Empirical Research Paper

The Probabilistic Price of Life Across Time: Generational and Probabilistic Distance Render a Life Today Worth More Than Ten Tomorrow

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Abstract

Is the certainty of saving a life today worth more than the less-certain possibility of saving 10 lives tomorrow? In six preregistered studies with U.S. samples from Prolific (N = 5,095), we employed an intergenerational probability discounting task, discovering people discount the value of life as uncertainty and intergenerational distance from the present increase. Specifically, as uncertainty about impacting the future rises, individuals increasingly prioritize saving fewer present lives over more future lives, particularly for more distant future beneficiaries (Studies 1–2b). Experimental evidence (Studies 3a–4) suggests that certainty perceptions drive intergenerational concern, rather than the inverse. Drawing upon seminal research from cognitive science and behavioral economics, these findings address gaps in emerging social psychological inquiry into long-term intergenerational concern, shed light on mechanisms underlying debates on the ethical philosophy of longtermism, and highlight practical implications for decision-makers, stressing the need to increase certainty perceptions surrounding about pro-future actions to enhance intergenerational beneficence.

Keywords

intergenerational discounting, ethical philosophy, longtermism, decision-making, intergroup processes, motivated bias

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Is knowing you can save a life today worth more than the possibility of saving 10 tomorrow? People regularly make decisions with implications for society's future. From electing officials to cooperating with public health guidelines during pandemics, behavior today can meaningfully shape the course of tomorrow (e.g., Algan et al., 2021). But prioritizing society's future often implies trading-off present-day needs (Fisher, 2023), and recent inquiry from social and cognitive science suggests that people's moral attitudes and prosocial tendencies typically favor the present (Law et al., 2024). This research primarily investigates interpersonal and intertemporal biases to understand and promote greater concern for future generations (Law et al., 2025; Syropoulos et al., 2024c). However, the future is also uncertain and hypothetical. What has not been explored is whether the tendency to favor near-term challenges over the long-term future may stem from a fundamental and rational aspect of decision-making: a preference for more- over less-certain outcomes (Doyle et al., 2023; Kahneman et al., 1991; Tversky & Kahneman, 1992; Tversky & Shafir, 1992).

From the standpoint of today, it is difficult to predict which actions will best serve society tomorrow (Karger et al., 2022). Longtermism, an increasingly influential ethical philosophy and social movement, advocates prioritizing the mitigation of existential threats to distal future generations—like unaligned artificial intelligence (AI)—over immediate societal challenges (MacAskill, 2022). Longtermism is beginning to have significant sway in international politics, with mentions of the movement appearing in official reports from the United Nations (2021). Nonetheless, philosophical and societal discourse is replete with criticism condemning the movement for sacrificing the prioritization of real lives in the present for the sake of speculative lives in an uncertain future (Emba, 2022).

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While threats like unaligned AI *might* prove devastating for society's future (Blaser, 2018; Moynihan, 2020), perceived uncertainty in forecasting distal future challenges and their solutions may help explain why longer-term threats are rarely prioritized over present ones (Hauser et al., 2014; Syropoulos et al., 2024c). Indeed, increasing uncertainty about the future decreases the ability to vividly imagine future events (Terpini & D'Argembeau, 2024), which can increase people's empathy for future others, as well as a willingness to help or harm them (Gaesser & Fowler, 2020; Morris et al., 2022; Vollberg et al., 2021; see Bo O'Connor & Fowler, 2023 for review). However, this viewpoint is notably absent from the growing body of literature examining the psychological mechanisms of long-term intergenerational concern, which until now has primarily emphasized the roles of interpersonal and intertemporal distance rather than uncertainty (Coleman & DeSteno, 2024; Law et al., 2024).

Barriers to Intergenerational Beneficence: Disparate Insights From Social-Cognitive Psychology, Behavioral Economics, and the Ethical Philosophy of Longtermism

Seminal research in behavioral economics has identified widespread tendencies to favor the present over the future in resource allocations (Chapman, 2001; Cropper et al., 1992; Johannesson & Johansson, 1996), and research in psychology is beginning to explore the cognitive, affective, and moral antecedents and practical consequences of long-term intergenerational beneficence (Coleman & DeSteno, 2024; Hauser et al., 2014; Syropoulos et al., 2024c). A key finding is a consistent downward trend in the responsibility, moral concern, and prosocial inclination people extend toward future others the farther they are from the present. Notably, this emerging literature has focused primarily on explanatory mechanisms related to intertemporal and interpersonal distance (Law et al., 2024; Syropoulos et al., 2024a).

Indeed, future generations are distant in both time and social connectedness—generations hundreds or thousands of years in the future are occupied by strangers we will never meet. But they are also occupied by *hypothetical* strangers, casting a veil of uncertainty over how we might best ensure future welfare in the present. Put differently, distal futures are hard to predict (Addis, 2020; D'Argembeau & Garcia Jimenez, 2020; Orwig et al., 2023), and existential challenges the future may face are often speculative and uncertain (Bostrom, 2002; Karger et al., 2022). A rich literature in cognitive science on risk aversion has documented widespread reluctance to making decisions under uncertainty (Kahneman et al., 1991; Tversky & Kahneman, 1992; Tversky & Shafir, 1992). For instance, people tend to discount the subjective value of personal rewards as they become less probable (i.e., probability discounting; e.g., Green et al., 2014; Jones & Rachlin, 2009).

Thus, it is plausible that people may prefer present and near-term beneficence over long-term intergenerational beneficence because they perceive the long-term future as more uncertain. Seminal research on intergenerational discounting from behavioral economics hints at this possibility (Chapman, 2001; Cropper et al., 1992; Frederick, 2003; Johannesson & Johansson, 1996; Tuen et al., 2023; Wade-Benzoni & Tost, 2009). For instance, reluctance in limiting personal resource consumption for the sake of the forthcoming generation becomes especially pronounced amid perceptions of greater uncertainty about the impact of present sacrifice on future beneficiaries (Wade-Benzoni, 2008). Similarly, perceptions of uncertainty surrounding threat from climate change diminishes farsighted pro-environmental engagement (Doyle et al., 2023; Matanggaran, 2017), and future-oriented uncertainty has been proposed, although not tested directly, as a limiting factor in the context of near-term, life-saving intergenerational beneficence (Frederick, 2003). While extant research has not investigated high-stakes intergenerational decision-making tradeoffs in the long term, such as prioritizing life-saving altruism toward distant future over present beneficiaries, it provides suggestive evidence that uncertainty merits consideration as a key mechanism in this context, alongside intertemporal and interpersonal distance.

Yet, existing knowledge yields varied predictions for uncertainty's role in long-term decision-making. For one, prioritizing society's present may represent an adaptive response to an uncertain future. Indeed, prioritizing present gains over riskier future prospects often leads to favorable outcomes, especially when resources are limited (see Mullainathan & Shafir, 2013 for review). Alternatively, uncertainty may be used as a rationalization for decisions that actually arise from prexisting bias toward valuing the present over the future. This alternative is supported by tendencies for people to unconsciously process information in a way that conforms to their preferences (e.g., Kahan, 2013).

Nonetheless, longtermism has risen to the forefront of philosophical and societal discourse on intergenerational ethics (Fisher, 2023). Supporters argue that, despite some acknowledged uncertainty, future populations are projected to be significantly larger due to historical and current growth rates. Consequently, longtermists prioritize mitigating threats to distant future generations, regardless of their distance from the present, over immediate societal challenges. They contend the potential for utilitarian impact on a vastly larger population in the future outweighs the potential for impact in the present (Greaves & MacAskill, 2019). Conversely, outspoken critics of longtermism find its principles objectionable, with much criticism centering on uncertainty (Emba, 2022). An important yet overlooked series of questions remain as to which side of this ongoing debate the cognitive processes governing decision-making in average adults tend to favor, whether uncertainty perceptions diminish levels of support for pro-future measures and whether boosting perceptions of certainty can cultivate greater intergenerational concern.

Do people commonly prioritize larger intergenerational gains in welfare over more-certain but smaller gains for the present, or does uncertainty diminish the subjective value of future relative to current life? Furthermore, does the effect of uncertainty compound alongside intergenerational distance, leading to *greater* reluctance to favor uncertain gains for the future relative to uncertain gains for the present? Finally, does greater valuation of present welfare reflect a biased antecedent or adaptive consequence of perceived uncertainty? Psychological insight into how intergenerational distance interacts with uncertainty is needed to address gaps in the literature on long-term intergenerational concern, gain deeper insight into the psychological underpinnings that drive prevailing debates on intergenerational ethics and, ultimately, help guide a brighter present and future by better understanding the barriers to intergenerational benefience.

The Present Studies

We introduce the intergenerational probability discounting task to examine how certainty and intergenerational distance affect longtermism-aligned decision-making. Our findings reveal that as certainty increases, individuals prioritize aiding both present and future beneficiaries. However, people tolerate uncertainty to a greate extent when saving present compared to future lives, suggesting uncertainty diminishes the subjective value of human life over time. Nevertheless, experimental evidence indicates that certainty perceptions precede rather than result from intergenerational attitudes, influencing beliefs, obligations, and support for policies benefiting the far future, and that intergenerational beneficence may be cultivated by boosting the actual or perceived certainty of pro-future measures. Table 1 presents key information for each of the six studies.

Study 1

Methods

Participants. All aspects of the study (hypotheses, design, sample size, and analytical decisions) were pre-registered, https://aspredicted.org/MKH_911. In line with our pre-registered power analysis, we recruited a sample of 250 participants via Prolific. Four participants were removed from the dataset according to our pre-registered exclusion criteria for duplicate IP addresses.

Materials and Procedure. We developed and administered the "Intergenerational Probability Discounting Task," which comprised four series of 11 dichotomous forced-choice trials (44 trials total), prompting participants to decide between saving a single individual from the current generation with absolute certainty (Option A) and saving the lives of 10 individuals from a future generation with varying degrees of certainty (Option B). Option A remained consistent across trials, and Option B varied at the trial level in terms of certainty (ranging from 0% to 100% in intervals of 10%) and timeframe (100, 1,000, 10,000, and 100,000 years in the future).

This task yields two primary outcomes of interest for the present investigation. The first corresponds to participants' binary choices at each level of certainty (from 0% to 100%) for each of the four timeframes (from 100 to 100,000 years in the future). Utilizing the 44 binary choices allows for an assessment of how choice preference for choosing to help either the proximal or distal beneficiary is impacted by increasing certainty that one's decision will meaningfully impact the intended target and to assess whether this pattern is consistent at each timeframe.

The second outcome of interest was the calculation of "indifference points" for each participant at each timeframe. This calculation involved two computational steps: (a) determining the "transition point" and (b) transforming the transition point into an indifference point:

Step 1: Calculating the Transition Point. We first identified the transition point in each participant's choices—the specific certainty level at which they switched from consistently preferring Option A (saving a single present-day life with 100% certainty) to consistently preferring Option B (saving 10 future lives with varying degrees of certainty). This transition point represents the minimum level of certainty a participant requires to choose the larger future benefit over the immediate one. For example, suppose a participant consistently chose Option A when Option B was associated with certainty levels from 0% up to 70%. However, when the certainty level of Option B increased from 70% to 80%, the participant switched to preferring Option B. This indicates that their point of subjective equivalence between the two options lies somewhere between 70% and 80% certainty. To estimate this point more precisely, we would have assigned the participant a transition point at the midpoint of these two certainty levels, which is 75% (Gershon & Fridman, 2022). This means the participant requires at least 75% certainty that their action will save the 10 future lives to consider it equivalent to saving a single present-day life with absolute certainty.

Step 2: Transforming Transition Points into Indifference Points. To align our data with standard discounting paradigms (e.g., Hill et al., 2017; Tuen et al., 2023)—where higher indifference points indicate greater subjective value ascribed to the more distant alternative (Option B)—we transformed the transition points. Specifically, we subtracted each participant's transition point from 100%, effectively converting units from minimum certainty levels into maximum uncertainty tolerance levels. In the previous example, a participant with a transition point of 75% certainty would receive an indifference point of 25% uncertainty tolerance (i.e., 100% − 75% = 25%). By applying this transformation, lower indifference points correspond to requiring greater

Table 1. Information for All Studies.

Study	Pre-registered	Platform	Length	N	N_{Man}	N_{Woman}	N_{White}	N_{Black}	N_{Asian}	M_{age}	SD_{age}
1	Yes	Prolific	4 min.	246	123	119	169	28	34	36.1	13.1
2a	Yes	Prolific	6 min.	489	236	239	369	54	63	39.9	13.0
2b	Yes	Prolific	6 min.	499	249	239	368	72	37	43.3	13.5
3a	Yes	Prolific	9 min.	960	476	462	679	151	92	42.8	13.9
3b	Yes	Prolific	10 min.	1,803	884	886	1,314	283	167	43.8	14.0
4	Yes	Prolific	12 min.	1,098	490	583	827	167	74	43.4	13.5

Table 2. Multilevel Logistic Regression Models.

Temporal distance of distal beneficiary	Intercept (estimate)	Certainty (estimate)	Variance (intercept)	Variance (certainty)	Observations
100	−7.704*	7.64*	61.09	26.52	2,706
1,000	−5.290*	2.84*	15.73	–	2,706
10,000	−95.928*	51.38*	25,994	2,300	2,706
100,000	−95.382*	50.57*	29,380	3,004	2,706

*$p < .001$.

certainty, or showing less tolerance for uncertainty, when deciding to help multiple beneficiaries in the future instead of a single beneficiary in the present. This approach allowed us to assess our pre-registered hypothesis that participants would exhibit a downward-sloping discounting function across increasing temporal distances, consistent with conventions from existing discounting paradigms (Hill et al., 2017).

Pre-Registered Hypotheses. We first explored how uncertainty influences people's choices when faced with the hypothetical dilemma of saving one life today versus ten in the distant future. We predicted people would be more likely to choose distal future over present beneficiaries with increasing certainty (H1) and require progressively greater levels of certainty to choose the distal future options as they are depicted progressively farther from the present (H2).

All materials, data, and analysis scripts for all studies in this manuscript are publicly available online, https://osf.io/scngu/?view_only=ba94f4cc9dd1447b9e9085fea8ccccd5.

Results

To investigate the impact of certainty on the likelihood of choosing to save the lives of 10 distal beneficiaries in future generations (instead of choosing to save the life of a single beneficiary in the present generation), a series of multilevel logistic regression models were fitted to the data using the "lme4" package in R Studio. The "certainty" variable, representing the level of certainty participants were told their choice would carry to save 10 future lives, was standardized prior to fitting the models to facilitate convergence. Four models were initially constructed, one for each timeframe (100, 1,000, 10,000, and 100,000 years from the present). Each model included standardized certainty as a fixed effect and participant-specific random intercepts and slopes to account for individual variability in baseline likelihood and sensitivity to certainty, respectively. Each model was fitted using the maximum likelihood estimation method with the Laplace Approximation. The "bobyqa" optimizer was employed to enhance convergence, with a maximum function evaluation set to 200,000. Upon initial analysis, the model pertaining to "1,000 years from the present" timeframe failed to converge and was simplified by allowing only for random variation in intercepts across participants.

All models showed a significant effect of certainty on decision-making, indicating that as certainty about being able to positively impact the future increases, the likelihood of choosing to help future recipients also increases (see Table 2 and Figure S1 in Supplemental Online Materials [SOM]). The effect of certainty was notably strong in all models, with the magnitude of the effect increasing slightly with the temporal distance of the recipient. These findings provide initial evidence that, when people view efforts to secure the future as uncertain, that view of uncertainty affects their support for long-term intergenerational goals and willingness to take action to prevent future harm.

For participants who displayed clear points of indifference on the Intergenerational Probability Discounting Task at each time frame,[1] we estimated a repeated-measures analysis of variance (ANOVA) specifying as the independent variable the temporal distance from the present of the distal beneficiary and the average indifference point as the dependent variable. The results (see Table 3) consistently demonstrate a clear pattern: participants require progressively greater certainty (i.e., showing less tolerance for uncertainty) to switch their choice preference from helping a singular individual in the present generation to helping 10 individuals

Table 3. Repeated-Measures ANOVA With Post Hoc Planned Comparisons With Bonferroni Corrections.

Temporal distance of distal beneficiary (years in future)	Average indifference point on intergenerational probability discounting task
Omnibus	$F(1.38, 86.85) = 11.90$, $p < .001$, $\eta^2p = .150$
100 vs. 1,000	$t(63) = 2.66$, $p_{Bonferroni} = .059$, Cohen's $d = .161$
100 vs. 10,000	$t(63) = 3.58$, $p_{Bonferroni} = .004$, Cohen's $d = .322$
100 vs. 100,000	$t(63) = 3.55$, $p_{Bonferroni} = .004$, Cohen's $d = .350$
1,000 vs. 10,000	$t(63) = 3.22$, $p_{Bonferroni} = .012$, Cohen's $d = .168$
1,000 vs. 100,000	$t(63) = 3.15$, $p_{Bonferroni} = .015$, Cohen's $d = .198$
10,000 vs. 100,000	$t(63) = 1.18$, $p_{Bonferroni} > .999$, Cohen's $d = .033$

Note. Degrees of freedom are non-whole numbers, reflecting the employment of the Greenhouse-Geisser correction to correct for violation of the sphericity assumption.

in a future generation as the future generation in question is depicted increasingly more distal from the present (see Figure 1). This finding suggests the effects of uncertainty on willingness to engage in intergenerational beneficence may be considered alongside intergenerational distance considerations regarding how far in time from the present the future under consideration is.

Study 2a

Methods

Participants. All aspects of the study (hypotheses, design, sample size, and analytical decisions) were pre-registered, https://aspredicted.org/JDS_95K. In line with our pre-registered power analysis, we recruited a sample of 500 participants via Prolific. An extra participant completed 100% of the survey but did not submit the survey to receive compensation and was retained in analyses. Twelve participants were removed from the dataset according to our pre-registered exclusion criteria for duplicate IP addresses.

Materials and Procedure. While we allowed the certainty associated with helping future beneficiaries to vary across trials in Study 1, the certainty associated with present-day alternative beneficiaries was held constant at 100%. Moreover, in Study 1, the more distant response option always involved aiding a larger number of beneficiaries, precluding a direct comparison of the extent to which people value the certainty of saving a present-day life in units of certainty associated with saving a future life. Study 2a aimed to address these gaps by employing two modified versions of the discounting task from Study 1, each comprising four series (i.e., one series per timeframe at which the distal beneficiary is depicted with the same levels as Study 1) of 11 dichotomous forced-choice trials: (a) the "Varying Future Certainty Task (VFCT)" and (b) the "Varying Present Certainty Task (VPCT)." For the VFCT, each trial presented a choice between saving a single individual from the current generation with 50% certainty (Option A) and saving the life of a single individual from a future generation with varying degrees of certainty (ranging from 0% to 100% in intervals of 10%, Option B). The VPCT was the same, except Option A represented saving a single individual from a future generation at 50% certainty, and Option B represented saving a single individual from the present generation at varying degrees of certainty. Each task comprised 44 trials in total.

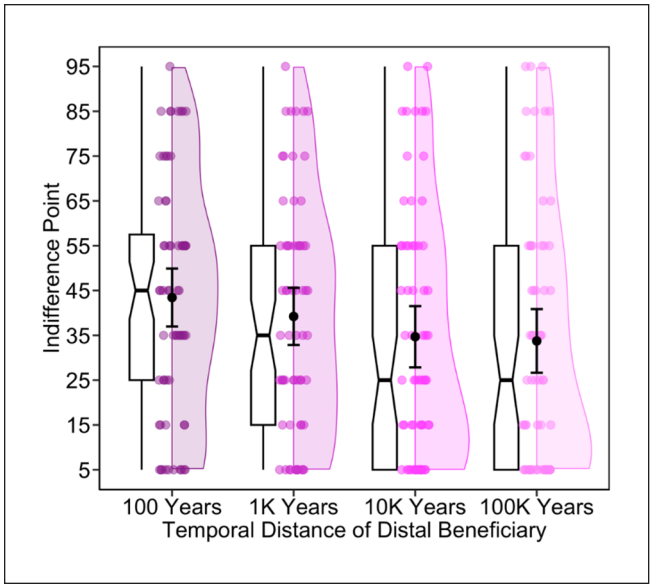

Figure 1. Average Indifference Point on Intergenerational Probability Discounting Task as Distal Beneficiary Becomes More Distal From the Present Day.

Note. Plots depicting the average amount of uncertainty at which participants switch from choosing to help a singular recipient in the present generation to 10 recipients in a future generation, depicted to exist 100, 1,000, 10,000, or 100,000 years from the present. The plot reveals a trend wherein participants require increasingly greater certainty (lesser uncertainty) to switch from choosing the proximal recipient to choosing the distal recipient as the distal recipient is depicted as being progressively farther in time from the present. Colored dots correspond to individual data points and are jittered for readability, with split violin plots overlaid to show the relative distribution of scores across conditions. Error bars depict ±1.96*SEM. Notched boxplots are included, with notches depicting a confidence interval around the median with a value of ±1.58*IQR/sqrt(n).

In addition to the two primary outcomes from Study 1, we also calculated for each task the trapezoidal area under the discounting curve of indifference points across levels of

Table 4. Results for Multilevel Logistic Regression Models.

Temporal distance of distal beneficiary	Intercept (estimate)	Certainty (estimate)	Variance (intercept)	Variance (certainty)	Observations
VFCT					
100	−5.77*	7.12*	31.23	50.31	5,379
1,000	−88.84*	47.10*	25,480	2,856	5,379
10,000	−10.03*	3.07*	68.56	–	5,379
100,000	−89.95*	47.34*	25,938	2,991	5,378[a]
VPCT					
100	1.83*	3.34*	6.734	–	5,379
1,000	40.26*	48.98*	5,251	1,284	5,379
10,000	3.14*	3.10*	8.945	–	5,379
100,000	110.29*	77.48*	32,900	3,926	5,379

[a]One subject failed to provide a response to one of the trials on the VFCT at the distance level of 100,000 years.
*$p < .001$.

timeframe (AUC), where higher scores represent greater tolerance for Option B uncertainty. Evaluating differences in AUC between the two tasks allows for an assessment of whether participants require greater certainty (i.e., show less tolerance for uncertainty) on average to choose Option B when this option represents an individual in a future versus the current generation. After participants completed both tasks in a randomized order, they completed a standard demographics questionnaire and were debriefed.

Pre-Registered Hypotheses. We predicted that people would be more likely to aid future beneficiaries on the VFCT (H1a) and present beneficiaries on the VPCT (H1b) as a function of increasing certainty. We also predicted that, as future beneficiaries on both tasks are depicted as being farther from the present, participants would require greater certainty to aid future beneficiaries on the VFCT (H2) and lesser certainty to aid present beneficiaries on the VPCT (H3). Finally, we predicted that the area under the discounting curve for the VPCT would be greater than that for the VFCT (H4), indicating that people tend to discount the value of future life to a greater extent than present life as a function of decreasing certainty.

Results

We ran four multilevel logistic regression models (one per timeframe) with the same specifications as Study 1 for both the VFCT and VPCT tasks. Upon initial analysis, for the VFCT, the model pertaining to the "10,000 years from the present" timeframe, and for the VPCT, the models pertaining to the "100 years from the present" and "10,000 years from the present" failed to converge. These models were simplified, allowing only for random variation in intercepts across participants.

As predicted, all models showed significant and strong effects of certainty on decision-making, indicating that, as certainty about being able to positively impact the future (VFCT) or present (VPCT) increases, the likelihood of choosing to save the life of an individual in the future or present, respectively, increases (see Table 4 and Figure S2 in SOM).

For participants who displayed clear points of indifference on the VFCT and VPCT versions of the Intergenerational Probability Discounting Task at each time frame, we estimated a repeated-measures ANOVA for each version of the task specifying as the independent variable the temporal distance from the present of the distal beneficiary and the average indifference point as the dependent variable. As predicted, the results (see Table 5) consistently demonstrate clear and opposing patterns for each of the two tasks. For the VFCT, participants require progressively greater certainty (i.e., show less tolerance for uncertainty) in order to switch their choice preference from saving one life in the present generation (with 50% certainty) to saving one life in a future generation (with varying degrees of certainty) as the future generation in question is depicted more distal from the present (see Figure 2). For the VPCT, participants require progressively lesser certainty (i.e., they are more tolerant of uncertainty) when switching their choice preference from saving a single life in a future generation (with 50% certainty) to saving a single life in the present generation (with varying degrees of certainty) as the future generation in question is depicted increasingly more distal from the present (see Figure 2).

Put differently, when considering the decision to save a life now versus in the future, people equate the subjective value of saving a life in the present with 50% certainty to saving lives in the future with slightly increasing certainty as the time horizon extends. Specifically, saving a life with 50% certainty now is equated to saving a life in 100 years with 58.4% certainty, in 1,000 years with 60.1% certainty, in 10,000 years with 62.1% certainty, and in 100,000 years with 65.5% certainty. Conversely, when the perspective is reversed, saving a life in 100 years with 50% certainty is viewed as equivalent to saving a life now with 36.5% certainty, and this perceived equivalence decreases as the future

Table 5 Repeated-Measures ANOVA With Post Hoc Planned Comparisons With Bonferroni Corrections

Temporal distance of distal beneficiary (years in future)	Average indifference point on intergenerational probability discounting task
VFCT	
Omnibus	$F(1.87, 286.63) = 14.96$, $p < .001$***, $\eta^2p = .089$
100 vs. 1,000	$t(153) = 1.78$, $p_{Bonferroni} = .461$, Cohen's $d = .086$
100 vs. 10,000	$t(153) = 2.77$, $p_{Bonferroni} = .038$*, Cohen's $d = .174$
100 vs. 100,000	$t(153) = 4.70$, $p_{Bonferroni} < .001$***, Cohen's $d = .333$
1,000 vs. 10,000	$t(153) = 2.66$, $p_{Bonferroni} = .052$, Cohen's $d = .088$
1,000 vs. 100,000	$t(153) = 4.85$, $p_{Bonferroni} < .001$***, Cohen's $d = .236$
10,000 vs. 100,000	$t(153) = 4.02$, $p_{Bonferroni} < .001$***, Cohen's $d = .141$
VPCT	
Omnibus	$F(1.78, 634.16) = 161.71$, $p < .001$***, $\eta^2p = .312$
100 vs. 1,000	$t(357) = -10.81$, $p_{Bonferroni} < .001$***, Cohen's $d = -.415$
100 vs. 10,000	$t(357) = -14.24$, $p_{Bonferroni} < .001$***, Cohen's $d = -.636$
100 vs. 100,000	$t(357) = -14.91$, $p_{Bonferroni} < .001$***, Cohen's $d = -.746$
1,000 vs. 10,000	$t(357) = -8.38$, $p_{Bonferroni} < .001$***, Cohen's $d = -.222$
1,000 vs. 100,000	$t(357) = -10.24$, $p_{Bonferroni} < .001$***, Cohen's $d = -.335$
10,000 vs. 100,000	$t(357) = -6.05$, $p_{Bonferroni} < .001$***, Cohen's $d = -.114$

Note. Degrees of freedom are non-whole numbers, reflecting the employment of the Greenhouse-Geisser correction to correct for violation of the sphericity assumption.
***$p < .001$, **$p < .01$, *$p < .05$.

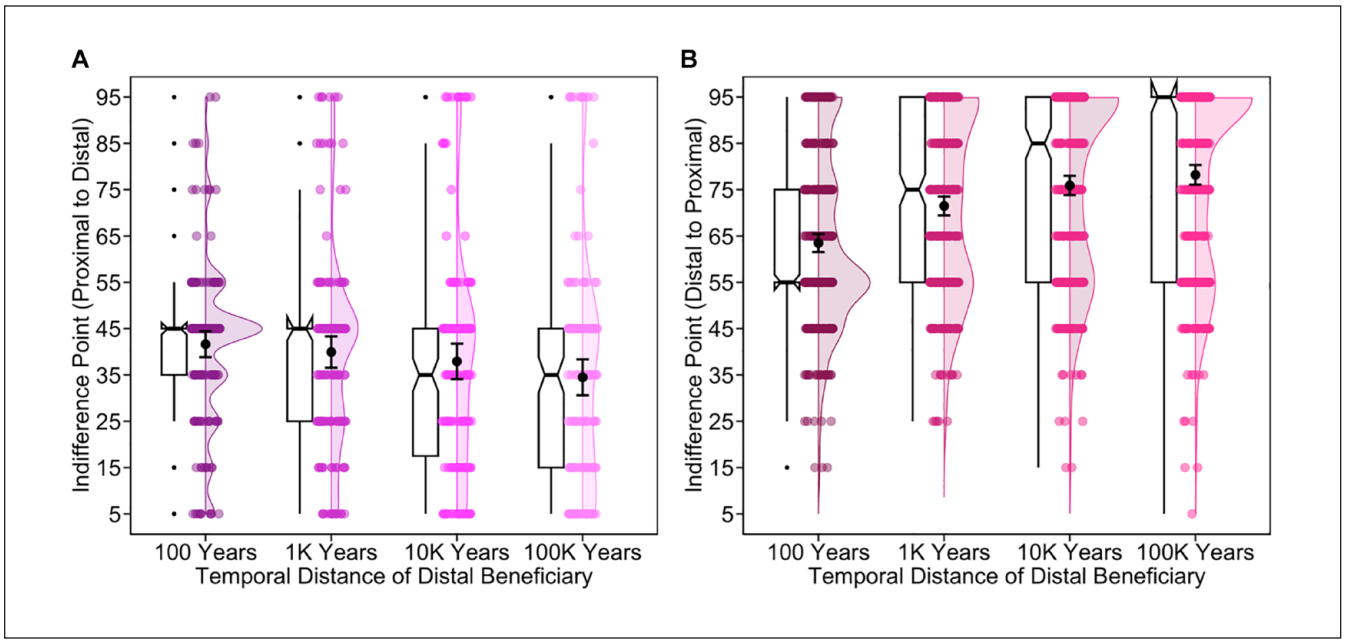

Figure 2. Average Indifference Point on Both Versions of the Intergenerational Probability Discounting Task as Distal Beneficiary Becomes More Distal From the Present Day: (A) VFCT and (B) VPCT.
Note. Plots depicting the average amount of uncertainty at which participants switch from (A) choosing to help a singular recipient in the present generation (with 50% certainty) to a singular recipient in a future generation (with varying degrees of certainty) on the VFCT version of the task and (B) choosing to help a singular recipient in a future generation (with 50% certainty) to a singular recipient in the present generation (with varying degrees of certainty) on the VPCT version of the task. On both versions of the task, the distal beneficiary is depicted to exist 100, 1,000, 10,000, or 100,000 years from the present. The plot reveals a trend wherein participants require increasingly greater certainty (lesser uncertainty) to switch from choosing the proximal recipient to choosing the distal recipient on the VFCT and progressively lesser certainty (i.e., they are more tolerant of uncertainty) when they switch from choosing the distal recipient to choosing the proximal recipient on the VPCT as the distal recipient is depicted as being progressively farther in time from the present. Colored dots correspond to individual data points and are jittered for readability, with split violin plots overlaid to show the relative distribution of scores across conditions. Error bars depict ±1.96*SEM. Notched boxplots are included, with notches depicting a confidence interval around the median with a value of ±1.58*IQR/sqrt(n).

time span increases, with 50% certainty at 1,000 years equating to 28.5% certainty now, 10,000 years to 24.1%, and 100,000 years to 21.8%.

Finally, as hypothesized, the average AUC was significantly greater for the VPCT (M = 6,700,000, SD = 2,020,000) compared to the VFCT (M = 3,620,000, SD = 2,330,000), $t(144) = 11.69$, $p < .001$, *Cohen's d* = .97.

Studies 1 and 2a show consistently that people's willingness to benefit future generations diminishes as the associated uncertainty increases. This tendency aligns with prevalent criticisms of longtermism philosophy (Crary, 2023; Emba, 2022; Fisher, 2023), emphasizing that perceived uncertainty about the future may pose a roadblock for efforts to promote intergenerational beneficence. However, the results from Study 2a also suggest a double standard, as participants show greater tolerance for uncertainty when it is associated with saving the life of a present versus future beneficiary, suggesting that the effects of uncertainty and intergenerational distance are compounding.

One possible explanation for the double standard noted above is that something other than uncertainty is at play, such as the comparatively lower levels of concern people feel for the welfare of future generations relative to present-day lives. For instance, according to expected utility theory, the expected utility of an outcome is the product of its probability and subjective value (Fishburn, 1981). Therefore, according to this perspective, when the subjective value of a beneficiary is low—as is the case for future beneficiaries whom people tend to value less than present-day individuals (Law et al., 2024)—the expected utility of an intervention that serves to aid that beneficiary is likely to be low as well, even with moderate probabilities of success. As a consequence, to achieve an expected utility sufficient to motivate intergenerational action, individuals may require higher probabilities—that is, greater certainty—than they would to motivate intragenerational action to benefit targets in the present day.

Study 2b

Methods

Participants. All aspects of the study (hypotheses, design, sample size, and analytical decisions) were pre-registered, https://aspredicted.org/3QB_R1R. In line with our pre-registered power analysis, we recruited a sample of 500 participants via Prolific. Three participants completed 100% of the survey but did not submit the survey to receive compensation and were retained in analyses. Four participants were removed from the dataset according to our pre-registered exclusion criteria for duplicate IP addresses.

Design, Materials, and Procedure. Building on the discovery that uncertainty has a stronger influence on decision-making in the context of intergenerational relative to intragenerational beneficence, we aimed to explore whether this bias persists even when the potential impact on lives saved in the future outweighs that in the present. Thus, we retained the "Varying Future Certainty Task (VFCT)" and "Varying Present Certainty Task (VPCT)" versions of the "Intergenerational Probability Discounting Task" from Study 2a for use in Study 2b. The only modification was consistently presenting scenarios where participants were asked to choose between helping 10 beneficiaries in the distant future and a single beneficiary in the present. This change enables a clearer evaluation of decision-making within the framework of longtermist philosophy, which prioritizes allocating resources to benefit the larger projected populations of the distant future rather than present-day needs to maximize utilitarian gains (MacAskill, 2022).

Moreover, attitudes toward intergenerational beneficence were measured using the 28-item Longtermism Beliefs Scale (LBS; Syropoulos et al., 2023), which captures concern for protecting the welfare of future humans across four timeframes (i.e., 1,000, 10,000, 100,000, and 1,000,000 years from the present). Scores were captured on slider scales ranging from 0 = strongly disagree to 100 = strongly agree and averaged together across the 28 items to yield a composite measure. We included this measure to evaluate whether greater valuation of welfare in future generations might be associated with reduced tendencies to weigh certainty considerations more heavily in the intergenerational versus intragenerational context. Participants completed the discounting task and the LBS in a randomized order prior to completing a standard demographics questionnaire and being debriefed.

Pre-Registered Hypotheses. In addition to pre-registering the same predictions as Study 2a (H1–H4), we also predicted that longtermism beliefs would be positively associated with indifference points (H5) and AUC (H6) on the VFCT, negatively associated with indifference points (H7) and AUC (H8) on the VPCT, and positively associated with the proportion of total choices made to benefit people in future generations across both versions of the discounting task (H9).

Results

Two series (one per each version of the task) of four multilevel logistic regression models (one per timeframe) were fitted to the data with the same specifications as in previous studies. Upon initial analysis, for the VFCT, the model pertaining to the "1,000 years from the present" timeframe failed to converge. This model was simplified, allowing only for random variation in intercepts across participants.

As predicted and mirroring the results from Study 2a, all models showed a significant and strong effect of certainty on decision-making, indicating that as certainty about being able to positively impact the future (VFCT) or present (VPCT) increases, the likelihood of choosing to save lives in the future or present, respectively, increases (see Table 6 and Figure S3 in SOM).

Table 6. Results for Multilevel Logistic Regression Models.

Temporal distance of distal beneficiary	Intercept (estimate)	Certainty (estimate)	Variance (intercept)	Variance (certainty)	Observations
VFCT					
100	−3.37*	6.31*	35.22	31.86	5,489
1,000	−3.15*	2.66*	13.65	–	5,489
10,000	−85.11*	44.75*	22,281	2,374	5,489
100,000	−85.29*	44.82*	21,309	2,317	5,489
VPCT					
100	1.53*	8.31*	46.85	32.11	5,489
1,000	4.12*	8.84*	78.17	35.27	5,489
10,000	7.31*	9.42*	133.20	42.43	5,489
100,000	8.69*	9.32*	141.28	36.53	5,488[a]

[a]One subject failed to provide a response to one of the trials on the VPCT at the distance level of 100,000 years.
*$p < .001$.

Table 7. Repeated-Measures ANOVA With Post Hoc Planned Comparisons With Bonferroni Corrections.

Temporal distance of distal beneficiary (years in future)	Average indifference point on intergenerational probability discounting task
VFCT	
Omnibus	$F(1.78, 360.27) = 42.66$, $p < .001$***, $\eta^2p = .174$
100 vs. 1,000	$t(202) = 4.95$, $p_{Bonferroni} < .001$***, Cohen's $d = .250$
100 vs. 10,000	$t(202) = 6.79$, $p_{Bonferroni} < .001$***, Cohen's $d = .422$
100 vs. 100,000	$t(202) = 7.76$, $p_{Bonferroni} < .001$***, Cohen's $d = .518$
1,000 vs. 10,000	$t(202) = 4.95$, $p_{Bonferroni} < .001$***, Cohen's $d = .187$
1,000 vs. 100,000	$t(202) = 6.52$, $p_{Bonferroni} < .001$***,, Cohen's $d = .286$
10,000 vs. 100,000	$t(202) = 3.54$, $p_{Bonferroni} = .003$**, Cohen's $d = .097$
VPCT	
Omnibus	$F(1.63, 515.15) = 89.13$, $p < .001$***, $\eta^2p = .220$
100 vs. 1,000	$t(316) = -6.95$, $p_{Bonferroni} < .001$***, Cohen's $d = -.239$
100 vs. 10,000	$t(316) = -9.91$, $p_{Bonferroni} < .001$***, Cohen's $d = -.437$
100 vs. 100,000	$t(316) = -10.71$, $p_{Bonferroni} < .001$***, Cohen's $d = -.535$
1,000 vs. 10,000	$t(316) = -8.69$, $p_{Bonferroni} < .001$***, Cohen's $d = -.198$
1,000 vs. 100,000	$t(316) = -9.33$, $p_{Bonferroni} < .001$***, Cohen's $d = -.298$
10,000 vs. 100,000	$t(316) = -5.13$, $p_{Bonferroni} < .001$***, Cohen's $d = -.101$

Note. Degrees of freedom are non-whole numbers, reflecting the employment of the Greenhouse-Geisser correction to correct for violation of the sphericity assumption.
***$p < .001$, **$p < .01$.

Consistent with Study 2a, we also estimated a repeated-measures ANOVA for each version of the task specifying as the independent variable the temporal distance from the present of the distal beneficiary and the average indifference point as the dependent variable. As predicted, despite participants being presented with scenarios where a comparatively greater number of lives could be saved when choosing distal over present beneficiaries, the results were consistent with those from Study 2a (see Table 7 and Figure 3). Put differently, when considering the decision to save a single life now versus 10 lives in the future, people equate the subjective value of saving a single life in the present with 50% certainty to saving 10 lives in the future with slightly increasing certainty as the time horizon extends. Specifically, saving a single life now with 50% certainty is equated to saving 10 lives in 100 years with 51.8% certainty, in 1,000 years with 56.6% certainty, in 10,000 years with 60.5% certainty, and in 100,000 years with 62.7% certainty. Conversely, when the perspective is reversed, saving 10 lives in 100 years with 50% certainty is viewed as equivalent to saving a single life now with 42.7% certainty, and this perceived equivalence decreases as the future time span increases, with 50% certainty at 1,000 years equating to 37.1% certainty now, 10,000 years to 32.2%, and 100,000 years to 29.6%.

Moreover, as hypothesized, the average AUC was significantly greater for the VPCT (M = 5,470,000, SD = 2,120,000) than for the VFCT (M = 3,630,000, SD = 2,120,000), $t(165) = 6.84$, $p < .001$, *Cohen's d* = .53. In

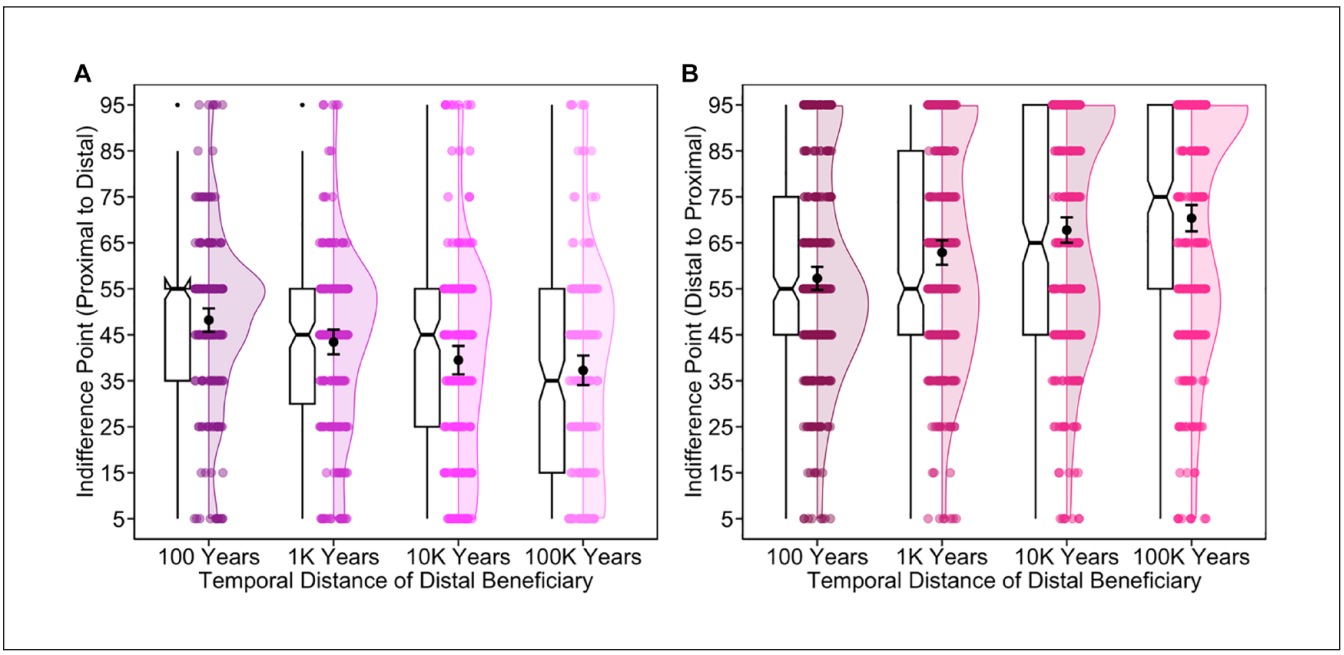

Figure 3. Average Indifference Point on Both Versions of the Intergenerational Probability Discounting Task as Distal Beneficiary Becomes More Distal From the Present Day: (A) VFCT and (B) VPCT.

Note. Plots depicting the average amount of uncertainty at which participants switch from (A) choosing to help a singular recipient in the present generation (with 50% certainty) to 10 recipients in a future generation (with varying degrees of certainty) on the VFCT version of the task and (B) choosing to help 10 recipients in a future generation (with 50% certainty) to a singular recipient in the present generation (with varying degrees of certainty) on the VPCT version of the task. On both versions of the task, the distal beneficiary is depicted to exist 100, 1,000, 10,000, or 100,000 years from the present. The plot reveals a trend wherein participants require increasingly greater certainty (lesser uncertainty) to switch from choosing the proximal recipient to choosing the distal recipient on the VFCT, and progressively lesser certainty (i.e., they are more tolerant of uncertainty) when they switch from choosing the distal recipient to choosing the proximal recipient on the VPCT as the distal recipient is depicted as being progressively farther in time from the present. Colored dots correspond to individual data points and are jittered for readability, with split violin plots overlaid to show the relative distribution of scores across conditions. Error bars depict ±1.96*SEM. Notched boxplots are included, with notches depicting a confidence interval around the median with a value of ±1.58*IQR/sqrt(n).

other words, participants had greater tolerance for uncertainty when it was associated with saving the life of a single present beneficiary versus the lives of 10 future beneficiaries. These findings further suggest a misalignment between commonplace decision-making tendencies in the intergenerational context and the utilitarian ideals espoused in longtermist ethical philosophy (Greaves & MacAskill, 2019).

Finally, as predicted, individual differences in longtermism beliefs (Cronbach's $\alpha = .985$) were positively associated indifference points and AUC on the VFCT, negatively associated with indifference points and AUC on the VPCT, and positively associated with the proportion of total choices that were made to benefit people in future generations across both versions of the intergenerational probability discounting task (see Table 8). Of particular note is that these relationships were stronger when the distal beneficiary was depicted as being farther in time from the present.

Study 3a

Methods

Participants. All aspects of the study (hypotheses, design, sample size, and analytical decisions) were pre-registered, https://aspredicted.org/1MM_XWK. In line with our pre-registered power analysis, we recruited a sample of 1,000 participants via Prolific. Four participants completed 100% of the survey but did not submit the survey to receive compensation and were retained in analyses. Forty-four participants were removed from the dataset according to our pre-registered exclusion criteria for duplicate IP addresses (10 participants) and failed attention checks (34 participants).

Design, Materials, and Procedure. In Study 3a, we tested whether uncertainty perceptions causally influence attitudes in line with intergenerational concern. We did so by systematically manipulating certainty as we did in prior studies, but this time measuring subjective perceptions of certainty before and after the manipulation. Subsequently, we measured the impact of certainty perceptions on longtermism beliefs as well as more practical measures of intergenerational concern, such as support for future-oriented reform and beliefs that various individual and collective entities should be doing more to safeguard the long-term future. Study 3a not only enabled us to test the hypotheses described below but also allowed us to assess the hypothesized associations with participants' *actual* perceptions of certainty rather

Table 8. Results for Simple Linear Regression Models.

Outcome	R^2	Intercept (estimate)	Longtermism beliefs (*ß*)	95% CI (upper, lower)
VFCT				
Indifference (100)	.01	39.16***	0.09	−.02, .19
Indifference (1,000)	.02	32.69***	0.13*	.01, .24
Indifference (10,000)	.02	29.35***	0.15*	.02, .28
Indifference (100,000)	.05	22.37***	0.23***	.10, .36
AUC	.04	2,660,000***	0.20**	.06, .34
VPCT				
Indifference (100)	.03	65.68***	−0.19***	−.29, −.09
Indifference (1,000)	.06	76.27***	−0.25***	−.35, −.15
Indifference (10,000)	.10	85.35***	−0.32***	−.41, −.22
Indifference (100,000)	.11	88.15***	−0.33***	−.43, −.23
AUC	.11	8,650,000***	−0.33***	−.43, −.22
Across tasks				
Proportion future	.09	0.18***	0.31***	.22, .39

***$p < .001$, **$p < .01$, *$p < .05$.

than just the manipulated level, serving as a built-in control for unconscious realism. This psychological phenomenon involves individuals substituting unrealistic assumptions with what they perceive as more realistic (see Greene et al., 2009 for a related discussion). For example, in the present investigation, participants may subconsciously combine the manipulated certainty level with their own intuitive perceptions of how certain they believe the outcome to be. Measuring uncertainty perceptions directly reconciles ambiguity, which could arise from allowing individual variation in these subjective perceptions to remain unmeasured.

Thus, in the first phase of the experiment, pre-manipulation certainty perceptions were first assessed by asking participants, "Here, we ask you to provide your most honest rating of how certain you feel (from 0% = completely uncertain to 100% = completely certain) that efforts taken by people living today can effectively reduce the risk of the challenges described above." Participants responded using a slider scale. Next, participants read, "There is a general consensus among experts that, at best, we have 10% certainty that our efforts today can effectively reduce the risk of future-oriented challenges." The expert estimate of certainty presented in the passage above differed between-subjects depending on random assignment to one of the three following conditions: the 10% condition, the 50% condition, or the 90% condition. As an attention check, participants were asked to indicate what level of certainty experts have that present-day efforts can effectively reduce the risk of future-oriented challenges using a single multiple-choice item. Afterward, certainty perceptions were assessed again, after manipulation. Participants' pre-manipulation certainty scores were subtracted from their post-manipulation certainty scores to capture change in certainty.

In the second phase of the experiment, to assess attitudes in line with intergenerational concern, we included the LBS (Cronbach's $\alpha = .99$; Syropoulos et al., 2023) as well as two more practical measures with greater real-world relevance. For the first, participants responded to 10 items capturing support for legal reform to protect the welfare of different entities (Syropoulos et al., 2024c; adapted from Martínez & Winter, 2023). Five of these items were filler items (e.g., humans living in the present, non-human animals, the environment), and five items captured the target outcome, support for reform to protect the welfare of future generations (humans living 100, 1,000, 10,000, 100,000, and 1,000,000 years in the future). The five future generations items were averaged into a single composite measure (Cronbach's $\alpha = .93$). For the second additional measure, participants indicated their agreement on a 7-point Likert-type scale to six items assessing their perceptions of whether different individual and collective entities (i.e., themselves, their community, their country, countries all over the world, the President, legislative bodies) should be doing more to protect future generations. These items too were averaged into a single composite measure (Cronbach's $\alpha = .96$). At the end of the survey, participants completed a standard demographics questionnaire and were debriefed.

Pre-Registered Hypotheses. Study 2b did not definitively explain the directionality of the observed effects between certainty perceptions and intergenerational concern, leaving room for three potential explanations. First, it is possible that greater perceptions of uncertainty regarding the ability to positively influence future generations might precede and reduce intergenerational concern, aligning with common criticisms of the longtermism philosophy (e.g., Crary, 2023; Emba, 2022) and research reavealing that prioritization of the present over the future can be an adaptive response to uncertainty (see Mullainathan & Shafir, 2013 for review). Second, elevated uncertainty perceptions may instead

Table 9. Results for Simple Linear Regression Models.

Predictor outcome	R^2	Intercept (estimate)	Standardized slope (ß)	95% CI (upper, lower)
Pre-manipulation certainty				
Longtermism beliefs	.20	26.56***	0.44***	.39, .50
Support for reform	.15	27.79***	0.39***	.33, .45
Doing more	.20	4.01***	0.45***	.39, .50
Post-manipulation certainty				
Longtermism beliefs	.15	35.36***	0.38***	.33, .44
Support for reform	.10	36.44***	0.32***	.26, .38
Doing more	.13	4.54***	0.36***	.30, .41
Change in certainty				
Longtermism beliefs	.00	56.68***	−0.04	−.10, .02
Support for reform	.00	54.46***	−0.05	−.12, .01
Doing more	.01	5.51***	−0.08*	−.14, −.02

*$p < .05$, ***$p < .001$.

represent a consequence of lower levels of intergenerational concern, applied as a post hoc rationalization for vauing present more than future welfare. Indeed, people tend to unconsciously process information in a way that conforms to their preferences (e.g., Kahan, 2013), which can influence factual beliefs about the world even in the face of conflicting evidence (see Liu & Ditto, 2013, for an example regarding moral preference for and factual beliefs regarding capital pushment). Alternatively, it is possible that both are valid explanations, with uncertainty perceptions and intergenerational concern being reciprocally related.

Here, we test the first possibility described above. We predicted that pre-manipulation (H1a–H1c), post-manipulation (H2a–H2c), and pre- to post-manipulation change in certainty perceptions (H3a–H3c) would be positively associated with each of the three intergenerational outcomes. Moreover, we predicted that there would be a condition effect on certainty (H5) and each of the three intergenerational outcomes (H5a–H5c), such that scores would be highest in the 90%, followed by the 50%, and finally the 10% condition. Finally, we hypothesized that change in certainty would mediate the relationships between condition and the three intergenerational outcomes (H6a–H6c).

Results

Study 3a conceptually replicated findings from Study 2b linking certainty perceptions to intergenerational attitudes. As predicted, and consistent with our prior findings, simple linear regression analyses revealed that both pre- and post-manipulation certainty perceptions were positively associated with scores on the LBS, capturing endorsement of the longtermism philosophical principle of intergenerational concern (see Table 9). We also extended these findings to show that this effect is not merely an artifact of unconscious realism and extends beyond scores on the LBS to more practical measures of intergenerational attitudes, such as support for future-oriented policy reform and perceptions that present-day entities should be doing more to safeguard the future.

However, we did not find that *change* in certainty was significantly associated with longtermism beliefs or support for future-oriented reform. Contrary to our predictions, greater positive change in certainty perceptions was associated with lower perceptions that present-day entities should be doing more to safeguard future generations. This may be attributable to a tendency for participants who experience a greater degree of positive change in certainty perceptions following the intervention to start with especially low certainty at baseline. This is supported by a significant and moderate negative relationship between pre-manipulation (baseline) certainty perceptions with pre- to post-manipulation change in certainty ($r = -.36$, $p < .001$) and moderate positive relationships between baseline certainty perceptions with the intergenerational outcomes (see Table 9).

Descriptive exploration revealed that pre-manipulation certainty perceptions were largely consistent across the three conditions: 10% condition ($N = 320$, $M = 62.5$, $SD = 26.2$), 50% condition ($N = 325$, $M = 62.7$, $SD = 27.6$), and 90% condition ($N = 315$, $M = 63.6$, $SD = 26.2$). Confirming the success of the manipulation, a one-way ANOVA was estimated, revealing a significant effect of condition on post-manipulation certainty. Post hoc tests using the Bonferroni alpha adjustment revealed that certainty perceptions following the manipulation were highest on average for participants in the 90% condition ($M = 71.5$, $SD = 23.6$), followed by the 50% condition ($M = 54.9$, $SD = 22.3$), and finally the 10% condition ($M = 38.9$, $SD = 29.1$).[2]

While the manipulation largely yielded results in the expected direction for the three primary intergenerational outcomes, the effects were small and did not reach statistical significance. Thus, it is plausible that our study lacked the necessary statistical power to detect effects of the observed magnitudes. See Table 10 for full results from these analyses. As these effects did not emerge as significant, we did not run

Table 10. Results for the One-Way ANOVAs With Post Hoc Planned Comparisons With Bonferroni Corrections.

Outcome	Condition (expert assessment of certainty)	
Post-manipulation certainty		
	Omnibus	$F(2, 957) = 133.37$, $p < .001$*, $\eta^2p = .218$
	10% vs. 50%	$t(643) = -8.06$, $p_{Bonferroni} < .001$*, Cohen's $d = -.635$
	10% vs. 90%	$t(633) = -16.33$, $p_{Bonferroni} < .001$*, Cohen's $d = -1.296$
	50% vs. 90%	$t(638) = -8.36$, $p_{Bonferroni} < .001$*, Cohen's $d = -.662$
Change in certainty		
	Omnibus	$F(2, 957) = 213.01$, $p < .001$*, $\eta^2p = .308$
	10% vs. 50%	$t(643) = -10.42$, $p_{Bonferroni} < .001$*, Cohen's $d = -.662$
	10% vs. 90%	$t(633) = -20.64$, $p_{Bonferroni} < .001$*, Cohen's $d = -1.478$
	50% vs. 90%	$t(638) = -10.33$, $p_{Bonferroni} < .001$*, Cohen's $d = -.662$
Longtermism beliefs (LBS)		
	Omnibus	$F(2, 957) = 2.349$, $p = .096$, $\eta^2p = .005$
	10% vs. 50%	$t(643) = -0.38$, $p_{Bonferroni} > .999$, Cohen's $d = -.030$
	10% vs. 90%	$t(633) = -2.04$, $p_{Bonferroni} = .125$, Cohen's $d = -.162$
	50% vs. 90%	$t(638) = -1.67$, $p_{Bonferroni} = .286$, Cohen's $d = -.130$
Support for reform		
	Omnibus	$F(2, 957) = 2.877$, $p = .056$, $\eta^2p = .006$
	10% vs. 50%	$t(643) = -0.18$, $p_{Bonferroni} > .999$, Cohen's $d = -.014$
	10% vs. 90%	$t(633) = -2.16$, $p_{Bonferroni} = .092$, Cohen's $d = -.172$
	50% vs. 90%	$t(638) = -1.99$, $p_{Bonferroni} = .141$, Cohen's $d = -.157$
Doing more		
	Omnibus	$F(2, 957) = 1.161$, $p = .313$, $\eta^2p = .002$
	10% vs. 50%	$t(643) = 0.42$, $p_{Bonferroni} > .999$, Cohen's $d = -.033$
	10% vs. 90%	$t(633) = -1.06$, $p_{Bonferroni} = .868$, Cohen's $d = -.084$
	50% vs. 90%	$t(638) = -1.48$, $p_{Bonferroni} = .417$, Cohen's $d = -.117$

*$p < .001$.

the pre-registered mediation models predicated on finding clear evidence for these direct effects. See SOM for additional, pre-registered secondary analyses.

Thus, evidence of a causal link between certainty perceptions and attitudes in alignment with the longtermism philosophy remains inconclusive, warranting a higher-powered replication of the present findings. Alternatively, it may be the case that the consistently observed association between certainty perceptions and intergenerational attitudes and decision-making is causal in the opposite direction. Possessing weaker attitudes of intergenerational concern may lead individuals to perceive greater uncertainty about the outcomes of future-oriented actions, possibly as a result of post hoc rationalization aimed at justifying inaction. This heightened perception of uncertainty—even if arrived upon as a result of bias rather than rational means—could amplify uncertainty's subsequent influence on decision-making, rendering individuals even less likely to engage in prosocial behaviors that benefit future generations. Consequently, this alternative explanation too may help explain the asymmetry revealed in Studies 2a and 2b, where uncertainty was found to have a disproportionately stronger negative impact on prosocial decisions benefiting future beneficiaries compared to present-day beneficiaries. Put plainly, lower concern for future welfare could increase perceived uncertainty as a result of bias, which in turn could magnify the discouraging effect of uncertainty on intergenerational prosocial actions.

Study 3b

Methods

Participants. All aspects of the study (hypotheses, design, sample size, and analytical decisions) were pre-registered, https://aspredicted.org/7PT_FLS. Study 3b served as a higher-powered conceptual replication of the effects found in Study 3a. Thus, in line with our pre-registered power analysis, we recruited a sample of 1,900 participants via Prolific. Eleven participants completed 100% of the survey but did not submit the survey to receive compensation and were retained in analyses. One hundred and eight participants were removed from the dataset according to our pre-registered exclusion criteria for duplicate IP addresses (38 participants) and failed attention checks (70 participants).

Materials and Procedure. Study 3b's design was nearly identical to Study 3a's, with three notable differences. First, the manipulation of certainty perceptions in Study 3b used only two levels (i.e., a 90% Condition vs. a 10% Condition). We opted to trade off the inclusion of a control condition to

Table 11. Results for Simple Linear Regression Models.

Predictor outcome	R^2	Intercept (estimate)	Standardized slope (ß)	95% CI (upper, lower)
Pre-manipulation certainty				
Longtermism beliefs (LBS)	.24	21.72*	0.49*	.45, .53
Support for reform	.19	22.27*	0.44*	.40, .48
Doing more	.27	3.75*	0.52*	.48, .56
Moral obligation	.18	14.55*	0.42*	.39, .46
Post-manipulation certainty				
Longtermism beliefs (LBS)	.20	31.65*	0.45*	.41, .49
Support for reform	.16	31.39*	0.40*	.35, .44
Doing more	.17	4.41*	0.42*	.37, .46
Moral obligation	.14	23.66*	0.37*	.33, .42

*$p < .001$.

optimize power. As our prior studies reveal a linear positive relationship between certainty perceptions and intergenerational outcomes, our primary interest in Study 3b was to establish temporal precedence for certainty perceptions with respect to the outcomes rather than to identify which condition (the 90% or 10% certainty condition) would drive potential effects. Put differently, we chose to prioritize investigating a causal effect of certainty on the outcomes over isolating the effects of different levels of certainty.

Second, to expand the scope of the investigation to additional intergenerational attitudes studied in related research (e.g., Law et al., 2024), participants were asked to indicate how morally obligated they felt to help and protect people in future generations, depicted to exist 100, 1,000, 10,000, 100,000, and 1,000,000 years from the present. Measurements were recorded on a slider scale ranging from 0 "No moral obligation" to 100 "Same moral obligation as someone living today" and averaged across timeframes to yield a single composite metric for each subject.

Finally, in Study 3a, we computed difference scores to capture change in certainty from pre- to post-manipulation. However, this metric posed challenges in interpretation, as it complicated the differentiation between the effects of baseline and post-manipulation certainty perceptions. Consequently, in Study 3b, we opted not to calculate difference scores, and instead, we concentrated on the post-manipulation measurement as the primary manipulation check and mediator variable. We utilized the pre-manipulation measurement to evaluate consistency across samples before the intervention.

Pre-Registered Hypotheses. We predicted that pre-manipulation (H1a–H1d) and post-manipulation (H2a–H2d) certainty perceptions would be positively associated with each of the four intergenerational outcomes. Moreover, we predicted that there would be a condition effect on post-manipulation certainty (H3) and each of the four intergenerational outcomes (H4a–H4d), such that scores would be higher in the 90% condition than those in the 10% condition. Finally, we hypothesized that post-manipulation certainty would mediate the relationships between condition and the four intergenerational outcomes (H5a–H6d).

Table 12. Results for Independent Samples t-Tests.

Outcome	Condition (expert assessment of certainty)
Post-manipulation certainty	$t(1801) = 25.42$, $p < .001$, Cohen's $d = 1.197$
Longtermism beliefs	$t(1801) = 5.07$, $p < .001$, Cohen's $d = .239$
Support for reform	$t(1801) = 5.02$, $p < .001$, Cohen's $d = .236$
Doing more	$t(1801) = 2.66$, $p = .008$, Cohen's $d = .125$
Moral obligation	$t(1801) = 4.06$, $p < .001$, Cohen's $d = .191$

Results

As predicted, and conceptually replicating our findings from Study 3a, simple linear regression analyses revealed that both pre- and post-manipulation certainty were positively associated with scores on the measures assessing longtermism beliefs, support for future-oriented reform, and perceptions that various entities should be doing more in the present day to safeguard future generations (see Table 11). Moreover, both measures of certainty were positively associated with the amount of moral obligation participants expressed feeling for future generations.

Descriptive exploration revealed that pre-manipulation certainty perceptions were largely consistent across the two conditions: 10% condition ($N = 901$, $M = 60.3$, $SD = 28.4$), and 90% condition ($N = 902$, $M = 62.6$, $SD = 27.6$). Confirming the success of the manipulation, an independent samples t-test revealed a significant effect of condition on post-manipulation certainty (see Table 12 and Figure 4), such that certainty was higher in the 90%

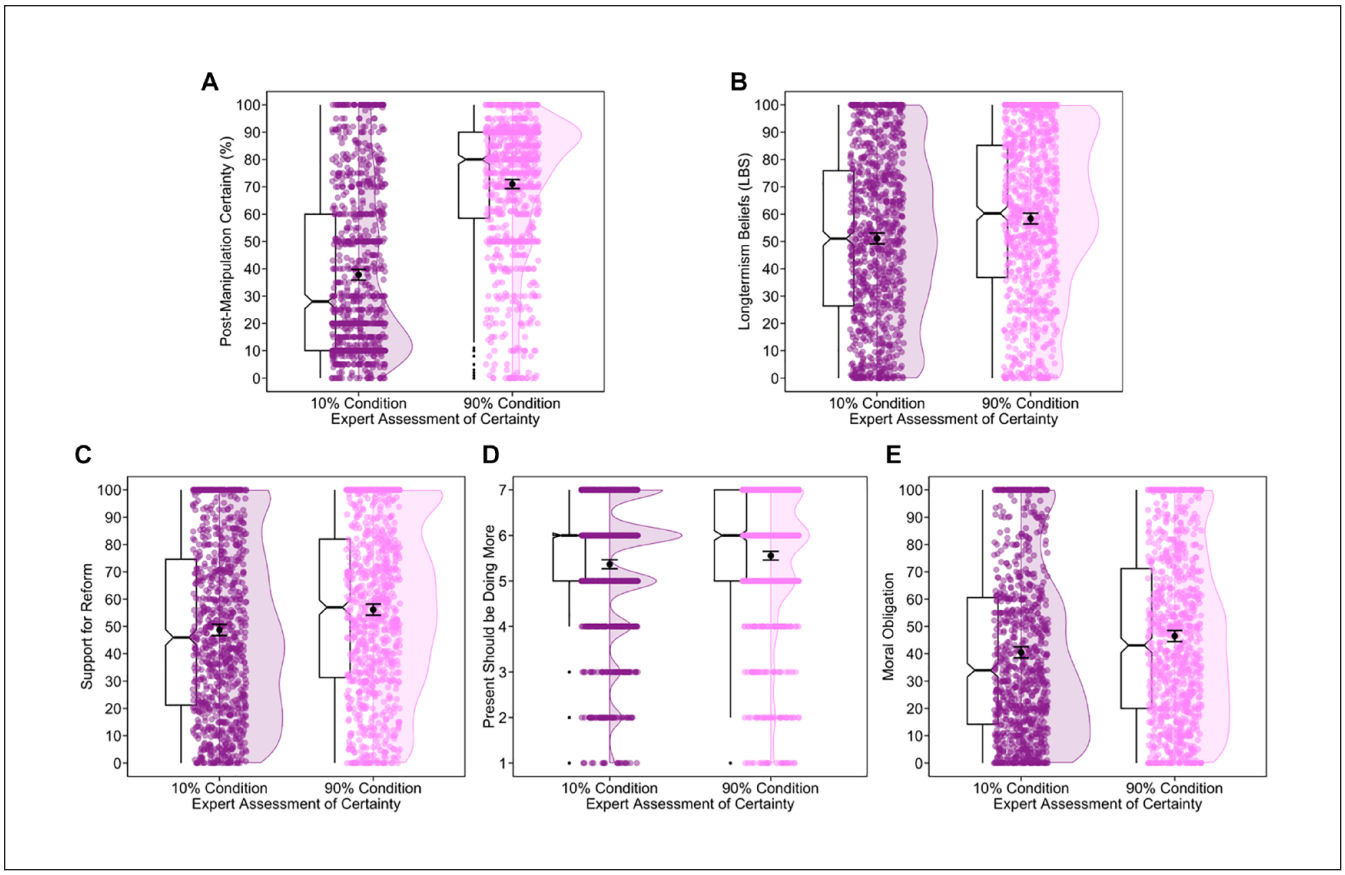

Figure 4. Certainty Perceptions and Attitudes in Line With Intergenerational Concern by Condition.
Note. Plots depicting condition differences in (A) post-manipulation certainty perceptions, (B) longtermism beliefs, (C) support for future-oriented policy reform, (D) perceptions that present-day individual and collective entities should be doing more to protect future generations, and (E) perceived moral obligation to help and protect future generations by condition (i.e., manipulated expert assessments of certainty level for positively impacting future generations). Plots reveal that the manipulation was successful in generating movement in certainty perceptions (A-B), as well as the outcomes measuring intergenerational attitudes (C-E). Colored dots correspond to individual data points and are jittered for readability, with split violin plots overlaid to show the relative distribution of scores across conditions. Error bars depict ±1.96*SEM. Notched boxplots are included, with notches depicting a confidence interval around the median with a value of ±1.58*IQR/sqrt(n).

condition versus the 10% condition.[3] Moreover, condition had a significant effect on each of the four outcomes (see Table 12 and Figure 4). Effects were similar in magnitude to those found in Study 3a.

Following our pre-registered analysis plan, we estimated mediation models for each outcome specifying condition as the predictor variable and post-manipulation certainty as the mediator. In the case of every outcome, certainty mediated the effect of condition, suggesting that perceptions of certainty to positively impact the future may play a causal role in driving attitudes in line with intergenerational concern (see Table 13; see SOM for additional, pre-registered secondary analyses). Nonetheless, it is important to acknowledge another possible pathway: individuals' intergenerational attitudes may influence their perceptions of certainty regarding their ability to positively impact the future. This offers an additional explanation for biases observed in our previous studies, where certainty perceptions hold more significance in decisions benefiting future than present targets.

Study 4

Methods

Participants. All aspects of the study (hypotheses, design, sample size, and analytical decisions) were pre-registered, https://aspredicted.org/5Q5_RQR. In line with our pre-registered power analysis, we recruited a sample of 1,100 participants via Prolific. Two participants were removed from the dataset according to our pre-registered exclusion criteria for duplicate IP addresses.

Materials and Procedure. To comprehensively chart the dynamic relationship between certainty perceptions and intergenerational attitudes, we manipulated longtermism beliefs in Study 4 using an intervention successfully employed in prior research (Syropoulos et al., 2024c) to examine a possible causal influence of intergenerational attitudes on certainty perceptions, potentially owing to post hoc rationalization. We manipulated longtermism

Table 13. Results for Mediation Models.

	X ⇒ M	M ⇒ Y	X ⇒ Y	Indirect effect	
Outcome	b (*SE*)	b (*SE*)	b (*SE*)	b (*SE*)	R^2
Longtermism beliefs	33.20* (1.30)	0.50* (0.02)	−9.25* (1.49)	16.53* (1.01)	.22
Support for reform	33.20* (1.30)	0.45* (0.02)	−7.41* (1.58)	14.81* (1.00)	.17
Doing more	33.20* (1.30)	0.02* (0.001)	−0.61* (0.07)	0.80* (0.05)	.20
Moral obligation	33.20* (1.30)	0.43* (0.02)	−8.33* (1.59)	14.31* (0.99)	.15

*$p < .001$.

beliefs between subjects. Participants in the Longtermism Condition completed a thought exercise derived from philosophical writings on longtermism (MacAskill, 2022) utilized in prior research (Syropoulos et al., 2024b). Participants were asked to first imagine engaging in an action to prevent future harm (i.e., picking up shards of glass from a broken water bottle on a hiking trail) prior to reading about and reflecting on the philosophical principle of "impartial intergenerational beneficence" from longtermism—namely, the standpoint that the welfare of all humans, no matter when in time they exist, is ethically important. Participants in the control condition completed a similar thought exercise which instead focused on content unrelated to longtermism or impartial intergenerational beneficence (i.e., the importance of bringing water to stay hydrated on a hike). Subsequently, and in the following order, participants completed the LBS, reported certainty perceptions, indicated their support for reform, completed a brief demographics questionnaire, and were debriefed.

Preregistered Hypotheses. We predicted that longtermism beliefs, certainty perceptions, and support for reform would be positively associated with each other (H1-H3), and that longtermism beliefs (H4) and support for reform (H5) would be higher in the Longtermism Condition than in the control. We pre-registered alternative hypotheses with respect to condition differences for certainty perceptions. We reasoned that, from a purely rational perspective, the extent to which one values and feels concern for protecting future generations should have no bearing on the perceived likelihood of positive outcomes for future people. From this perspective, inducing longtermism beliefs should not influence certainty perceptions (H6a). On the other hand, people at times base factual judgments on their biases and values (Liu & Ditto, 2013) and show unrealistic optimism in likelihood perceptions for desired versus undesired future outcomes (Weinstein, 1980). Thus, we reasoned certainty perceptions might be greater in the Longtermism Condition relative to the control (H6b). Finally, we predicted that longtermism beliefs would mediate the relationship between condition and certainty if H4 and H6b were confirmed (H7) and between condition and support for reform if H4 and H5 were confirmed (H8).

Results

As predicted, and conceptually replicating our previous findings, simple linear regression revealed that longtermism beliefs were positively associated with certainty perceptions ($\beta = .49$, $p < .001$, 95% CI: [.35, .52]) and support for future-oriented reform ($\beta = .82$, $p < .001$, 95% CI: [.79, .86]), with the latter two variables being positively associated with each other ($\beta = .22$, $p < .001$, 95% CI: [.14, .30]).

Confirming the success of the manipulation, an independent samples *t*-test revealed a small, but significant effect of condition on longtermism beliefs (Longtermism Condition: $M = 65.4$, $SD = 28.8$; Control Condition: $M = 61.3$, $SD = 28.5$; $t(1096) = -2.35$, $p = .019$, Cohen's $d = -.142$). Moreover, condition had the predicted effect on support for future-oriented reform (Longtermism Condition: $M = 63.3$, $SD = 30.7$; Control Condition: $M = 59.1$, $SD = 29.7$; $t(1096) = -2.29$, $p = .022$, Cohen's $d = -.139$). We pre-registered alternative hypotheses for whether condition would influence certainty perceptions. A frequentist *t*-test revealed no significant condition difference (Longtermism Condition: $M = 62.7$, $SD = 28.6$; Control Condition: $M = 61.8$, $SD = 29.5$; $t(1096) = -0.53$, $p = .595$, Cohen's $d = -.032$), and a Bayesian *t*-test using the Cauchy prior (Rouder et al., 2009) revealed strong evidence for the null hypothesis ($BF_{01} = 12.86$; $BF_{10} = 0.08$, 95% CI: [−.15, .09]), supporting that certainty perceptions are unlikely to result from intergenerational attitudes in a causal sense. Our prior results suggest instead that intergenerational attitudes are more likely to follow from certainty perceptions.

Finally, following our pre-registered analysis plan, a mediation model with the same specifications as the prior study showed that longtermism beliefs mediated the effect of condition on support for reform, suggesting a causal role of intergenerational attitudes in intergenerational beneficence ($R^2 = .68$; X ⇒ M: $b = 4.07$, $SE = 1.73$, $p = .019$; M ⇒ Y: $b = 0.87$, $SE = 0.02$, $p < .001$; X ⇒ Y: $b = 4.19$, $SE = 1.82$, $p = .021$; Indirect Effect: $b = 3.53$, $SE = 1.50$, $p = .019$). See SOM for additional, pre-registered secondary analyses.

General Discussion

Our findings indicate that as uncertainty about affecting the future grows, individuals tend to prioritize saving fewer present lives over a greater number of future lives (Studies 1

and 2b). These findings align with seminal and recent research from cognitive science (e.g., Doyle et al., 2023; Tversky & Shafir, 1992) and behavioral economics (Wade-Benzoni, 2008; Wade-Benzoni & Tost, 2009) documenting tendencies to discount personal rewards and economic benefits for others as a function of perceived uncertainty. Here, we find that people go as far as discounting the value of actions to save human lives when saving them seems less likely and do so to a greater extent when those lives exist in the future versus when they exist in the present.

To situate these findings within established frameworks of risk aversion (Kahneman et al., 1991; Tversky & Kahneman, 1992; Tversky & Shafir, 1992), as well as temporal (Bulley et al., 2019; Critchfield & Kollins, 2001), social (Jones, 2022), and intergenerational discounting (often considered a convergence of temporal and social discounting effects; Wade-Benzoni & Tost, 2009), our findings partially reflect these well-documented preferences. Indeed, people generally value rewards more highly when they are certain rather than uncertain, immediate rather than delayed, and when they benefit socially close rather than distant individuals. Likewise, people tend to place higher value on rewards benefiting the present generation over future generations, perhaps because future generations are simultaneously perceived as temporally and socially distant (Wade-Benzoni & Tost, 2009). However, our research expands on existing knowledge of risk aversion and intergenerational discounting (and, by extension, temporal and social discounting) by examining their combined influence on outcome valuation in contexts where these preferences naturally intersect—namely, high-stakes intergenerational choices.

While prior research on risk aversion has documented uncertainty's independent effect on outcome valuation (Kahneman et al., 1991; Tversky & Kahneman, 1992; Tversky & Shafir, 1992)—and while prior theoretical discussions on intergenerational discounting have noted the impact of temporal and social distance on intergenerational resource allocations (Wade-Benzoni & Tost, 2009)—our findings suggest that perceptions of uncertainty weigh upon people's valuation of intergenerational outcomes as well and in ways not fully explained by conventional models of risk aversion, temporal, social, or intergenerational discounting alone. Specifically, we find that the influence of uncertainty is not merely additive but instead exerts a multiplicative effect on the subjective value of outcomes as intergenerational distance grows. That is, while uncertainty also diminishes the value of measures that save present-day lives, it does so to a much lesser extent than it does for those that save future lives, even when choosing to benefit the future could save ten times as many.

For instance, we find that saving a single life now with 50% certainty is subjectively equivalent to saving 10 in 100,000 years with 62.7% certainty. This aligns with existing knowledge of how interpersonal and intertemporal distance constrain intergenerational concern (Coleman & DeSteno, 2024; Cropper et al., 1992; Hauser et al., 2014; Johannesson & Johansson, 1996; Law et al., 2024; Syropoulos et al., 2024a). Yet, our findings address a major gap in understanding by demonstrating that perceptions of uncertainty also play a fundamental role in these relationships, strengthening progressively with increasing intergenerational distance. This possibility has been raised in seminal discussions on the behavioral economics of intergenerational decision-making (e.g., Frederick, 2003) but has remained untested until now. Thus, in examining a recombination of known factors that influence the subjective value of outcomes, our research offers new insights into intergenerational decision-making, demonstrating that as intergenerational distance increases, so too does the influence of perceived uncertainty on valuation and decisions to benefit the future. Consequently, we encourage forthcoming research on intergenerational discounting to explore not only how temporal and social discounting factors jointly reduce the perceived value of outcomes in intergenerational decisions but also how amplified perceptions of uncertainty may further intensify these effects.

Furthermore, the findings help develop empirical insight into the underpinnings of ongoing philosophical and societal debates over longtermism (Greaves & MacAskill, 2019; MacAskill, 2022; Ord, 2021). As longtermist thinking gains traction in political discourse on intergenerational ethics (e.g., United Nations, 2021), the movement's numerous detractors warn accepting its premises may be dangerous, sidelining the needs of society today for the sake of a hypothetical (and thus uncertain) society tomorrow (Emba, 2022; Fisher, 2023). We show that decision-making tendencies in ordinary adults are largely in alignment with the opposition. Moreover, we provide correlational and experimental evidence that heightened uncertainty perceptions lead to lower levels of longtermist intergenerational concern, which reduces support for longtermism-aligned policy reforms, prescriptions for future-oriented action, and moral obligation to future generations (Studies 3a–4). Critically, we rule out an inverse pathway, finding negative attitudes toward longtermism do not elevate perceived uncertainty as a post hoc rationalization. Rather, perceived uncertainty, in a more rational manner (Mullainathan & Shafir, 2013), tends to diminish attitudes toward longtermism.

Of course, the present findings do not speak to the normative value of longtermism. Rather, they suggest that pro-future measures in alignment with the objectives of longtermism are likely to see greater support when their likelihood of success is high and communicated clearly. These results hold practical implications for decision-makers involved with policy, non-profits, and the longtermism movement. For today's society, where uncertainty often diminishes intergenerational concern, policymakers should be attentive to public perceptions of certainty when prioritizing future outcomes over present-day issues to better address

the needs of future generations by crafting more widely-supported policies. For advocates of longtermism, these studies highlight the importance of addressing and mitigating uncertainty in pragmatic efforts to safeguard the future. Longtermist non-profits can enhance their actual and perceived effectiveness by rigorously assessing funding opportunities on a clear metric of certainty, akin to approaches adopted in the adjacent effective altruism movement (GiveWell, 2023).

Future research should explore the relationships examined here in samples comprising special populations like longtermists, policymakers, and individuals working in industries which may impactfully shape the future, such as climate advocacy and AI safety. Such research might uncover differences in attitudes between these higher-impact groups, whose members likely have greater knowledge of certainty forecasts for various pro-future measures, and the general population. Furthermore, while our studies focused on decision-making, future research could assess moral judgments of longtermism-aligned tradeoffs in certainty and generational closeness for welfare gains (see Everett et al., 2018; Law et al., 2022; McManus et al., 2020 for similar research pertaining to effective altruism). Such research can reveal the ethical standing of longtermism in the mind of the typical adult and reveal potential social consequences of longtermist behaviors. Indeed, understanding folk intuitions provides valuable insights into the moral psychology of the populace, which can inform policy recommendations and implementation, bridging descriptive and normative theories of intergenerational beneficence.

Despite the strengths of our research (e.g., highly-powered samples, pre-registered hypotheses, internal replications), our samples comprised only U.S. participants recruited on Prolific, underscoring the need to investigate possible demographic, national, and cultural variation in the findings across representative domestic and international samples. For instance, collectivist or long-term oriented cultures (Minkov & Kaasa, 2022) might show greater future-oriented valuation under uncertainty. Moreover, while we implemented measures to minimize the potential for demand characteristics bias (e.g., utilizing between-subjects designs, no experimenter-participant interactions) and found evidence suggesting such bias was unlikely (e.g., considerable variability among manipulation checks and outcomes even within experimental conditions, significant deviation in certainty perceptions from "expert ratings" provided in the experimental materials), future research could explore additional strategies to further mitigate this risk (e.g., using more elaborate deception, cover stories, and more subtle manipulations of certainty and intergenerational attitudes).

While we are fairly confident our findings show the link between uncertainty and future valuation is not driven by motivated bias, future research using more naturalistic approaches like experience sampling could further explore aspects of these relationships beyond subjects' introspective access. Relatedly, because there was a discrepancy between expert-provided certainty ratings and participants' post-manipulation certainty perceptions in Study 3a, we acknowledge that it remains possible pre-existing attitudes toward the future may have played some role beyond the manipulation. While the findings from Study 4—in which induced intergenerational attitudes did not lead to significant changes in certainty perceptions—suggest that a direct causal relationship between intergenerational attitudes and certainty is less likely, routinely feeling greater concern for future generations in daily life may influence certainty perceptions in a manner that cannot be captured in the context of a one-shot experimental induction. For instance, people who value the welfare of future generations to a greater extent, such as longtermists, may think about the future more regularly, imagine the future with greater episodic detail, and as a consequence (see Bulley et al., 2016 for a related finding), feel more confident in expert certainty forecasts, all else equal. Longitudinal assessments and studies of self-identifying longtermists can shed further light on this possibility.

In sum, the present studies address a line of inquiry unanswered in the psychological literature and ongoing debate over long-term intergenerational ethics. Our findings suggest that the value of a life depends on how far away in time it exists and how likely it is than one can save it. More importantly, the present findings are consistent with the position endorsed by many in research, philosophy, policy, and society at large that, although the future matters, when present concerns can be addressed with greater certainty, they ought to be prioritized. Ultimately, the findings underscore the importance of carefully evaluating and communicating the certainty of measures to safeguard the future if mitigating global catastrophic risks is a societal objective.

Declaration of Conflicting Interests

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Ethics

This research was approved by the Institutional Review Board of Boston College, protocol code 12.064.01 (Social Judgment and Decision-Making), 3 October 2023, and by the Institutional Review Board of University at Albany, State University of New York, protocol code 22X187 (Social Judgment and Decision-Making Study (Online)), 15 August 2022.

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Supplemental Material

Supplemental material is available online with this article.

Notes

1. In line with conventions from prior research employing discounting paradigms (e.g., Gershon & Fridman, 2022; Jones & Rachlin, 2009; Tuen et al., 2023), indifference points were only calculated for participants who showed clear points of indifference (i.e., those who switched from consistently choosing Option A to consistently choosing Option B, and who only switched their choice preference one time). Thus, indifference points could not be calculated for participants with missing data, who always chose Option A or Option B, or who switched between the two options multiple times.
2. To help rule out the possibility of demand characteristics bias, we conducted exploratory one-sample *t*-tests comparing the average post-manipulation certainty levels in each condition to the expert certainty levels presented in the experimental materials. The results showed significant deviations between participants' certainty perceptions and the expert ratings presented in all conditions (10%: $t(319) = 17.8$, $p < .001$, *Cohen's d* = 1.00; 50%: $t(324) = 3.96$, $p < .001$, *Cohen's d* = .22; 90%: $t(314) = -13.0$, $p < .001$, *Cohen's d* = −.78), indicating that participants by and large did not adhere to the expert ratings entirely, which would be an indicator of a demand response, thus ensuring that any potential demand characteristics bias was likely minimal.
3. Exploratory one-sample *t*-tests showed significant deviations between participants' certainty perceptions and the expert ratings presented in both conditions (10%: $t(900) = 27.8$, $p < .001$, *Cohen's d* = .93; 90%: $t(314) = -22.6$, $p < .001$, *Cohen's d* = −.75), indicating that participants by and large did not adhere to the expert ratings entirely, which would be an indicator of a demand response, thus ensuring that any potential demand characteristics bias was likely minimal.

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