), and altruistic ($4) investments. **a-c** Frequency of investment strategies, per group, as a function of round of the climate game in the **a,** short-delay condition, **b,** intergenerational condition, and **c,** legacy induction condition. **d,** Frequency of investment strategies, per group, collapsed over rounds for all conditions.

share investments are substituted for selfish investments. Thereafter, fair-share investments decline over rounds, whereas selfish investments increase over rounds. In both conditions, altruistic investments are relatively infrequent and increase only slightly over rounds. The pattern of investment strategies in these two conditions is remarkably similar to that observed by Jacquet et al. (2013). The novel finding with respect to these data is that in the legacy induction condition, a distribution of investment strategies which is more akin to that observed in the short-delay condition is established, except that the decline in fair-share investments over rounds is steeper and is accompanied by a gradual rise in selfish investments.

We analysed the data without respect to round since we were primarily interested in how the coarse distribution of the three investment strategies differed within each condition. A 3 (condition) × 3 (investment-strategy: selfish vs. fair-share vs. altruistic) ANOVA on the frequency of investments collapsed over rounds revealed no significant main effect of condition, $F(2,81) = 6.079e{-}30$, $p = 1.000$, a significant main effect of investment-type, $F(2,81) = 35.90$, $p < 0.001$, together with a significant interaction, $F(4,81) = 6.551$, $p < 0.001$.

To investigate the interaction, we examined the effect of investment-type for each condition separately. There was a significant effect of investment-type in the short-delay condition, $F(2,27) = 22.75$, $p < 0.001$, with fair-share investments being most frequent ($38.20 ± 3.97), followed by selfish investments ($11.70 ± 3.80), with altruistic investments being least frequent ($10.10 ± 1.63). There was also a significant effect of investment-type in the intergenerational condition, $F(2,27) = 13.25$, $p < 0.001$, this time with selfish investments being most frequent ($28.90 ± 4.27), followed by fair-share investments ($23.60 ± 2.60), with altruistic investments being least frequent ($7.50 ± 1.79). Finally, there was also a significant effect of investment-type in the legacy induction condition, $F(2,27) = 20.23$, $p < 0.001$—mirroring the broad pattern observed in the short-delay condition, fair-share investments were most frequent ($32.00 ± 3.55), followed by selfish investments ($17.70 ± 3.95), with altruistic investments being least frequent ($10.30 ± 1.31).

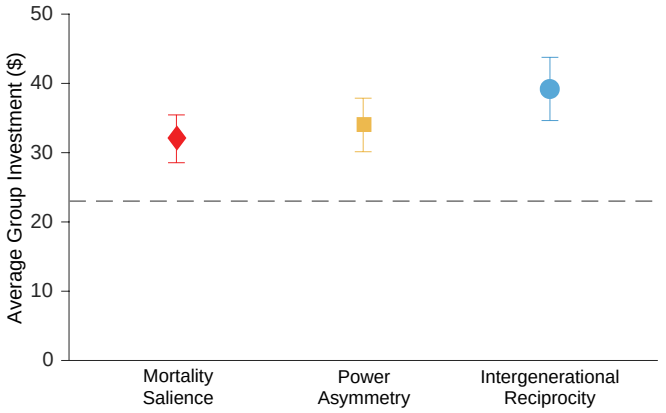

Fig. 5. Average group investments following presentation of the mortality salience, power asymmetry, and intergenerational reciprocity messages in the legacy induction condition, compared to the intergenerational baseline (hatched line). All three legacy enacting messages contributed to the mitigation of intergenerational discounting in the legacy induction condition.

3.4. Effectiveness of individual messages

In the final analysis, we examined whether the increase in investments in the legacy induction condition, compared to the intergenerational condition, was driven by all three persuasive messages, a sub-set of those messages, or one message in particular. To this end, for each group in the legacy induction condition, we estimated the investments elicited by each of the three messages by summing the contributions made by group members over the round immediately following the presentation of the message up until the round before the next message was presented, or the game ended—namely rounds 1–3, 4–6, or 7–10, depending on the locus of the message within the game for a given group. To provide a suitable baseline against which to compare the group investments elicited by each message, for each group in the intergenerational condition we computed the total amount invested in the climate account across the same three sets of rounds by summing the total group investments over rounds 1–3, 4–6, and 7–10, separately, and then calculating the average of these values.

The results are shown in Fig. 5: compared to baseline ($23.16 ± 3.60), group investments in the legacy induction condition were 28% higher following presentation of the mortality salience message ($32.00 ± 3.45), 32% higher following presentation of the power asymmetry message ($34.00 ± 3.86), and 41% higher following presentation of the intergenerational reciprocity message ($39.20 ± 4.56)—a significant difference between baseline and message-type, $F(3,36) = 2.95$, $p = 0.044$. Thus, all three legacy enacting messages contributed to the mitigation of intergenerational discounting in the legacy induction condition.

4. Discussion

We examined the effect of intergenerational discounting in a climate cooperation game. Consistent with earlier work (Jacquet et al., 2013), we find that intergenerational discounting is a major obstacle to cooperating with the future. When the benefits of cooperation accrue to actors in the present, investments in the public good are sustained at high levels and groups can coordinate to avert 'dangerous climate change' with near-certainty. However, when the benefits of cooperation accrue to actors in the future, investments in the public good suffer and 'dangerous climate change' is almost inevitable. Our novel contribution is to show that when the legacy motive is activated—by exposing people to persuasive messages that promote death awareness, highlight power asymmetries, and instil a desire to reciprocate forward the beneficent acts of prior generations—intergenerational discounting is mitigated. Specifically, investments in the public good increase, as does the probability of averting 'dangerous climate change'. This intergenerationally beneficent behaviour arises due to a change in the dynamics of group investments—whereas selfish investments predominate when intergenerational discounting is high, when legacy motivations are enacted a fair-share investment rule emerges within groups similar to that seen when intergenerational discounting is absent entirely.

One question raised by our results is the extent to which the high levels of intergenerational beneficence in our legacy induction condition were due to the specific legacy that would be bestowed on future generations (tree planting). We know one factor that influences individual intergenerational discounting tendencies is outcome uncertainty—that is, as uncertainty about the benefit that will be passed on to future generations based on the actions of the current generation increases, intergenerational beneficence decreases (Wade-Benzoni, 2008; although see Wade-Benzoni et al., 2008 for boundary conditions). The legacy of planting trees in our study can be considered a situation involving low outcome uncertainty, as we supplied players with precise information about how many trees would be planted, who would plant them and when, how long the trees would sequester CO_2, and how this would benefit future generations (arguably participants may have been uncertain about whether or not we would in fact use their endowments to invest in tree planting, if the collective target was reached. However, we think this is unlikely given that we provided each player with a contract, signed by the chief investigator, verifying that their endowments would be used for this purpose). An example of a legacy that might result in high levels of outcome uncertainty could be donating the player endowments to a non-governmental organisation fighting to keep fossil fuels in the ground. In this case, there are likely to be considerable ambiguities surrounding precisely how the endowment would be used, and what tangible outcomes would be generated as a result. Such uncertainty and ambiguity may make it easier for participants to justify making decisions that favour themselves over future generations. Extrapolating the results from studies of intergenerational discounting on personal choice, we would expect that increased outcome uncertainty would undermine the effectiveness of legacy motivation induction in our group-based setting, but it remains an open empirical question whether this is indeed the case.

At the outset, we predicted that the distribution of selfish, fair-share, and altruistic investments in the legacy induction condition would resemble that seen in the short-delay condition, with fair-share investments dominating over selfish and altruistic investments. Although this prediction was borne out in the data, it is arguably somewhat surprising that legacy motive induction did not increase the frequency of altruistic investments, compared to the intergenerational condition. In attempting to explain this result, we note that laboratory experiments using public goods games have shown that most players are conditional cooperators whose investments in the public good are a positive function of their beliefs about what other players will invest (Fischbacher and Gächter, 2010; Fischbacher et al., 2001). According to some models (e.g., Bolton and Ockenfels, 2000; Fehr and Schmidt, 1999), this conditional cooperation is the result of a fairness preference based on inequity aversion—players have a preference for equity in player payoffs that results in them experiencing "guilt" if they receive a payoff that is higher than other players (advantageous inequity) and "envy" if they receive a payoff that is lower than other players (disadvantageous inequity). If players are conditionally cooperative and motivated by inequity aversion, then one interpretation of the preference for fair-share investments in our legacy induction condition is that, by reducing individual discounting tendencies, legacy induction increases players' beliefs that other players will invest their fair-share of $20 toward reaching the $120 target, which means that they too will prefer to invest $20 in total to ensure equity in player payoffs. There are various different contribution trajectories by which players can invest their $20 (involving different combinations of $0, $2, and $4 investments over

rounds) but the most salient trajectory involves a $2 fair-share investment on each round. If all players commit to this strategy, then there is no need to use the altruistic investment strategy of $4 because the collective target can be reached without it, and the endowment to future generations does not increase with investments that exceed the $120 collective target. Of course, some players will invest less than their fair-share of $20, and provided that the shortfall in investments is not too large, other players may compensate for that shortfall with altruistic investments of $4. However, because of inequity aversion, players will be reluctant to do so if the shortfall in investments is large, as the disutility associated with disadvantageous inequity will overshadow the utility of supplying the endowment to the next generation. Based on this interpretation, there is little reason to expect in our game that legacy motive induction should increase altruistic investments. We note that inequity aversion and conditional cooperation can also explain why fair-share investments predominated in the short-delay condition.

Although it is tempting to view the intergenerationally beneficent behaviour that results when legacy motivations are enacted as a pure expression of other-regarding preferences, paradoxically, the legacy motive is a mechanism for leveraging short-term self-interest for the long-term best interests of the collective (Wade-Benzoni and Tost, 2009). People invest in legacies for largely—although not entirely—selfish reasons. Specifically, by providing a little piece of symbolic immortality, legacies offer an opportunity to give life meaning and purpose, and help buffer anxiety about the inevitability of death (Wade-Benzoni, 2019). Indeed, the desire to live on and be remembered positively by future generations for one's actions is perhaps one of the most powerful of all human drives (Wade-Benzoni, 2019). Just as people seek to protect their positive reputations when they are alive, so too do they seek to protect their positive reputations as embodied in the legacies they leave behind. In this way, a legacy can be thought of as a reputation-preserving mechanism that directs people to behave in ethically and socially responsible ways to protect their good public standing in society after they are gone.

There are some potential limitations of the current study that merit comment. First, we did not include manipulation checks in our legacy induction condition to verify that the legacy motive had been induced or enhanced after participants had read each persuasive message. This was a strategic decision, since we were concerned that such manipulation checks would introduce demand characteristics that would make the intended purpose of the messages more transparent to our participants and influence their behaviour. Second, time and cost related factors prevented us from including a control intervention condition in which participants were exposed to persuasive messages that were similar to those used in the legacy induction condition, except they did not make salient the legacy motive. However, the persuasive messages have high face validity in relation to the theoretical mechanisms they are assumed to tap—although see our next point—and previous work has shown that these mechanisms do indeed mitigate intergenerational discounting tendencies when activated (Wade-Benzoni, 2019; Wade-Benzoni and Tost, 2009). Third, although we took care to ensure that each text passage manipulated only the mechanism implied by its verbal label, on reflection some of the passages may have manipulated more than one of the three mechanisms, or yet other mechanisms that have been shown to induce the legacy motive. For example, although the power asymmetry passage highlights the power asymmetry among present and future generations—especially in the second and third paragraphs—the first paragraph draws attention to the actions of past generations and how they shaped the world we inherited, which is more in line with the mechanism of intergenerational reciprocity. Similarly, although the intergenerational reciprocity passage manipulates intergenerational reciprocity by instilling a desire to reciprocate forward the beneficent acts of a previous generation, it also promotes identification and affinity toward a specific past generation (World War II veterans who were associated with the Allies), which is a mechanism distinct from intergenerational reciprocity that has also been shown to promote intergenerational beneficence (Wade-Benzoni, 2008; Wade-Benzoni and Tost, 2009). Despite the limitation, the passage manipulations were still discrete from one another within the confines of having passages that plausibly reflect how a message might be crafted in the real world, where some conflation of mechanisms is difficult to avoid. Finally, the players in our experiment are from Western, educated, industrialised, rich, and democratic (WEIRD; Henrich et al., 2010a; Henrich et al., 2010b) societies. We know there are cross-cultural differences in discounting tendencies (Wang et al., 2016), so it is possible there may also be cross-cultural differences in the strength of the legacy motive. However, given that WEIRD societies are largely responsible for creating and resolving the climate change problem, legacy-enacting messages like those used here provide a viable mechanism for spurring action amongst the citizens of such societies.

Traditional research on temporal and social discounting would lead us to expect that in the face of intergenerational discounting, the prospects of resolving the two tragedies of climate change are slim. However, intergenerational dilemmas can induce psychological dynamics that yield strong incentives for cooperating with the future. In particular, such dilemmas are more ethically charged than traditional social dilemmas, given the powerlessness of future generations to influence the decisions of actors in the present regarding the benefits or burdens that will be bestowed on them in the future. This creates a moral obligation for current actors to behave in a socially responsible manner that does not exploit helpless future generations. Critically, what people obtain by cooperating with the future is a legacy—the opportunity to project their personal life meaning and identity into the future, and in so doing stave off the anxiety of death (Wade-Benzoni, 2019). We propose that persuasive communications to encourage public citizens, organisations, and governments to care for the climate should make salient the intergenerational nature of climate change, and explicitly frame climate cooperation around legacy motivation considerations. Legacy promoting instruments could also be created, such as climate charities that offer the opportunity to make donations to climate protection public so that a person's impact can be recorded and made visible to future generations.

We know persuasive messaging alone is not enough—ultimately, powerful mechanisms are required that can strategically restructure the incentives of this intergenerational dilemma, so that the short-term benefits of cooperation exceed those of defection. Such mechanisms include "climate clubs" (Nordhaus, 2015; Stewart et al., 2013)—small coalitions of collectives incentivised by public goods made contingent on climate protection—and strategic enforcement mechanisms at the international level, such as trade restrictions against countries that fail to meet their emission reduction targets (Barrett, 2003; 2007). However, countries cannot be forced to join cooperative coalitions, nor can they be forced to sign international environmental agreements that necessitate they surrender some of their sovereignty so they may be punished by other countries for failing to cooperate. Furthermore, the will of a country is determined by the will of its people, and unless citizens can be persuaded to act now on behalf of future generations, it is unlikely their governments will. Thus, whether it is cultivating the intergenerational altruism of public citizens, or motivating countries to form cooperative coalitions or sign international agreements that require them to surrender a piece of their sovereignty, our results show that persuasive legacy-promoting intergenerational messages may be the key to rallying the support necessary to mobilise such actions.

Declaration of Competing Interest

None.

Acknowledgments

This research was facilitated by a grant from the Climate Adaptation Flagship of the Commonwealth Scientific and Industrial Research Organisation awarded to MJH and IW.

Supplementary material

Supplementary material associated with this article can be found, in the online version, at 10.1016/j.gloenvcha.2019.102008.

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