

## Article

# Envisaging Mitigation Action Can Induce Lower Discounting toward Future Environmental Gains and Promote Pro-Environmental Behavior

Liang-Chu Ho <sup>1</sup>, Yu-Hsien Sung <sup>1</sup>, Chia-Chun Wu <sup>2</sup> , Pei-Shan Lee <sup>1</sup>  and Wen-Bin Chiou <sup>1,\*</sup> 

<sup>1</sup> Institute of Education, National Sun Yat-sen University, Kaohsiung 80424, Taiwan;

ellen@livemail.tw (L.-C.H.); sung6306@hotmail.com (Y.-H.S.); guidance33@gmail.com (P.-S.L.)

<sup>2</sup> Department of Psychology and Social Work, National Defense University, Taipei 112061, Taiwan; wuchaichai@gmail.com

\* Correspondence: wbchiou@mail.nsysu.edu.tw

Received: 2 October 2020; Accepted: 6 November 2020; Published: 9 November 2020



**Abstract:** Low engagement with climate change may stem from the tendency to discount the distant benefits of mitigation action. Hence, a reduced tendency to discount the future should be associated with increased involvement in climate change mitigation. Prior research has demonstrated that episodic future thinking (EFT; i.e., envisioning future events that involve self-projection) can reduce discounting. In two laboratory studies, we showed that engaging in EFT about mitigation action was associated with a lower discounting tendency toward future environmental gains (Experiments 1 and 2) and a greater tendency to act pro-environmentally, as manifested by using air conditioning in an energy-saving manner (Experiment 1), choosing a meal with less environmental impact (Experiment 2), and willingness to participate in beach cleaning (Experiment 2). The present findings suggest that engagement in EFT about mitigation action may represent a promising strategy for improving personal involvement in climate change.

**Keywords:** climate change; discounting; episodic future thinking; mitigation; pro-environmental behavior

## 1. Introduction

Many people still perceive climate change as a remote, future threat [1–4]. Due to the long-term and uncertain nature of climate change impact, the general public appears to discount the future threats of climate change and the distant benefits of mitigating behavior [5–8]. From a psychological approach, the tendency to discount future gains should be a crucial determinant of engaging in climate change mitigation. Prior research on interventions to reduce the discounting tendency suggests that engaging in episodic future thinking (EFT; self-projection of oneself to pre-experiencing future events [9]) can induce individuals to discount the future less [10–15]. In this article, we report experimental demonstration that engaging in EFT to pre-experience life events involving mitigation can reduce the tendency to discount future environmental gains and promote the tendency to act pro-environmentally.

### 1.1. Episodic Future Thinking and the Discounting Tendency

In principle, EFT refers to vivid mental simulation of future events, whereas semantic future thinking (SFT) refers to general knowledge about future events [9]. Taking intended future mitigation behaviors as an example, engagement in SFT about mitigation behavior may entail enacting more scriptlike knowledge (e.g., taking public transport for short journeys, using environment-friendly tableware, or choosing a meal with lower environmental impact), whereas engagement in EFT about mitigation behavior may entail more vivid and concrete mental representations of action episodes that

include places, objects, occasions, and specific times in the future. The distinction between SFT and EFT in relation to mitigation behavior is basically the distinction between merely knowing about mitigation actions and implementing mitigation actions in the future. Thus, engaging in EFT rather than SFT would be more likely to induce a future-oriented mindset. Engaging in EFT has been demonstrated to stimulate brain substrates related to prospective thinking, leading to a future orientation [10,16,17]. Research has shown that engaging in EFT reduces the tendency toward discounting future gains. For example, Peters and Büchel [17] demonstrated that engaging in EFT was associated with less discounting of intertemporal choices. Similarly, Cheng and Chiou [18] showed that engaging in prospective imagery resulted in less discounting of future gains achieved by saving. Daniel et al. [11] also showed that EFT intervention was sufficient to reduce discounting tendencies among obese and lean participants.

Furthermore, engaging in EFT requires individuals to envision themselves acting at a particular time and place in the future. Using EFT to pre-experience future life events associated with mitigation acts might be particularly relevant to future implementation of our intended actions. Accordingly, Atance and O'Neill [9] argued that EFT mediates the effect of implementing intention on behavioral change and goal attainment. For example, participants instructed to list the positive aspects of their desired future (SFT manipulation) were less likely to fulfill their goals [19,20]. Compared with participants who had only formed the goal of taking a vitamin C pill (i.e., engaging in SFT), those who were required to project themselves into a particular time and place in which they were taking the pill (i.e., engaging in EFT) missed fewer doses in the future [21].

In sum, the effect of EFT in reducing discounting may occur because the prospective mental representations involved in EFT stimulate one's consideration of distant benefits [10,18] or the value of future outcomes [22–24]. Prompting the consideration of future gains should be associated with a lower discounting tendency toward the future [24–27]. Therefore, engaging in EFT about mitigation actions may lead to a greater focus on a future environmental payoff. Thus, we predicted that EFT focused on life events related to mitigation action would induce a lower discounting tendency toward future gains from climate change mitigation.

### *1.2. The Discounting Tendency and Pro-Environmental Behavior*

Communications of the future impacts of climate change have been framed as distant threats [2,8]. At the individual level, the discounting of a future risk such as climate change represents a pervasive tendency in which daily, immediate concerns take precedence over remote threats [5,28]. A viable explanation for less engagement of the general public with climate change is that the negative impacts of climate change tend to be perceived as a set of distant, uncertain events [2,6,8,29]. Nevertheless, individuals also tend to discount the future benefits of taking mitigation action toward climate change [5–7]. The large but delayed benefits of pro-environmental behavior are less attractive than the less pro-environmental choice with lower response effort and achieving short-term outcomes [7,30]. Thus, the discounting tendency may play a crucial role in climate change engagement by leading to less focusing on future gains of mitigating behavior [31,32].

The effect of engaging in EFT on the discounting tendency suggests that a mindset intervention that promotes future orientation should induce individuals to be both more deterred by the delayed costs of doing nothing to mitigate climate change and more attracted by the distant benefits of taking mitigating action. Thus, a strong focus on the future should lead to more engagement in pro-environmental behavior [24,32,33]. Given that engaging in EFT about mitigation action would reduce the tendency to discount future environmental gains, this lower discounting tendency should increase the likelihood of acting pro-environmentally.

### *1.3. Overview of the Current Research*

In sum, the abovementioned theoretical considerations and empirical findings suggest that engaging in EFT to envisage life events related to mitigation action should be effective in reducing

the discounting tendency toward future environmental gains and promoting the tendency toward pro-environmental acts. We conducted two laboratory experiments to test whether engaging in EFT regarding mitigating action would reduce the tendency to discount the future and increase the tendency to perform pro-environmental behavior. Specifically, Experiment 1 examined whether engaging in EFT to envisage life events related to mitigating action is associated with a lower level of discounting toward future environmental gains and a higher likelihood of using air conditioning in an energy-saving manner. Experiment 2 was a replication study in which the effects of engaging in mitigation-EFT on other pro-environmental behaviors (e.g., choosing a meal with lower environmental impact and participating in a beach-cleaning activity) were examined. Moreover, the mediating role of discounting in the relationship between engaging in mitigation-EFT and pro-environmental behavior was tested. In addition, SPSS software (version 19.0; © 2010; IBM SPSS, Inc., Chicago, IL) was used to perform statistical analyses. The PROCESS Macro for SPSS (version 3.5; © 2012–2020 by Andrew F. Hayes; [www.afhayes.com](http://www.afhayes.com)) was employed to assess the indirect effect of the mediation model.

## 2. Experiment 1

### 2.1. Method

We recruited 93 college students (51 females and 42 males; mean age = 20.9 years,  $SD = 1.2$ ) at a university in southern Taiwan to participate in this experiment. The sample size was obtained by calculating the required sample size for a one-factor between-subjects design ( $\alpha = 0.05$ ,  $\omega^2 = 0.10$ , and power = 0.80) [34]. The present study was conducted in accordance with the Declaration of Helsinki and was approved by the IRB of Kaohsiung Medical University. The informed consent was obtained from all participants.

Participants were told that they would engage in pilot testing of several unrelated tasks. Every three participants were randomly assigned to one of the three experimental conditions (EFT, SFT, and control) via block randomization. In the mitigation-EFT condition, the participants were asked to write down three future life events associated with mitigation action that they would enact on in the future. Each participant was then instructed to close eyes and to envisage the events s/he had listed as specifically and vividly as possible (such as a specific time of day, the setting and occasion of the events, the persons and objects that would be present during the event) [15,35]. They had 2 min to pre-experience each life event mentally. In the mitigation-SFT condition, the participants were instructed to write down three mitigation behaviors that they would enact in the future. The yoking procedure was employed to match the time allowed to perform the thinking task [15]. To avoid the problem that manipulation checks may amplify, undo, or interact with the effects of a manipulation [36], we conducted a pilot study ( $N = 60$ ; 32 females) to check on the effectiveness of our thinking manipulation. Participants were randomly assigned to perform either the mitigation-EFT or mitigation-SFT tasks. After task completion, all participants were asked to rate the vividness and concreteness of their mental representations on a 7-point scale (1 = *not at all*, 7 = *very much*). The ratings of vividness ( $M$  (mean) = 5.27,  $SD$  (standard deviation) = 0.91;  $t(29) = 7.648$ ,  $p < 0.001$ , Cohen's  $d = 1.39$ ) and concreteness ( $M = 5.13$ ,  $SD = 0.94$ ;  $t(29) = 6.624$ ,  $p < 0.001$ ,  $d = 1.21$ ) under the mitigation-EFT condition were significantly higher than the midpoint of the scale (test value = 4.0). Moreover, both ratings of vividness and concreteness were significantly greater under the mitigation-EFT condition than those under the mitigation-SFT condition (vividness:  $M = 3.33$ ,  $SD = 1.03$ ;  $t(58) = 7.722$ ,  $p < 0.001$ ,  $d = 1.99$ , mean difference = 1.94, 95% confidence interval (CI): 1.43–2.43; concreteness:  $M = 3.97$ ,  $SD = 1.07$ ;  $t(58) = 4.502$ ,  $p < 0.001$ ,  $d = 1.83$ , mean difference = 1.16, 95% CI: 0.65–1.67). These findings indicate that the effects of the EFT versus SFT manipulations on mental representations differed as intended. In the control condition, the participants did not receive any thinking manipulation. Instead, they completed an unrelated questionnaire (i.e., the Big Five Inventory) [37–39]. It took approximately 6–8 min for control participants to finish the ostensible survey. The mean time spent completing the experimental task among the three experimental conditions was approximately equal.

Later, all participants completed an ostensible questionnaire. The first part involved a temporal-discounting task regarding a gain scenario of air quality improvement, which was adapted from Hardisty and Weber [30]. Participants first read “Instead of taking the bus or using a mass rapid transit system, the majority of university students in Kaohsiung City use scooters as their primary mode of transport [40]. However, the CO<sub>2</sub> emissions from driving scooters are three or four times those from driving cars.” They were then instructed to envisage that the city government was considering a fare-compensation policy to encourage university students to use mass transit. Air quality would improve significantly for a period of 7 weeks if most of them took public transportation for short journeys. The government planned to implement the policy immediately for 7 weeks but was also considering doing it 1 year in the future, for a different length of time. Participants selected between “improved air quality immediately for 7 weeks” and “improved air quality 1 year from now for the same number of weeks or more” in eight binary choices. The number of weeks in the future was 7, 8, 9, 10, 11, 12, 13, or 14. Following the method for measuring the discounting tendency in a nonmonetary task [30,41], the discounting rate ( $k$  = indifference value/7–1) for each participant was computed. Larger values of the discounting rate represent greater discounting toward future environmental gains. Besides demographic questions (i.e., sex, age, ethnicity, and program), the second part included an item assessing the tendency toward pro-environmental action (“From now on, are you willing to turn on the air conditioning only when the room temperature is > 28 °C?”). The tendency toward energy-saving use of air conditioning was rated on a 7-point scale (0 = *very unlikely*, 6 = *very likely*).

## 2.2. Results and Discussion

As predicted, an analysis of variance (ANOVA) of the discounting measure revealed that the discounting tendency toward future environmental gains was related to experimental condition ( $F(2, 90) = 4.057, p = 0.021, \eta^2_p = 0.08$ ; Table 1). Participants under the mitigation-EFT condition showed lower discounting rates ( $M = 0.34$ ) than did those in the mitigation-SFT ( $M = 0.49; t = -2.385, p = 0.019, d = 0.64$ ; mean difference = 0.15, 95% CI: 0.03–0.27) and control ( $M = 0.50; t = -2.542, p = 0.013, d = 0.67$ ; mean difference = 0.16, 95% CI: 0.04–0.28) groups. The difference in the discounting rate between the mitigation-SFT and control condition was not significant ( $t = -0.157, p = 0.876$ ).

**Table 1.** The discounting tendency and the tendency toward energy-saving use of air conditioning as a function of experimental condition.

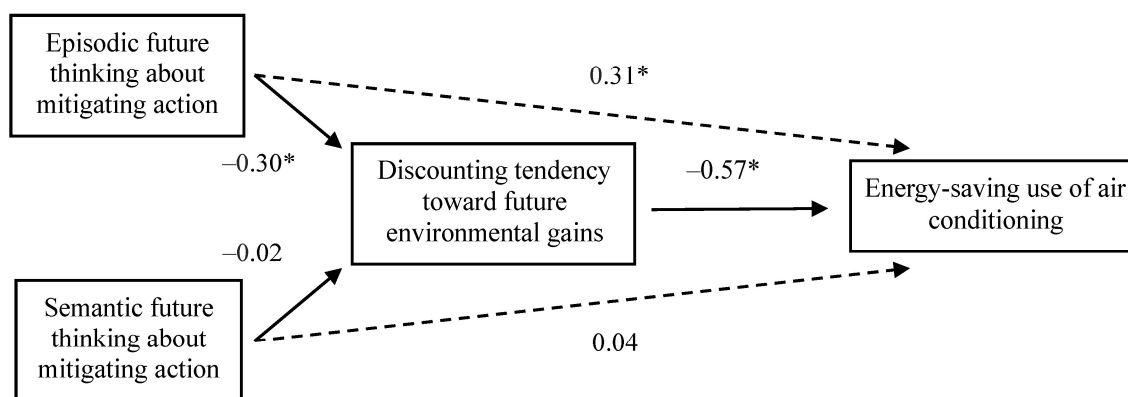
Measure	Mitigation-EFT		Mitigation-SFT		Control	
	Mean	SD	Mean	SD	Mean	SD
Discounting rate ( $k$ parameter)	0.34	0.23	0.49	0.24	0.50	0.25
Tendency toward energy-saving use of air conditioning (0–6)	5.26	1.55	4.23	1.73	4.10	1.81

Note: Each study condition consisted of 31 participants. Units of the measure are given in parentheses. A larger discounting rate represents a higher tendency to discount future environmental gains. EFT = episodic future thinking. SFT = semantic future thinking. SD = standard deviation.

As expected, the ANOVA of the dependent measure showed that the tendency toward energy-saving use of air conditioning was associated with experimental condition ( $F(2, 90) = 4.346, p = 0.016, \eta^2_p = 0.09$ ; Table 1). Participants in the mitigation-EFT group were more likely to report that they were willing to use air conditioning in an energy-saving manner ( $M = 5.26$ ) than were those in the mitigation-SFT ( $M = 4.23; t = 2.391, p = 0.019, d = 0.63$ ; mean difference = 1.03, 95% CI: 0.19–1.87) and control ( $M = 4.10; t = 2.690, p = 0.009, d = 0.69$ ; mean difference = 1.16, 95% CI: 0.32–2.00) groups. The tendency toward energy-saving use of air conditioning did not differ between the mitigation-SFT and control groups ( $t = 0.299, p = 0.776$ ).

We further examined whether the discounting tendency toward future environmental gains would act as a mediator of the experimental effect. Two dummy variables (the first dummy variable for the mitigation-SFT condition and the second dummy variable for the mitigation-EFT condition)

were created for our three-group categorical independent variable with treating the control condition as the reference category (see Figure 1). Results of bootstrap analysis [42] revealed a nonsignificant indirect effect ( $B$  (unstandardized beta) = 0.04,  $SE = 0.25$ , the 95% bias-corrected confidence CI:  $-0.44$  to  $0.57$ ; bootstrap resamples = 5000) in the relationship between engaging in mitigation-SFT and the dependent measure (i.e., energy-saving use of air conditioning) but a significant indirect effect ( $B = 0.63$ ,  $SE = 0.26$ , the 95% bias-corrected confidence CI:  $0.15$  to  $1.16$ ) in the relationship between engaging in mitigation-EFT and the dependent measure.



**Figure 1.** The mediation model for Experiment 1. Dashed-line arrows indicate direct effects of thinking manipulation on the tendency toward energy-saving use of air conditioning. Path values are standardized coefficients. Asterisks indicate significant coefficients ( $p < 0.05$ ).

Specifically, engaging in mitigation-EFT was inversely related to the discounting rate ( $B = -0.16$ ,  $SE = 0.06$ ,  $t = -2.542$ ,  $p = 0.013$ ); the discounting rate was negatively associated with the tendency toward energy-saving use of air conditioning ( $B = -3.99$ ,  $SE = 0.61$ ,  $t = -6.573$ ,  $p < 0.001$ ). The association between engagement in mitigation-EFT and the tendency to use air conditioning in an energy-saving manner ( $B = 1.16$ ,  $SE = 0.43$ ,  $t = 2.69$ ,  $p = 0.009$ ) became nonsignificant ( $B = 0.53$ ,  $SE = 0.37$ ,  $t = 1.448$ ,  $p = 0.151$ ) when controlling for the discounting rate.

Our first experiment demonstrated that engagement in mitigation-EFT can induce a lower discounting tendency toward future environmental gains and promote the tendency to use air conditioning in an energy-saving manner. Moreover, the discounting tendency toward future environmental gains mediated the link between engagement in mitigation-EFT and the tendency toward pro-environmental action. In the second experiment, two behavioral measures were employed to replicate the effect of engagement in mitigation-EFT on the tendency to act pro-environmentally.

### 3. Experiment 2: A Replication Study

#### 3.1. Method

One hundred and two undergraduates (54 females, 48 males; mean age = 20.7 years,  $SD = 1.3$ ) at a university in southern Taiwan were recruited to participate in this experiment. Participants received extra course credits for their participation. Our first experiment included a control condition. However, we found no significant differences in the dependent measures between the control and mitigation-SFT conditions. Hence, we included only the mitigation-EFT and mitigation-SFT in the replication. The required sample size was determined by calculating the sample size required for testing the mean difference between two study groups ( $\alpha = 0.05$ ;  $d = 0.50$ , medium effect size; power = 0.80) [34].

Upon arrival at the laboratory, participants were told that they were helping us with pilot testing of several unrelated tasks. After providing consent, participants were randomly assigned to receive either the mitigation-EFT or mitigation-SFT manipulation. Two experimental manipulations were identical to those employed in our first experiment.



After experimental manipulation, participants were instructed complete the discounting task, which was identical to that of Experiment 1. The experimenter presented a participation reward sheet after participants completed the discounting measure. Following Lee et al. [43], participants made the choice between vegetarian and nonvegetarian meal boxes. The reward sheet contained information about the price, caloric content, and the level of carbon dioxide emissions. The price and caloric content of the two meal boxes were identical. However, the level of carbon dioxide emissions of the vegetarian option was lower than that of the nonvegetarian option. At the end of the experiment, the experimenter mentioned an upcoming beach-cleaning activity and then exited the laboratory to bring the chosen meal box for each participant. Thus, participants were left alone to indicate their participation willingness by providing contact information. The choice of a vegetarian meal box (i.e., a diet with lower environmental impact) and participation willingness toward participating in a pro-environmental activity were used as the dependent measures of this experiment.

### 3.2. Results and Discussion

Table 2 reveals that participants in the mitigation-EFT group showed a lower discounting tendency toward future environmental gains ( $M = 0.38$ ) than did those in the mitigation-SFT group ( $M = 0.48$ ;  $t(100) = -2.504$ ,  $p = 0.043$ ,  $d = 0.40$ ; mean difference = 0.10, 95% CI: 0.003–0.02). Both the choice of a diet with lower environmental impact (i.e., a vegetarian meal box;  $\chi^2 = 4.772$ ,  $p = 0.03$ ) and the willingness to participate in beach cleaning ( $\chi^2 = 4.752$ ,  $p = 0.029$ ) were associated with experimental condition. A logistic regression analysis revealed that a diet with lower environmental impact was more often chosen as a participation reward by participants under the mitigation-EFT condition (20 of 51) than by those under the mitigation-SFT condition (10 of 51;  $B = 0.97$ ,  $SE = 0.46$ ,  $p = 0.032$ , Wald = 4.58, odds ratio (OR) = 2.65, 95% CI: 1.09–6.45). A similar pattern of participation willingness toward a beach-cleaning activity was also found, showing that participants under the mitigation-EFT condition were more likely to indicate that they would participate in a beach-cleaning activity (30 of 51) than were those under the mitigation-SFT condition (19 of 51;  $B = 0.88$ ,  $SE = 0.41$ ,  $p = 0.031$ , Wald = 4.68, OR = 2.41, 95% CI: 1.09–5.33).

**Table 2.** Descriptive statistics of the measures in Experiment 2.

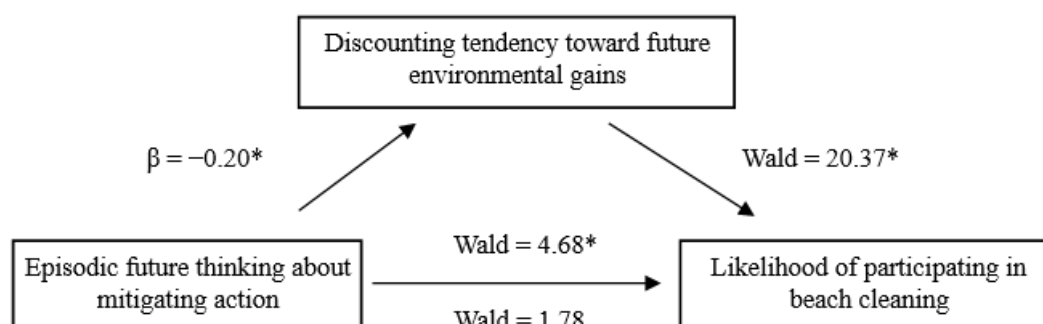
Measure	Mitigation-EFT		Mitigation-SFT	
	Mean	SD	Mean	SD
Discounting rate ( $k$ parameter)	0.38	0.25	0.48	0.25
Choosing a vegetarian meal box (%)	39.2	4.9	19.6	4.0
Participating in beach cleaning (%)	58.8	5.0	37.3	4.9

Note: Each study condition involved 51 participants. Units of the dependent measure are presented in parentheses. A smaller discounting rate indicates a lower tendency to discount future environmental gains. EFT = episodic future thinking. SFT = semantic future thinking. SD = standard deviation.

Moreover, we employed linear regression and logistic regression analyses to examine whether the discounting tendency toward future environmental gains mediated the link between the thinking manipulation and the choice of a diet with lower environmental impact (i.e., a vegetarian meal box). The mitigation-SFT condition was treated as the reference group for the dummy variable (1 = mitigation-EFT, 0 = mitigation-SFT). Engaging in mitigation-EFT predicted the discounting tendency toward future environmental gains ( $B = -0.10$ ,  $SE = 0.05$ ,  $\beta = -0.20$ ,  $t = -2.054$ ,  $p = 0.043$ ), and the discounting tendency predicted the choice of a vegetarian meal box ( $B = -3.01$ ,  $SE = 1.04$ , Wald = 8.43,  $Z = -2.903$ ,  $p = 0.004$ ). Furthermore, the relationship between engaging in mitigation-EFT and the choice of a vegetarian meal box ( $B = 0.97$ ,  $SE = 0.45$ , Wald = 4.58,  $Z = 2.14$ ,  $p = 0.032$ ) became insignificant ( $B = 0.75$ ,  $SE = 0.48$ , Wald = 2.46,  $Z = 1.57$ ,  $p = 0.117$ ) when the discounting tendency was controlled for. A bootstrap analysis showed that the indirect effect was significant ( $B = 0.32$ ,  $SE = 0.20$ , 95% bias-corrected CI: 0.02–0.84; bootstrap resamples = 5000). Thus, the mediation analysis suggested

that a lower discounting tendency toward future environmental gains, induced by engagement in mitigation-EFT, increased the likelihood of choosing a diet with lower environmental impact.

Additionally, a mediating role of the discounting tendency in the experimental effect was also found with regard to participation willingness toward beach cleaning. There was an inverse relationship between the discounting rate and the likelihood of participating in beach cleaning ( $B = -4.65$ ,  $SE = 1.03$ ,  $Z = -4.514$ ,  $p < 0.001$ ). The effect of engagement in mitigation-EFT on the likelihood of participating in beach cleaning ( $B = 0.88$ ,  $SE = 0.41$ ,  $Z = 2.163$ ,  $p = 0.031$ ) was not significant ( $B = 0.62$ ,  $SE = 0.47$ ,  $Z = 1.334$ ,  $p = 0.182$ ) when controlling for the discounting tendency toward future environmental gains (see Figure 2). Furthermore, the indirect effect of the discounting tendency in the mediation model ( $B = 0.50$ ,  $SE = 0.28$ , 95% bias-corrected CI: 0.02–1.12; bootstrap resamples = 5000) was significant.



**Figure 2.** The discounting tendency toward environmental gains mediated the effect of thinking manipulation (1 = episodic future thinking about mitigating action, 0 = semantic future thinking about mitigation action) on the likelihood of participating in beach cleaning in Experiment 2. On the lower path, the values below and above the arrow are the results of analyses in which the mediator was and was not included in the model, respectively. An asterisk indicates a  $p$ -value of less than 0.05.

In short, the association between engagement in mitigation-EFT and a lower discounting tendency was replicated in the second experiment. The effect of engagement in mitigation-EFT on the tendency to act pro-environmentally was also replicated for the two behavioral measures. Our second experiment supported the mediation hypothesis by showing that engaging in mitigation-EFT induced lower discounting toward future environmental gains and increased the tendency to perform pro-environmental acts such as choosing a diet with lower environmental impact and participating in a pro-environmental activity.

#### 4. General Discussion

Building on recent advances that demonstrated the reduction effect of engagement in EFT on the tendency to discount the future [10–15] and the association between the discounting tendency and climate change engagement [5–8], we contend that engagement in EFT to envisage life events involving mitigation action may induce a lower discounting tendency and enhance the tendency to engage in pro-environmental action. We found that engaging in EFT associated with mitigation events promoted the inclination to act pro-environmentally, as reflected by a greater tendency to use air conditioning in an energy-saving manner (Experiment 1), a higher likelihood of choosing a diet with lower environmental impact (Experiment 2), and a higher inclination to participate in beach cleaning (Experiment 2). Furthermore, we observed that the discounting tendency toward future environmental gains mediated the association between our mitigation-EFT intervention and the tendency to act pro-environmentally. To our knowledge, this study may be the first demonstration showing that engagement in EFT regarding mitigation action can induce lower discounting toward future gains from climate change mitigation and thereby promote pro-environmental behavior. The present findings indicate an important implication: envisaging life events involving personal mitigation action is effective for improving engagement with climate change.

Findings from our two laboratory studies contribute to the literature by showing that engagement in EFT regarding mitigation action may promote the tendency toward pro-environmental action. This effect is congruent with the notion of implementation intention [44,45], which posits that forming specific action plans can increase the likelihood of performing the intended actions. The enhancement effect of implementation intention on goal attainment might be achieved by a strengthened linkage between the specified situation and the intended response [46–48]. Envisioning life events associated with personal mitigation action involves vivid and concrete representations of specific situational cues and specific mitigation behaviors. Participants engaging in mitigation-EFT showed a higher tendency toward performing pro-environmental behaviors than did those engaging in mitigation-SFT. Furthermore, the observed nonsignificant relationship between engagement in mitigation-SFT and the tendency to act pro-environmentally is in line with the notion of fantasy realization [19], which proposes that merely listing intended future behaviors would not lead to goal attainment. Thus, SFT that is geared to a scriptlike routine (e.g., turning off lights when they are not in use) entails only semantic knowledge about mitigation behavior. By contrast, EFT about mitigation action entails a specific episode of one's implementing mitigation behavior (i.e., implementation intention). Hence, the concrete imagery involved in EFT, including the personal action plan, might promote goal commitment [20,48].

We observed that discounting among participants engaging in mitigation-SFT did not differ from that among control participants, indicating that engagement in SFT about mitigation action was not effective in reducing the tendency to discount future environmental gains. Participants in the mitigation-SFT condition were only instructed to write down mitigation behaviors. They did not engage in prospective imagery to pre-experience life events associated with their listed mitigation acts. Hence, the difference in the discounting tendency, although not significant, might result from the power of prospective images to promote a focus on future gains. In addition, we found that the discounting tendency toward future environmental gains mediated the association between engaging in mitigation-EFT and the tendency to perform pro-environmental action. Hence, finding ways to counteract the discounting tendency toward future benefits from climate change mitigation may represent a promising strategy for promoting pro-environmental behavior. In the current research, we employed actual behavior (choice of meal) along with hypothetical behaviors (willingness to use air conditioning in an energy-saving manner and willingness to sign up for beach cleaning) as indicators of the tendency toward acting pro-environmentally. The use of actual behaviors rather than self-reported behaviors (e.g., waste reduction and recycling behaviors [25]; commuting by public transportation [33]; water conservation [49]; ecofriendly shopping and offsetting carbon emissions [50]) may avoid social desirability bias and also increase the study's generalizability.

The present findings have important implications for enhancing public engagement in pro-environmental behavior. The effect of engaging in mitigation-EFT (vs. mitigation-SFT) on the tendency toward pro-environmental behavior suggests that mitigation behavior guidelines with scriptlike, nonspecific actions would not be sufficient to promote pro-environmental behavior. Successful promotion of mitigation behavior might be attained by providing the public with episodic action plans (e.g., video demonstrations). Moreover, the public should be encouraged to pre-experience future life events involving mitigation action. The current research found that engaging in mitigation EFT reduced discounting toward future environmental gains. Additionally, from the perspective of construal-level theory [51], engaging in EFT (relative to SFT) to envision life events associated with mitigation action should result in a more concrete construal of future events, which may lead individuals to perceive future events as temporally closer [52,53]. Hence, engagement in EFT might lead to the imagined mitigation act being perceived as occurring in the near future. The application of virtual and augmented reality technologies may be helpful in developing episodic action plans for implementing mitigation action.

With respect to limitations of this research, our laboratory findings represent immediate effects. Claims about the generalizability and persistence of experimental effects are not warranted. The lack of a pre- and post-test design did not allow us to examine the discounting reduction effect. We used



an air quality improvement scenario to assess the discounting tendency; alternative measures of discounting, such as the area under the curve [54] and scenarios regarding other environmental outcomes [30,41], should be adopted in future research. We recruited college students to participate in the present study. A replication study involving a large-scale community sample may expand the generalizability of our findings. Sargisson and Schöner [55] suggested that people might be more willing to act when mitigation behaviors are easy compared to when they are difficult. However, under our two thinking conditions (mitigation-EFT and mitigation-SFT), participants were instructed to list mitigation behaviors that they “would enact” in the future. Hence, the difficulty of mitigation action would be likely not to account for the observed differences between the two thinking conditions. Including a measure of perceived difficulty may allow future research to examine this possible effect. A limitation of the current research was that we did not analyze the textual data in a qualitative manner, which might have provided information about whether the topics and behaviors listed by participants were similar under the two thinking conditions. Furthermore, asking participants to list mitigation behaviors that they would enact might encourage them to assume a green identity and create positive feelings, both of which have been shown to promote pro-environmental behavior [50,56]. Given that participants in the two thinking groups listed mitigation behaviors that they “would enact” in the future, the primed positive feeling or green identity may already have been present. Therefore, the primed positive feeling or green identity may not serve as the mediators of the observer link between engaging in mitigation-EFT (vs. mitigation-SFT) and the tendency toward pro-environmental behavior. Additionally, although our pilot testing for the manipulation check indicated that engaging in mitigation-EFT generated more concrete mental representations than did engaging in mitigation-SFT, the focus in both thinking conditions was on mitigation behaviors rather than future environmental gains. Thus, differential construal levels employed by participants in the thinking task may not explain the reduction effect of mitigation-EFT (vs. mitigation-SFT) on the tendency to discount future environmental gains. Finally, our discounting measure did not match the mitigation behaviors that participants listed in the thinking task. Future research may provide participants with a list of mitigation behaviors in which they should engage and then employ a discounting measure regarding future gains attributable to the same behaviors.

The current research suggests several important issues that are worthy of further investigation. First, is the effect of engaging in EFT regarding mitigation action on pro-environmental behavior observed in daily life? Second, our dependent measures regarding pro-environmental acts did not match the mitigation events listed during EFT manipulation. Whether experimental effects would be more pronounced when the mitigation actions envisaged during the EFT intervention are identical to those of the dependent measures is worthy of investigation. Third, given that the accessibility of situational cues is a major determinant regarding the enhancement effect of implementation intentions on goal attainment [45,48], it would be interesting to examine whether mentally simulated mitigation actions in a virtual or augmented reality environment would be more effective in inducing pro-environmental acts. Finally, some personal factors may moderate the effect of engagement in EFT of mitigation action on pro-environmental behavior. For example, personal experience of climate change impact has been shown to mainly influence individuals’ concern toward climate change [57]. Cultural values, such as pro-egalitarian values, are associated with individual support for climate change mitigation policies [58]. Individuals with the tendency to live in the here and now (i.e., greater temporal myopia) are more likely to discount future gains [59,60]. Optimistic beliefs can partially explain a persistent lack of public engagement with climate change [6,8]. Hence, the promoting effect of engagement in mitigation-EFT on pro-environmental behavior would be more prominent for people with direct experience of climate-related damage (or high pro-egalitarian values) and be less pronounced for those with temporal myopia (or optimism bias).

## 5. Conclusions

The present study observed that engaging in EFT to envisage life events involving mitigation action induces a lower discounting tendency toward future environmental gains and promotes the inclination to perform pro-environmental action. In the intertemporal choice of mitigation engagement, discounting refers to the undervaluing of distant or future benefits [7,26,28]. Individuals may be less likely to act against climate change when environmental gains from mitigation engagement are perceived to be distant, uncertain, and/or elsewhere [6,8]. Our findings suggest that using EFT to mentally represent mitigating action may promote pro-environmental behavior by discounting future gains from climate change mitigation less.

**Author Contributions:** Conceptualization, all authors; Formal analysis, (L.-C.H.) and (W.-B.C.); Investigation, (Y.-H.S.), (C.-C.W.), (P.-S.L.) and (W.-B.C.); Methodology, (W.-B.C.); Writing—original draft, (L.-C.H.), (Y.-H.S.), (C.-C.W.) and (W.-B.C.); Writing—review & editing, (P.-S.L.) and (W.-B.C.). All authors have read and agreed to the published version of the manuscript.

**Funding:** This research was funded by Ministry of Science and Technology, Taiwan (grant number MOST 107-2410-H-110-037-MY2) and the APC was funded by National Sun Yat-sen University.

**Conflicts of Interest:** The authors declare no conflict of interest.

**Data Sharing:** Anonymized datasets of the two experiments can be retrieved from the Mendeley Data (<http://dx.doi.org/10.17632/cspk6srm9d.1>).

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