

Does episodic future thinking differ when considering the future of the natural environment? An experimental test

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The cognitive ability to mental time travel allows people to project themselves backward and forward in time. Research has shown that anticipating and envisioning possible future events, and imagining ourselves experiencing those events, have many implications for health, finance, and environmental protection. While many public policies in these domains consider events that may occur decades into the future, current evidence suggests individuals typically consider a much shorter temporal distance when spontaneously thinking about the future. Here we examined whether this typical short temporal distance would vary if individuals were primed to think about the future of the natural environment in a between-subjects experiment with online respondents (212 MTurkers). We compared responses from individuals randomly asked to think about the future in general (control condition) to those asked to think about the future of the natural environment (main experimental condition) or the future of the work environment (contrasting experimental condition). Results confirmed that individuals typically think very short term into the future, with a temporal distance between 1 and 5 years. Supporting our intuition, results showed that individuals asked to think about the future of the natural environment were statistically more likely to think longer term (10 years or more) compared to those in the other two conditions. We discuss the implications of our findings for time-scale mismatches in policy making.

Keywords: *Prospection, Episodic Future thinking, Environmental management, Environmental policy, Time-scale mismatches*

INTRODUCTION

In the present, the past is more knowable than the future—but people think far more about the future than the past. Both facts derive from the principle that the future can be changed whereas the past cannot.

— Roy F. Baumeister, Kathleen D. Vohs, and Gabriele Oettingen

As the opening quote illustrates, we have the cognitive capacity to traverse temporal distances from the past to the future and back to the present time. Indeed, we can transcend the present by thinking about events from the past as well as events that are still to happen in the future. This capacity to routinely engage in mental time travel to remember the past and envision the future is well-established (see, e.g., Tulving, 1983; Suddendorf & Corballis, 1997, 2007). Though we engage in both retrospection and prospection, there is evidence indicating an asymmetry in temporal thinking whereby we tend to prioritize thinking about the future more than thinking about the past (Baumeister et al., 2016; Greene et al., 2022).

In particular, *episodic future thinking* is a cognitive process that assists people in drawing from their past experiences and present circumstances to mentally construct novel future scenarios (Schacter et al., 2017; Suddendorf & Redshaw, 2013). It has been defined as “an ability to project the self forward in time to pre-experience an event” (Atance & O’Neill, 2001, p. 537), or “the capacity to imagine or simulate experiences that might occur in one’s personal future” (Schacter, Benoit &

Szpunar, 2017, p. 41). Episodic future thinking ranges from thoughts about the immediate future (i.e., planning tonight’s dinner) to thoughts about the much later future (i.e., planning to retire; Bulley et al., 2016), and helps us with problem-solving, planning and decision-making (Baumeister et al., 2016; Schacter et al., 2017). Thinking about the future can also assist psychological well-being, as people can reduce their anxiety about what may occur and foresee positive future events (Baumeister et al., 2016; Salgado & Berntsen, 2018; Schacter et al., 2017). Thinking into the future is thus an essential cognitive process that assists people in planning for their later lives, both in the short and long term (Andre et al., 2018), and it has a great influence on intertemporal decision-making.

There are three critical functions of our capacity to think about the future: it allows us to engage in imaginative projections of potential future scenarios, it assists us in making educated guesses about what lies ahead based on insights from past experiences, and it assists in directing our attention towards goals and objectives (Oettingen, Sevincer, & Gollwitzer, 2018). Comparative research also supports the importance of future thinking for culture and cultural evolution (Vale, Coughlin, & Brosnan, 2022).

Future thinking is particularly relevant for understanding and addressing environmental problems. Traditionally, the management of environmental resources has been understood as a social dilemma in which individual interests to maximize extraction of resources are at odds with interests to protect resources for the collective benefit of the whole community (Hardin, 1968). Updated conceptualizations add temporal

considerations to this individual-collective conflict by arguing that the management of environmental resources comprises a conflict between short-term individual interests and long-term collective interests (Hendrickx, Poortinga, & van der Kooij, 2001; Van Lange et al., 2013). To illustrate, Wilson et al. (2015) highlighted the importance of reducing temporal mismatches between decision-makers creating environmental policies and the individuals thinking and acting in a much shorter, more personal timeframe. In Aotearoa New Zealand, there is also the need to reduce temporal mismatches between decision makers creating environmental policies that are deemed shorter term than iwi values and aspirations (Bargh et al., 2023).

Cross-sectional, meta-analytical, experimental, and cross-cultural findings support the importance of future thinking for understanding environmental problems, policy development, and mobilising pro-environmental behaviour (e.g., Arnocky, Milfont, & Nicol, 2013; Bain et al., 2016; Carmi & Arnon, 2014; Milfont, Wilson, & Diniz, 2012; Schaub, 2022). Previous research has examined related aspects of future thinking in relation to environmentalism, including broader constructs such as future time orientation (i.e., extent to which individuals focus on and plan for future goals and outcomes; Milfont & Gouveia, 2006) and legacy motives (i.e., a person's desire to leave something lasting beyond their lifetime; Milfont & Sibley, 2011; Syropoulos et al., 2023; Zaval, Markowitz, & Weber, 2015), as well as more specific constructs or variables including consideration of future consequences and delay discounting (Macaskill, Hunt, & Milfont, 2019), strengthened long-term concerns as a result of becoming a parent (Milfont, Poortinga, & Sibley, 2020), and long-termism beliefs (i.e., a heightened moral duty to protect the welfare and well-being of future generations; Syropoulos, Law, & Young, 2024). The combined evidence from this literature indicates that greater future thinking is associated with higher levels of pro-environmental attitudes and behaviours. Episodic future thinking is thus critical for managing environmental resources because it entails protecting Earth's ecosystems for future generations. This critical intergenerational feature of resource management is well illustrated by the purpose statement of our Ministry for the Environment: *He taiao tōnui mō ngā reanga katoa – A flourishing environment for every generation.*

The Present Study

Despite the importance of future thinking for human functioning and its applied benefit when managing environmental resources, it is unclear whether episodic future thinking differs as a function of considering the natural environment. While previous research examining future-environmentalism links has focused on the extent to which future thinking can mobilise pro-environmental actions, situating the temporal aspect as antecedent of environmentalism, here we extend this literature by experimentally examining whether thinking about the natural environment impacts people's temporal frames. In other words, would people be more likely to think over longer temporal distances when considering the future of the natural environment in contrast to merely thinking about the future in general terms? Some studies have examined the specific periods that people can think into

the future. To illustrate, Berntsen and Jacobsen (2008) found that 90% of voluntary future thinking (intentionally thinking about the future) and 98% of involuntary future thinking (thoughts about the future coming to mind without effort) occurred within five years of a person's future. More recently, Van Der Duin et al. (2020) found that 60% of participants in their study thought only 20 years into the future. Accordingly, we are interested in investigating whether the specific periods that people think into the future would differ if participants were primed to think about the future of the natural environment. This investigation will help us understand potential temporal mismatches between environmental policies and individuals' abilities to think about these policies.

To our knowledge, no study has examined the extent to which time frames for voluntary future thinking would differ from those for future thinking about the natural environment. We thus conducted an experimental study to examine this interesting theoretical question, which can inform how environmental information is framed and how to emphasise the long-term consequences of not adequately managing natural resources. Accordingly, the present study comprises a simple between-subjects experimental design intended to verify the extent to which the temporal distance would vary when asking individuals to think about the future (control condition) when compared to asking individuals to think about the future of the natural environment (main experimental condition) or to think about the future of the work environment (contrasting experimental condition). We reasoned that thinking about the future of the work environment would be a suitable contrast given that many people experienced recent changes in ways of working, including shifts to working from home due to the COVID-19 pandemic and implications of artificial intelligence (see, e.g., Malhotra, 2021).

Participants completed a range of measures, including recording their "usual thoughts about the future" under three conditions: during daily activities (control condition), the future condition of the natural environment (natural environment condition), and the future condition of the work environment (work environment condition; see the Method section for wording). The goal of the manipulation was to prime participants' episodic future thinking by having them envision personal future experiences and project them forward in time.

Since the manipulation projected participants forward in time, our primary focus was to capture how far into the future participants would think after the experimental manipulation. Accordingly, we used a multiple-choice question for participants to indicate the temporal distance that came to mind when thinking about the future. To explore any unintended effects of the experimental manipulation, we also included established measures assessing temporal focus, mood state, pro-environmental intention, and work commitment. Since the experimental manipulation asked participants to think about the future, we expected that participants might be likely to display a higher score on the future focus measure compared to scores on the past or present focus measures. We also expected that participants in the natural environmental condition would be more likely to score higher in the pro-environmental measure compared to participants in the

other conditions. Similarly, we expected that participants in the work environment condition could be more likely to score higher in a work commitment measure compared to participants in the other conditions. Finally, we expected no impact of the experimental manipulation on participants' mood.

METHODS

Participants

We report data collected by CloudResearch from 212 US adults between 30 March-12 April 2024. All IP addresses were in the US, and participants' age ranged from 20 to 78 ($M = 37.53$, $SD = 11.46$). The majority self-identified as female ($n = 138$, 65.10%) and White or European American ($n = 147$, 69.3%). When asked about all sources of income of members of their household, the majority ($n = 147$, 69.3%) indicated being below or equal to the US average annual household income of \$67,521 in 2023, and only 32.1% ($n = 68$) of the participants had completed a Bachelor's degree. Regarding religiosity, participants were somewhat religious ($M = 4.52$, $SD = 2.40$) as indicated by a statistically significant one-sample t -test using the scale's middle point of 4, $t(210) = 3.157$, $p = .002$, $d = 2.40$. Regarding political orientation, participants were neutral in terms of left vs. right self-positioning ($M = 5.37$, $SD = 2.57$), $t(208) = .74$, $p = .459$; however, participants self-placed as more liberal (vs. more conservative) politically ($M = 3.89$, $SD = 1.75$), $t(207) = 13.22$, $p < .001$. Participants in the natural environment condition ($M = 5.22$, $SD = 2.14$) were more religious than participants in both the control ($M = 4.21$, $SD = 2.37$) and work environment ($M = 4.16$, $SD = 2.55$) conditions, $F(2) = 49.75$, $p = .013$. The experimental groups did not differ in any of the other socio-demographic variables.

Measures

Socio-Demographic Variables. The online survey started with eight socio-demographic questions. These were: age ["How old are you in years?", open-ended response]; gender ["What is your gender? Male, Female, Non-binary / third gender, Prefer not to say, other (please specify below)"]; ethnicity ["Which ethnicity do you identify with? (select all that apply); White or European American, Black or African American, Hispanic/Latino(a), American Indian/Native American or Alaska Native, Asian, Native Hawaiian or Other Pacific Islander, Prefer not to say, Other (please specify below)"]; level of education ["What is the highest level of education you have completed? Some high school or less, High school diploma or GED, Some college, but no degree, Associates or technical degree, Bachelor's degree, Graduate or professional degree (MA, MS, MBA, PhD, JD, MD, DDS, etc.), Prefer not to say, Other (please specify below)"]; religiosity ["How religious are you, if at all?", rated on a 8-point scale anchored at 0 = not at all religious and 7 = very religious]; socio-economic status ["The average annual household income in the United States in 2023 was \$67,521. Considering all of the sources of income of members of your household, is your income:", rated on a 7-point scale anchored at 1 = very

much below this average and 7 = very much above this average]; and political orientation. Self-placement on political orientation was measured with two separate items for right-wing/left-wing and conservative/liberal orientations. The items read: "In political matters, people sometimes talk about 'the left' and 'the right.'" [or "liberals" and "conservatives."] How would you place your views on this scale, generally speaking?". The items were rated on a 10-point scale from 1 = left [very liberal] to 10 = right [very conservative]. These items correlated strongly in all three conditions ($r > .70$, $p < .001$).

Experimental manipulation. We present the text for each of the three experimental conditions below. The basic wording was inspired by similar instructions detailed by D'Argembeau, Renaud and Van Der Linden (2011):

Control Condition: *We are interested in your usual thoughts about the future. That is, the thoughts you have about the future during your daily activities, whatever their content, personal importance, level of abstraction, and emotional value. When thinking about the future in a typical day in your life, what time frame does your thought refer to? This future time period could be in days, weeks, months or years.*

Natural Environment Condition: *We are interested in your usual thoughts about the future condition of the natural environment. That is, the thoughts you have about the future condition of the natural environment during your daily activities, whatever their content, personal importance, level of abstraction, and emotional value. When thinking about the future condition of the natural environment in a typical day in your life, what time frame does your thought refer to? This future time period could be in days, weeks, months or years.*

Work Environment Condition: *We are interested in your usual thoughts about the future condition of the work environment. That is, the thoughts you have about the future condition of the work environment during your daily activities, whatever their content, personal importance, level of abstraction, and emotional value. When thinking about the future condition of the work environment in a typical day in your life, what time frame does your thought refer to? This future time period could be in days, weeks, months or years.*

Dependent variable. We used a multiple-choice question to access the extent to which the experimental manipulation impacted participants' future time frame. The question read "You typed the future time period that came to mind in the previous page. What future time period did your thought refer to? (Please choose the category that best corresponds to your previous answer.)".¹ Participants could select a single response from a set of 12 options: Later the same day, Within the same week, Within the next week, Between a week and a

¹ When writing the manuscript, we noticed a typo in this sentence ('though' instead of 'thought'), which we have corrected here. We believe this error did not affect

participants' understanding or the experimental manipulation.

month, Between a month and a year, Between 1 and 5 years, Between 5 and 10 years, Between 10 and 15 years, Between 15 and 20 years, Between 20 and 25 years, Between 25 and 30 years, and More than 30 years. This question was inspired by a similar question used by D'Argembeau, Renaud and Van Der Linden (2011) who considered only seven temporal distances (i.e., later the same day, within the next week, between a week and a month, between a month and a year, between 1 and 5 years, between 5 and 10 years, and more than 10 years).

Additional measures. After the experimental manipulation and dependent variable, participants completed four validated measures: the 12-item Temporal Focus Scale (Shipp, Edwards, & Lambert, 2009), the 20-item Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988), the 12-items Personal Pro-Environmental Intention scale (Bain et al., 2016), and the 9-item Organizational Commitment Scale; Balfour & Wechsler, 1996). The four scales were presented in this order with items from each scale presented in random order to participants. In this study, the Cronbach's alpha for each measure in the entire sample were: Positive Mood ($\alpha = .93$), Negative Mood ($\alpha = .96$), Past Temporal Focus ($\alpha = .86$), Present Temporal Focus ($\alpha = .82$), Future Temporal Focus ($\alpha = .85$), Pro-Environmental Intention ($\alpha = .83$), and Work Commitment ($\alpha = .86$).

Procedure

CloudResearch was commissioned to recruit 300 adults (over 18 years old) from the US, including only participants who had a minimum of (a) 100 task completions and (b) a 95% hit approval rate on the crowdsourcing marketplace Amazon Mechanical Turk (MTurk). Sample size was determined by our budgetary constraints. CloudResearch uses their SENTRY system prior to respondents entering the study, which automatically detects and filters out low-quality or fraudulent respondents. Participants completed the online survey via Qualtrics.

To improve data quality, we asked participants about their commitment to complete the study. We stated the following on the first page after they gave informed consent to partake in the study: **"We care about the quality of our survey data."** [bold in the original] For us to get the most accurate measures of your opinions, it is important that you provide thoughtful answers to each question in this survey. Do you commit to providing thoughtful answers to the questions in this survey?" All participants responded with "Yes, I will". The questionnaire then continued to the socio-demographic questions detailed below.

After the socio-demographic questions and before the participants could progress to the main part of the survey comprising the experimental manipulation, we asked them to have a break and concentrate on the questionnaire. The text read: "Thank you for agreeing to take part in this study and for your commitment. The main part begins on the next pages. Please read each question carefully to provide thoughtful answers. **You can start the main part of the survey soon. Take a few deep breaths before you start.**" [bold in the original] We forced participants to stay on this "deep breaths" page for 15 seconds before they could progress to the subsequent page. Participants were

then randomly presented with one of the experimental conditions, followed by two open-ended questions on the same page: "Please type the future time period that comes to mind", and "When thinking about the future, what was the main idea that came to mind?". These questions were used to make sure participants were fully engaged with and aware of the temporal thinking task, with answers to these questions used as a manipulation check or to validate answers to the dependent variable as detailed above.

The study was approved by the Human Research Ethics Committee at the authors' university (reference FS2024-02; approval date: 27 March 2024). We used the ethics application as a pre-registration of our research objectives and predictions. The ethics application and data are available for download from the Open Science Framework: <https://osf.io/hvgxk/files/osfstorage>.

RESULTS

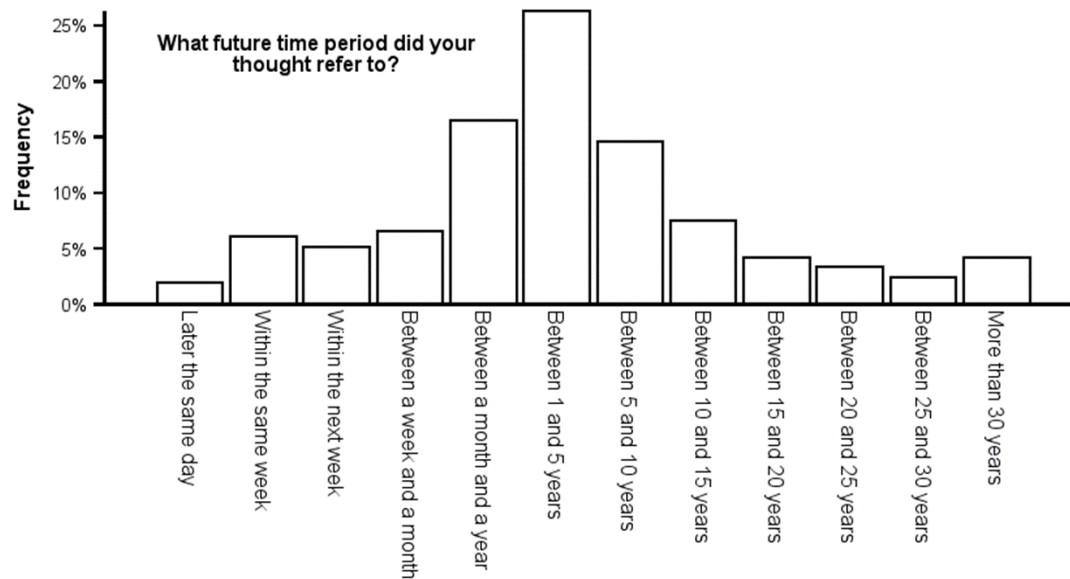
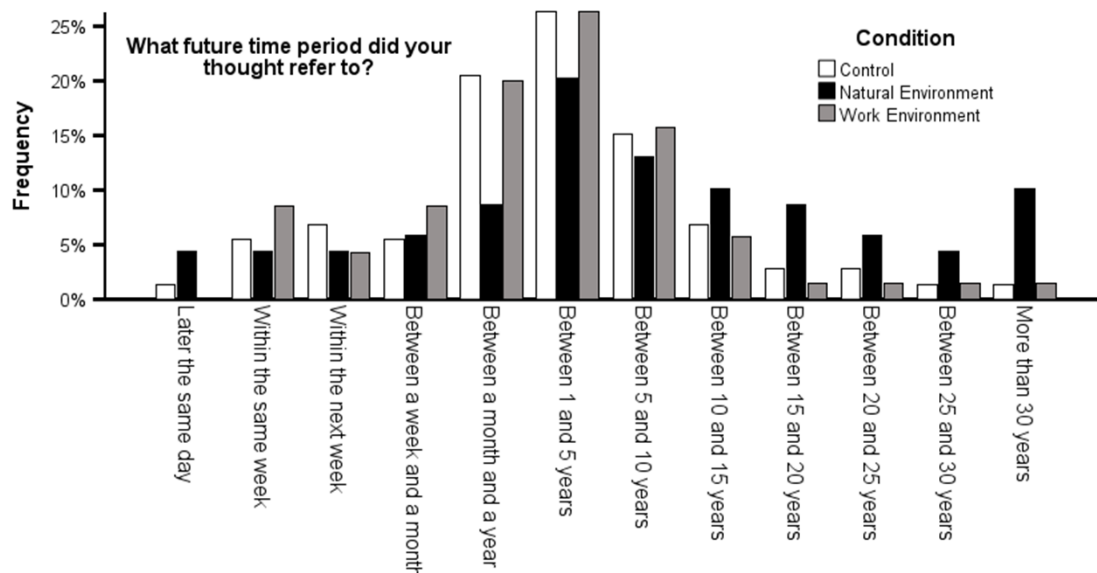
Manipulation and Attention Checks

We examined responses to the open-ended question presented after the experimental manipulation (i.e., "When thinking about the future, what was the main idea that came to mind?") to check if the manipulation worked. All conditions asked participants to think about the future, but the control condition focused on the future in general while the other conditions were specific about the future of the natural environment or the future of the work environment. The content of participants' answers should thus reflect the distinct requests made in each experimental condition. We provide all participants' answers for each condition in the Supplementary Material. We used generative artificial intelligence (AI) first to read the answers separately for each experimental condition and then to provide an independent summary of the answers using the prompt "Please provide a short summary of these statements". To replicate the generative AI summaries, we employed both ChatGPT version 3.5 and Gemini version 1.5 Pro, developed by OpenAI and Google, respectively. Table 1 provides three examples of verbatim answers given by participants in each condition and the summaries produced by generative AI. As expected, participants in the natural environment condition provided answers related to environmental issues, those in the work environment condition provided answers related to their careers or financial situation, and those in the control condition provided general answers about the future. Inspection of these responses provided qualitative evidence that the experimental manipulation worked.

After the experimental manipulation, participants completed the validated measures included in the survey. We included two attention check items embedded within the temporal focus and work commitment scales (i.e., "Please select 'Never' for this statement", "Please select 'Neutral' for this statement", respectively). Sixteen participants did not pass the first attention check and only 6 did not pass the second attention check. Excluding these participants did not impact the overall results reported below, so we kept all participants in the analysis.

Table 1. Inspection of open-ended answers to manipulation check question

Condition	Work Environment (n = 70)	Natural Environment (n = 69)	Control (n = 73)
Selected Verbatim Answers	" The increasing use of technology and automation in the workplace, leading to potential job displacement and changes in skill requirements." " I would like to see minimum wages go up to \$15-\$20 per hour because that would help tremendously to offset the high prices in the economy." " Things are changing at a very rapid pace. People will need to adapt."	" Considering the current trajectory of environmental degradation, it is imperative to acknowledge the concerning projections for the state of our environment in the next 50 years. Without swift and impactful actions to address climate change, habitat destruction, and pollution, there is a high likelihood of witnessing a significant decline in environmental quality which could ultimately result in potential challenges for the survival of human populations." " That we are destroying the natural environment and that it will come back to "bite" us through unintended consequences." " I am thinking of how we will leave it for the next generation, meaning my daughters who will be here when I'm gone."	" The main idea for me was hopefully in the future, that being 10 years from now, after I've been working very hard that I'll have earned a nice house, car, wife, family, and can finally enjoy my life." " I think about being a homemaker and living on a beautiful farm with many dogs." " I think about financial security and whether or not I will have enough income to survive."
AI summary produced by ChatGPT 3.5	The statements cover a range of thoughts and concerns about the future of work and the environment it entails. There's a focus on financial stability, technological advancements, potential job displacement due to automation, and the balance between work and personal life. Some express optimism about exploring new opportunities, while others fear job instability and stress. Concerns about income, job security, and the impact of technology on employment are prevalent themes. Overall, the text reflects a mixture of hopes, fears, and uncertainties about the evolving nature of work and its environment.	The statements collectively highlight various perspectives on the future condition of the natural environment and humanity's impact on it. There's a clear division between optimistic views of sustainability and proactive measures to protect the environment, and pessimistic outlooks driven by concerns about pollution, climate change, and the potential for environmental degradation. Themes such as urgency for collective action, the consequences of unchecked human activity, and the importance of environmental preservation emerge throughout the statements. Additionally, there's a focus on personal reflections regarding living conditions, financial stability, and the desire for positive change.	The statements reflect diverse considerations about the future, including personal aspirations, financial concerns, and family dynamics. People contemplate various time frames, from immediate needs like paying bills to long-term goals such as retirement planning. There's a mix of hope and apprehension, with individuals envisioning career advancements, family growth, and potential challenges like climate change. Overall, the future is viewed through a lens of uncertainty and anticipation, with people planning, dreaming, and preparing for what lies ahead in their lives.
AI summary produced by Gemini 1.5 Pro	The future of work is full of both opportunities and challenges. Some people worry about job displacement due to automation, while others see a chance for more remote work and flexible hours. There's a focus on financial stability and work-life balance, with some hoping for higher wages and shorter work weeks. Technology is expected to play a big role, with some concerned about AI and others excited about increased efficiency. Overall, there's a sense that the future workplace will be quite different from what we know today.	The future of the environment is a big concern. People worry that climate change, pollution, and resource depletion will leave a ravaged planet. Others are hopeful that we can take action to preserve nature and create a sustainable future.	The future sparks thoughts about our personal dreams, relationships, and well-being, alongside anxieties about finances, the planet's health, and aging. We grapple with both hopes for achievement and fears of the unknown.

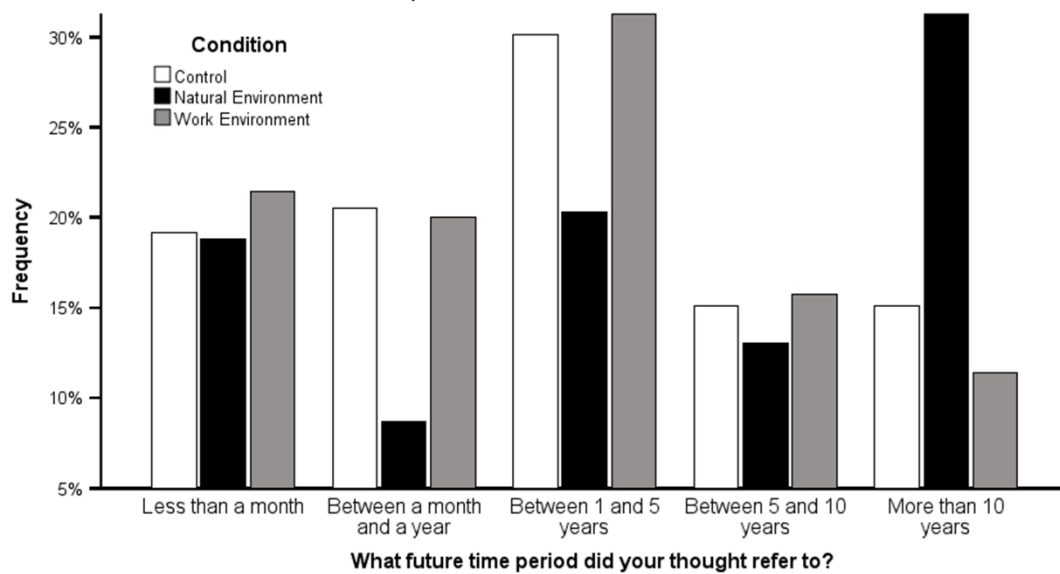
Figure 1. Temporal distance options selected by participants in the control condition.**Figure 2.** Temporal distance options selected by participants in each experimental condition.

Spontaneously Occurring Episodic Future Thinking

We began by examining the temporal distance that participants in the control group thought when asked about the future. As shown in Figure 1, the typical temporal distance for individuals asked to think about the future in a typical day in their lives is between 1 and 5 years. A chi-square goodness-of-fit test confirmed that there are statistically significant differences between the observed and expected (equal) frequencies in each category, $\chi^2(11, n = 73) = 78.73, p < .001$, indicating differential preference of the temporal distances. These results indicate a clear preference for temporal distance between 1 and 5 years, but our prediction is that episodic future thinking would differ as a function of the experimental manipulation which we examine next.

Episodic Future Thinking as a Function of Experimental Condition

Visual inspection of the data in Figure 2 clearly indicates consistencies and variability across conditions. First, the selection of the 1-to-5-years option was consistent across experimental conditions, indicating that individuals' episodic future thinking is not too far ahead into the future (regardless of the temporal framing of the question). Second, participants in the control and work environment conditions showed similar temporal preferences, particularly the three options comprising temporal frames between a month and 10 years. Finally, participants in the natural environment condition were more likely to select options for longer temporal distances, including 7 participants who selected the more temporally distant option of over 30 years—only 1 participant in each of the other conditions selected this option.

Figure 3. Recoded temporal distance options selected by participants in each experimental condition.

Data in Figures 1 and 2 indicate low preference for responses at both endpoints of the temporal distance options. Given the distribution of responses and to increase parsimony, we reduced the 12 options into 5 by combining the first four low-end options into a “less than a month” category and by combining the last five high-end options into a “more than 10 years” category. Figure 3 presents the temporal distance preference for each condition after this recode. We then conducted a chi-square test of independence to examine the temporal distance preference across the experimental conditions. The results indicated that the relationship between the three experimental conditions and the five temporal distance categories was statistically significant, $\chi^2(8, n = 212) = 20.55, p = .008$. Overall, and confirming our predictions, the results indicate that participants asked to think about the future of the natural environment are more likely to consider longer temporal distance compared to those asked to think about the future in general or to think about the future of the work environment. Though individuals tend to think in relatively short-term (i.e., between 1 and 5 years), when primed to think about the natural environment, participants’ temporal distance extends longer.

To provide another indication of the impact of the manipulation on episodic future thinking, we examined

the responses participants gave to the open-ended question presented right after the experimental manipulation: “Please type the future time period that comes to mind”. Examining participants’ responses from each condition independently, we prompted generative AI to convert the responses into numeric format and then calculate an average temporal scale. According to ChatGPT 3.5, responses in the control condition had an average temporal scale of approximately 9.19 years, those in the work environment condition an approximate average of 10.97 years, and those in the natural environment condition an approximate average of 30.3 years. According to Gemini 1.5 Pro, the average temporal scale in the control condition was approximately 5.48 years, approximately 3.96 years in the work environment condition, and approximately 9.51 years in the natural environment condition. Although the temporal scale averages varied across the generative AI, both indicated that responses given by participants in the natural environment condition comprised longer temporal distance than responses given by those in the other experimental conditions. In conjunction, the results from the multiple-choice question summarised in Figures 2 and 3, as well as summaries independently produced by generative AI when analysing responses from an open-ended question, confirm that people’s episodic future

Table 2. Descriptive statistics and ANOVA results examining experimental impact on other variables.

Dependent Variable	Control (<i>n</i> = 73)		Nature (<i>n</i> = 69)		Work (<i>n</i> = 70)		<i>F</i>	<i>p</i> -value
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Past focus	4.33	1.31	4.31	1.29	4.31	1.29	1.01	0.37
Present focus	4.85	1.11	4.92	1.05	4.92	1.05	0.09	0.92
Future focus	4.89	1.19	4.97	1.11	4.97	1.11	0.17	0.84
Positive mood	3.06	0.97	3.16	0.88	3.16	0.88	0.20	0.82
Negative mood	1.97	0.97	2.04	1.17	2.04	1.17	0.58	0.56
Pro-Environmental Intention	3.42	0.78	3.49	0.68	3.49	0.68	0.38	0.68
Work Commitment	4.42	1.32	4.53	1.07	4.53	1.07	0.45	0.64

thinking extends longer into the future when thinking about the future of the natural environment.

Impact of the Experimental Manipulation on Other Variables

Finally, we examined whether the experimental manipulation impacted other variables included in our study. To recap, we expected no experimental impact on mood, and that scores on the future focus, pro-environmental, and work commitment measures would be highest in their matched conditions. Table 2 presents these additional results. As expected, the experimental manipulation had no impact on participants' mood. However, results indicate that across conditions, participants did not differ in any of the other measures considered. One possible explanation is that while the scenarios were sufficient to shift participants' temporal frame, confirming our main prediction, the scenarios depicted in the experimental manipulations may not have been strong or immersive enough to alter or activate trait-level constructs. We elaborate further on this in the Discussion section.

DISCUSSION

Humans think about events from the past and imagine events that may happen in the future. This ability, known as mental time travel, is well-documented in psychology and research has identified a temporal asymmetry indicating that we are more likely to plan and anticipate events still to happen in the future than to reflect on or look back at past events or experiences. One reason for this bias towards the future is the fact that the future is mutable while the past is already gone, as neatly illustrated in the quote from Baumeister, Vohs and Oettingen (2016) that opened this manuscript. Related to this temporal asymmetry, episodic future thinking is a cognitive process that helps us use our past and present to construct new future scenarios. This capacity to envision and plan possible future events or scenarios based on past experiences and present circumstances is critical for human functioning, but one relatively unexplored topic is the extent to which episodic future thinking comprises shorter or longer temporal distances when individuals think about the future in general or when thinking about the future of the natural environment. We addressed this question in the present experimental study, which provides two main contributions to the literature.

First, our findings indicate that the typical temporal distance people tend to think into the future is relatively short, comprising between 1 and 5 years. This aligns with previous research suggesting that long-term planning is uncommon for most people and that a five-year timeframe is the most typical temporal distance people feel comfortable envisioning (e.g., Berntsen & Jacobsen, 2008; Van Der Duin et al., 2020). Thus, our findings further illustrate that we are limited in our capacity to travel into the future, which is important when considering the temporal mismatch between individuals' future thinking abilities and the policies created for long-term change, such as environmental policies.

It is worth noting that how far people can think into the future may depend on individual differences, such as a person's future sightedness or what they anticipate the future will hold (Thorstad & Wolff, 2017; Bulley et al., 2016), people's executive processing (D'Argembeau et

al., 2010), and even personality traits (Fortunato & Furey, 2009). Individuals' future thinking ability can also be influenced by their cultural milieu (Wang et al., 2014; Sircova et al., 2015). Within Aotearoa New Zealand, this is illustrated by this Māori Whakatauki: *Kia whakatōmuri te haere whakamua* – I walk backwards into the future with my eyes fixed on my past. Cultural differences in the scales at which people experience and perceive environmental issues exist and can be mismatched from the scales at which policy takes place. In particular, understanding temporal scales and mismatches can improve environmental outcomes (Cosens et al., 2017).

Notwithstanding potential individual and cultural differences, evidence indicates that people are cognitively more comfortable in thinking about the future in short temporal distance. This is illustrated by findings reported by Berntsen and Jacobsen (2008), who found that 90% of voluntary future thinking and 98% of involuntary future thinking occurred within five years of a person's future. A large US study with more than 2,800 adults conducted by the Institute for the Future (2017) also found that 27% of participants rarely thought about the future further than five years, 36% of participants rarely thought about the future further than ten years, and 53% of participants rarely thought about the future past 30 years. Experimental research using prospect-prime manipulations to induce participants to think about the future instead of the present also typically uses temporal distances within this range (e.g., 4 years in the future; Cheng, Shein, & Chiou, 2011, Experiment 1). These findings align with Roberts and Feeny's (2009) bi-cone structure explaining humans' ability to mental time travel. According to their visual representation of a bi-cone structure, the cones for mental travel to the past and to the future are widest closer to the present, as people can recall memories and think about the immediate future quicker than they can think about the longer-term past or future. The further away the future thought is, the harder it is for the person to imagine or plan for this, with less detail or goal consideration taken (see also Liberman & Trope, 2008).

That we have a limited capacity to mentally travel too far into the future has important implications for the management of natural resources, which brings us to the second main contribution of our study. We demonstrated that temporal distance varies as a function of the experimental manipulation, being much longer into the future when participants are primed to think about the natural environment compared to thinking about the future in general or the future of the work environment. Our findings provide some level of assurance that individuals are likely to think in longer temporal distances when considering the natural environment. This suggests not only that individuals are *willing* to think long-term when prompted, but also that they are *able* to do so particularly in the environmental domain. The timescale mismatch between human cognition and long-term issues, as discussed by Wilson et al. (2015), remains a challenge; however, our findings offer a hopeful insight that considering the future of the natural environment may temporarily extend individuals' temporal focus. Future research could explore how to sustain this effect and identify the traits or contexts that make individuals more responsive to long-term framing. This is important

because intertemporal decision making is critical in the environmental domain (Hendrickx, Poortinga, & van der Kooij, 2001), involving a resource dilemma whereby individuals must give up personal immediate rewards to achieve greater long-term environmental advantages for the collective. Predictably, research has shown future thinking to be associated with delay discounting, indicating that a preference for immediate rewards is more likely among individuals with lower levels of future-oriented thinking (e.g., Macaskill, Hunt, & Milfont, 2019). Similar findings are observed when considering episodic future thinking more specifically, with episodic future thinking being associated with reduced delay discounting (Ye et al., 2022).

While the idea that individuals might naturally lean towards long-term considerations as a result of thinking about the future of the natural environment is somewhat comforting, the issue is more complex. To illustrate, the management of natural resources involves not only temporal considerations but also mismatching levels of scale organisationally (e.g., government agencies; iwi, hapū and whānau; NGOs) and spatially (e.g., local, regional, national). Hence, it is important to consider the interplay between these organizational, spatial and temporal scales for effective conservation of natural resources. Although this interplay is not tackled explicitly, Wilson et al. (2015) discuss critical cognitive and structural tools decision-makers can use to mitigate time-scale mismatches that could also be useful for examining other scale mismatches. While cognitive tools alter how information is processed and used during decision-making (e.g., changing the perceived value of gains and costs over time to motivate conservation actions), structural tools modify the consequences of actions (e.g., financial incentives, changing the default). Managing complex socio-ecological problems will require recognizing (and ideally resolving) these problematic mismatches. Indeed, explicitly identifying scale dependencies between social, ecological and organisational levels will be important to improve decision making.

Our findings also contribute to the growing literature on the role of future thinking in environmentalism, which has shown greater future orientation associated with stronger pro-environmental attitudes and behaviours across diverse methods and cultural contexts (e.g., Arnocky et al., 2013; Bain et al., 2016; Carmi & Arnon, 2014; Milfont & Sibley, 2011; Milfont, Wilson, & Diniz, 2011; Syropoulos et al., 2023; Zaval, Markowitz, & Weber, 2015). While previous research has primarily examined how future thinking can mobilise pro-environmental attitudes and behaviours—treating temporal thinking as an antecedent of environmentalism—we extend this work by testing the reverse: whether thinking about the natural environment can, in turn, influence people's temporal frames. We believe this is a promising new research direction, and future studies could attempt to integrate these two perspectives into a single experimental design, which would generate new insights for future–environmentalism links and the management of natural resources.

Finally, our study also illustrates the application of generative AI for qualitative data analysis, which is an emerging line of research (Morgan, 2023). In a recent *Nature* commentary, Gruda (2024) outlined applications of generative AI in academic writing, editing and peer

review. The broader potential of generative AI has also begun to be explored beyond academic writing. Take personality research as an example. Contemporary models of personality have taken a lexical approach, contending that natural languages offer valuable information into terms or traits used to characterize individuals (Goldberg, 1981). By selecting trait-descriptive adjectives from dictionaries to create assessment tools, researchers asked individuals to rate these naturally occurring adjectives to describe themselves and others, leading to the identification of main personality domains, such as the Big Five model of personality comprising Openness to Experience, Conscientiousness, Extraversion, Agreeableness, and Neuroticism (John & Srivastava, 1999). Given that these personality domains were originally drawn from natural languages, and generative AI uses large language models, the generative AI technology is well-suited for validating findings from personality research. Indeed, a growing literature is using generative AI to create personas (e.g., an adult from South Korea) and then investigate whether personality data generated by these personas validates personality research findings from real participants (e.g., de Winter, Driessen, & Dodou, 2024; Niszczoła & Janczak, 2025). In a less sophisticated but still interesting application, we used generative AI to expedite the analysis of qualitative data.

Before concluding, it is important to note limitations of our study. First, we expected to have a larger sample size, but due to participant recruitment issues experienced by CloudResearch, we had to stop data collection with over 200 participants instead of the 300 targeted. Yet, we still had a relatively large number of participants in each experimental condition. Second, we relied on a single multi-choice question as our dependent variable, which limits the validity of our findings. The measure was inspired by temporal distances observed in a previous study (D'Argembeau, Renaud, & Van Der Linden, 2011); however, in hindsight, we could have used other measures such as a slider question starting from 'later today' to 'over 50 years'. Third, it is possible that the effect of the experimental manipulation may interact with participants' traits. This was not the goal of this study, but future high-powered studies could examine, for example, whether individuals' variation in how far they naturally think into the future would interact with the manipulation framing. It is possible that the manipulation would be heightened for future-prone individuals (cf. Nowack, Milfont, & van der Meer, 2013), who would then think over longer temporal distances when considering the future of the natural environment when compared to their counterparts. Finally, our sample was limited to MTurk participants from the US due to the convenience of collecting data using CloudResearch. It would be important to replicate our findings in Aotearoa New Zealand, particularly knowing that Māori temporal thinking about the past and the future tends to be much longer term, as illustrated by an emphasis on genealogy (*whakapapa*) and the wellbeing of *Papatūānuku* (the Earth Mother) to future generations (see, e.g., Bargh et al., 2023).

To conclude, our study provides further evidence that individuals tend to think in short temporal horizons (typically between 1 and 5 years) and novel evidence indicating that this typical temporal distance extends into longer time distance when individuals are asked to think

about the future of the natural environment (compared to thinking about the future in general or the future of the work environment). Thinking about the future has practical implications for resource management and other policy areas illustrated by a dedicated page by the Department of the Prime Minister and Cabinet (<https://www.dpvc.govt.nz/our-programmes/policy-project/policy-methods-toolbox/futures-thinking>). Future research investigating temporal framing alongside policy-makers' priorities and community reactions to those policies will be key to better decision-making and resource management. We hope this study, which provides novel evidence for extended future thinking about the natural environment, inspires further research on the topic.

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