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How Celebrities' Green Messages on Twitter Influence Public Attitudes and Behavioral Intentions to Mitigate Climate Change

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Abstract: This research adds to the growing body of literature on the role of celebrities as emergent spokespersons in climate advocacy using Twitter. This study investigates the effects of framing of celebrities' messages (emotional framing and framing of celebrity involvement) on public attitudes and behaviors to address climate change. A sequential mediation process is examined with structural equation modeling. In addition, this study assesses the role of parasocial relationship (PSR) with celebrities as predictors and moderators of the impact of framing of celebrity involvement. The results indicate that fear appeals were more effective than hope appeals in driving participation in activism, but emotional framing did not affect any other variables. Framing of celebrity involvement appeals using first-person pronouns led to more positive attitudes, but had no effect on behaviors. In addition, PSR was a strong positive predictor of attitudes and behaviors.

Keywords: climate change; environmental advocacy; celebrity; message framing; emotion

1. Introduction

High-profile celebrities have the capacity to attract public attention and mobilize public engagement in the social causes they are involved in [1,2]. They can also serve as role models for individuals in promoting pro-social behaviors. Risk prevention messages delivered by celebrities increasingly affect public risk perception and behavioral change, particularly among young people, through psychological involvement [3,4]. Among various causes, the climate change issue has received the most attention and efforts from major celebrities. While previous studies provide some evidence on the potential advantages of using celebrity spokespersons in environmental advocacy [1,2], very little empirical study has been conducted on the impacts of celebrity interventions.

In addition to sources of messages, how the climate crisis is framed impacts positive attitudes, risk perception [5], and willingness to take action to combat climate change [6]. However, there is a lack of understanding about effective message strategies when using celebrity sources. To fill this research gap, this study focuses on emotional framing and framing of celebrity involvement, which can exert influences on climate attitudes and behaviors.

Previous studies indicate that strategic use of emotions such as fear and hope relate to environmental attitudes and behaviors. Fear appeals were found to be useful in driving pro-environmental attitudes and behaviors [7], as fear evokes risk awareness [8]. Research has shown that hope appeals elicit perceived efficacy [9], which results in public engagement in the climate issue [10]. These studies indirectly indicate that emotions play a critical role in framing of celebrities' advocacy messages.

On the other hand, a celebrity's environmental involvement such as charitable work and environmental education leads to public engagement in environmental discourses [11]. This finding

indicates that the demonstration of a celebrity's involvement is expected to positively affect the adoption of the celebrity's eco-attitude and behaviors.

Social media research has been conducted to reveal an information diffusion algorithm [12], the process underlying community formation [13], and user interaction and community building on social networks [14]. However, there has been very little empirical research on the effect of celebrities' social media use on environmental attitudes and behaviors.

Thus, the aim of this study is threefold: to understand (1) effective communication strategies in celebrity climate advocacy, (2) the psychological process underlying framing effects, and (3) the role of psychological attachment with celebrities in climate attitudes and behaviors in the context of Twitter. Based on these objectives, this study investigates the effects of framing of celebrities' messages on individuals' attitudes and behaviors for climate change mitigation. This study also explores a sequential mediation process between emotional framing and pro-environmental behaviors. In addition, this study assesses the role of psychological bonds with celebrities as predictors and moderators of the impact of framing of celebrity involvement. This study contributes to understanding the role of celebrities in climate change communication. It also provides practical implications on how to effectively design persuasive messages when using celebrity spokespersons for environmental advocacy via Twitter.

2. Role of Emotion in Environmental Advocacy

Frames and wording are particularly effective in increasing public concerns and pro-environmental actions [5]. Fear and hope are considered relevant emotions in recommending health-related behaviors. Fear appeals are intended to arouse fear of undesirable outcomes by highlighting the possible threat or danger if people do not adopt recommended actions to prevent those outcomes. The effectiveness of fear appeals comes from their focus on a recipient's perceived risk for the subsequent negative outcomes and the depicted severity and susceptibility of threat [15]. Fear frames were found to be useful in driving attitudinal and behavioral changes related to adopting recommendation to avoid the depicted threat. It has been shown that fear appeals result in a greater level of risk awareness [8] and the perception of severity of climate change impact [5]. Fear appeals are also influential in driving peoples' pro-environmental attitudes and behavioral intentions [7].

While hope is one of the basic and relevant emotions in driving human behavior, little has been studied about the concept of hope [16]. Hope appeals elicit the perception of possibility that people can achieve their goals or positive outcomes. Hope appeals are useful in encouraging pro-environmental behaviors because they can evoke perceived efficacy [9], which can consequently influence the likelihood of engagement in climate change mitigation [10]. Hope and perceived efficacy are strongly correlated with a willingness to engage in pro-environmental behaviors and to support climate change policies [10].

It is expected that emotionally framed climate change messages will lead to greater positive attitudes and behaviors to mitigate climate change than messages unrelated to climate change. Based on the findings in previous studies, this study also proposes a sequential mediation process between emotional framing and pro-environmental behaviors. Accordingly, the following hypotheses are suggested:

Hypothesis 1 (H1). *In celebrities' climate advocacy via Twitter, both emotion-framed messages (fear and hope) will result in more (a) positive attitudes and (b) behaviors toward climate change mitigation than messages unrelated to climate change (control condition).*

Hypothesis 2 (H2). *In celebrities' climate advocacy via Twitter, fear appeals will result in more risk awareness (first mediator), and risk awareness will lead to more positive attitudes (second mediator), then positive attitudes will influence more behaviors toward climate change mitigation than hope appeals.*

Hypothesis 3 (H3). *In celebrities' climate advocacy via Twitter, hope appeals will result in more perceived efficacy (first mediator), and perceived efficacy will lead to more positive attitudes (second mediator), then positive attitudes will lead to more behaviors toward climate change mitigation than fear appeals.*

Theoretical and empirical investigations on the effectiveness of fear and hope frames in climate advocacy suggest mixed findings regarding whether positive or negative emotion is more effective in climate change advocacy. In addition, no research was conducted in the context of celebrity messages. Thus, this raises a question about which emotional strategy is more influential when celebrities advocate environmental issues. To address this, Research Question 1 will compare the effects of fear and hope appeals in driving positive attitudes and behaviors related to climate change:

RQ1: *In celebrities' climate advocacy via Twitter, is one emotional appeal (hope or fear) more effective than the other in driving (a) positive attitudes and (b) behaviors toward climate change mitigation?*

3. Role of Celebrity Involvement in Environmental Advocacy

Celebrity involvement in climate change campaigning contributes to increasing news coverage, more public concern and attention, and understanding the causes and consequences of climate change [17,18]. Considering that the salience of environmental issues positively relates to the adoption of climate change policies [19], celebrity interventions can be expected to have behavioral impacts as well. However, little has been studied about the effects of celebrities' advocacy for climate change mitigation [17].

A few studies provide inconsistent findings regarding the impacts of celebrity climate advocacy. Climate communication campaigns using popular culture such as concerts (e.g., Live Earth) may have a limited behavioral impact on promoting green purchases, not on other critical actions [18]. However, demonstration of celebrities' commitments or efforts to address the environmental problem such as involvement in charitable work or environmental education catalyzed public engagement in climate discourses [11]. A critical barrier in using celebrity sources for climate advocacy is that people are skeptical about the authenticity of celebrities' environmental activities due to their high carbon footprints [17]. These findings imply that messages featuring celebrity's involvement may have desired persuasive outcomes.

Despite the importance, no empirical study measured framing of celebrity involvement. This study proposes a novel approach for framing of celebrity involvement. In this study, framing of celebrity involvement is operationalized as inclusion of a first-person singular pronoun (FPP) such as I, me, or my that describes celebrities' engagement in tackling the climate crisis. FPP explicitly reference the self [19]. In celebrities' advocacy messages, FPP such as "I" refer to the celebrity. Thus, celebrities' advocacy messaging using FPP represent the celebrity's involvement in mitigating climate change.

First-person language reflects personal thoughts and feelings [20]. More importantly, first-person language signals the speaker's actions, support, and personal efforts on social issues [21]. For example, politicians use FPP to strategically describe themselves, showing their personal opinions and positions toward certain issues, which can influence the perception of the speaker by others [22]. In the context of celebrities' advocacy, celebrities' FPP use directly references what they do and how they engage in advocacy activities. Thus, expressing the celebrity's involvement in the climate issue by using FPP can result in more role modeling effects compared to messages without non-first-person pronouns (NFPP). Considering that individuals' PSR with celebrities leads to public engagement in social causes advocated by the celebrities [4], the moderating role of PSR in the influence of framing of celebrity involvement is also predicted. Based on the discussion above, this study proposes the following hypotheses:

Hypothesis 4 (H4). *In celebrity climate advocacy via Twitter, messages with FPP that express celebrity involvement will lead to a greater level of (a) positive attitudes and (b) behaviors toward climate change mitigation, compared to messages that do not express celebrity involvement.*

Hypothesis 5 (H5). *In celebrity climate advocacy via Twitter, the beneficial influence of messages with FPP on (a) positive attitudes and (b) behaviors toward climate change mitigation will be greater for people who have a stronger PSR with the celebrity, compared to messages without celebrity involvement).*

4. Parasocial Relationship with Celebrity Advocates

Individuals' emotional bonds with media performers have impacts on desirable attitudinal and behavioral outcomes [3]. A parasocial relation (PSR) is "a seeming face-to-face relationship" created between a media persona and audience members [23] (p. 215). PSR has persuasive influence on knowledge, perceptions, and behaviors concerning specific social issues such as health, environment, and politics [3,24]. Audiences are also likely to perform the behaviors advocated by celebrities and adopt attitudes and beliefs similar to those held by celebrities [4]. Brown and Basil [3] discovered that young adults' emotional involvement with "Magic" Johnson through PSR increased their concern about AIDS and the risk of AIDS to heterosexuals, and promoted HIV prevention practices. In line with this, Brown et al. [24] noted that PSR with OJ Simpson affected audiences' beliefs about him, with those who had a stronger parasocial bond with him tending to believe his innocence regarding his murder charges. Brown [4] found that viewers who had stronger involvement with the celebrity, through PSR and identification, were more likely to increase their support of wildlife conservation. Twitter, which directly connects celebrities and individuals, is useful to enhance PSR [25]. Based on the discussion above, this study proposes the following hypothesis regarding the impact of PSR on climate attitudes and behaviors.

Hypothesis 6 (H6). *In celebrities' climate advocacy via Twitter, people who have a stronger PSR with the celebrity will have (a) more positive attitudes and (b) greater behaviors toward climate change mitigation.*

Hypothesis 7 (H7). *Attitudes will mediate the impact of PSR on behaviors toward climate change mitigation.*

5. Method

5.1. Participants

The main study used a convenience sample of 758 college students at a large university in the southern U.S. Fifty six students who completed less than half of the measures and 9 students who were under the age of 18 years were excluded because this study was limited to participants aged 18 or older. Thus, the final sample used for the main study consisted of 693 undergraduate students. Using the software package G*Power [26], which used Cohen's large effect size criteria for F tests [27], this study computed sample size estimation using the conventional parameters (effect size F: 0.40, α err prob: 0.05, Power: 0.80) to test effects in between-subject designs. According to the results, the recommended sample size was 52 when comparing two experimental groups and 64 when comparing the two experimental groups and control group. Thus, a sample of 693 met the criteria.

The sample included approximately twice as many females as males (441 females, 208 males, 5 others, and 39 not reported). The age of participants ranged from 18 to 67 ($M = 19.90$ years old, $SD = 4.10$). More than one-third of respondents (37.8%) identified as Black/African American, 21.5% as White/Caucasian, 14.6% as Asian/Pacific Islander, 8.1% as Hispanic/Latina(o), 0.3% as Native American, 9.7% as multiracial, 2.0% as other, and 6.1% did not report their race/ethnicity. On average, they were slightly politically liberal, and had parents who had some college education. More than half of the respondents (51.8%) were Twitter users. Table 1 summarizes the characteristic of the respondents.

Table 1. Characteristics of Respondents.

Variable	<i>M</i>	<i>SD</i>	<i>N</i>
Age	19.90	4.10	639
The number of days using Twitter	4.34	2.81	343
Twitter daily usage time (minutes)	90.23	147.44	316
The number of Twitter followers	3.81	1.57	365
The number of Twitter followings	3.61	1.54	364

Note. The rating scales for the number of followers and followings ranged from 1 to 5, 3: 101 to 150 and 4: 141 to 200 people.

5.2. Pilot Tests

A 2 (celebrity: Leonardo DiCaprio or Pharrell Williams) \times 2 (emotional framing: fear or hope) \times 2 (framing of celebrity involvement: FPP or NFPP) between-subjects factorial design was used. The experimental stimuli were developed by revising original tweets of Leonardo DiCaprio, Ian Somerhalder, and Pharrell Williams. Seven tweets, advocating climate change mitigation were developed for each condition, and then each of the seven tweets was edited to create four different versions for the four experimental conditions. A fifth set of seven tweets was created for the control group. These tweets were unrelated messages without any information on climate advocacy. Manipulation of emotional framing and framing of celebrity involvement was evaluated by analyzing how the differently framed tweets were perceived as intended.

In addition, to determine which two celebrities were perceived most similarly, PSR, familiarity, attractiveness, likability, and thoughts on celebrities' involvement in climate advocacy were rated. To ensure that besides independent variables, the celebrity's characteristics would not inadvertently influence the persuasive effects on audience responses, this study determines celebrities who were similarly perceived by the respondents. The results of pilot tests showed that the respondents perceived Leonardo DiCaprio and Pharrell Williams very similarly in terms of PSR, likability, and attractiveness, and involvement in climate change.

5.3. Materials

Based on the results of pilot tests, four sets of tweets were selected for each condition and revised to convey more of the intended emotions and stronger perception of the celebrity's involvement in climate action in the FPP condition. Each set of tweets was attributed to either Leonardo DiCaprio or Pharrell Williams. Figures A1–A5 show messages attached to Leonardo DiCaprio (see Appendix A).

Emotional framing was manipulated by creating tweets that framed climate change in terms of fear or hope. The fear-framed tweets emphasized the adverse consequences of climate change. These tweets attempted to evoke fear-related emotions (e.g., fear, threat, concern, or uncertainty) about not taking action to address the climate crisis. The hope-framed tweets emphasized that taking action to mitigate climate change can be effective and lead to beneficial outcomes for the environment (Chadwick, 2015). These tweets focused on success and attempted to evoke hope-related emotions (e.g., hope, optimism, or confidence) about taking action to address climate change.

Framing of celebrity involvement was operationalized to use FPP (e.g., I, me, or my) or avoid using FPP in the celebrity's advocacy messages. The FPP condition focused on evoking the perception of the celebrity's engagement in resolving the climate crisis with the celebrity's voice. The NFPP condition did not contain FPP in advocacy messages.

5.4. Procedure

This study was approved by the university's institutional review board (IRB). This study used deception by pretending that messages presented were created by celebrities. Participants were randomly directed to one of the questionnaires and completed the questionnaire through Survey Monkey. After reading the tweets, the respondents rated their risk awareness, perceived response

efficacy, attitudes and behaviors toward climate change mitigation, as well as PSR. In addition, the participants' beliefs about climate change, knowledge about climate change, political ideology, and sociodemographic information such as age and gender were measured. At the end of the survey, they were debriefed about the deception used in this study.

5.5. Measures

All items used in measures were stated in Table A1 and appear in the Appendix A.

Measure of risk awareness. Risk awareness toward climate change was measured using three items adapted from Spence and Pidgeon [5]: "The consequences of climate change will be severe", "Impacts of climate change are likely to be extreme", and "The effects of climate change are unlikely to be too serious" on a 7-point Likert scale (1 = strongly disagree to 7 = strongly agree). After reverse coding, the three items were averaged ($M = 5.44$, $SD = 1.27$; $\alpha = 0.73$).

Measure of perceived response efficacy. Perceived response efficacy toward climate change mitigation was measured with items based on studies of Kellstedt, Zahran and Vedlitz [28] and Morton et al. [6]. The other two items were adopted from Morton et al.'s study. These items are "Climate change can be averted by mobilising collective effort" and "If we act collectively, we will be able to minimize the consequences of climate change". All items were rated on a 7-point scale (1 = strongly disagree to 7 = strongly agree). The five items were averaged ($M = 5.01$, $SD = 1.17$; $\alpha = 0.85$).

Measure of attitude. Attitude toward climate change mitigation was measured by asking how positive respondents are about climate change mitigation, using items adapted from Spence and Pidgeon [5]. These items examine respondents' overall attitude, attitude in terms of a personal focus, and attitude in terms of a social focus on climate change mitigation. All items were rated on a 7-point scale (1 = strongly negative to 7 = strongly positive). The three items were averaged ($M = 4.44$, $SD = 1.46$; $\alpha = 0.88$).

Measure of behaviors. Behavior intention in the future toward climate change mitigation was measured by three dimensions, including support for government action, intention for sustainable behaviors, and intention for participation in activism. Support for government action on climate mitigation was measured using three items adapted from Hart and Nisbet [29]. An example of the items is "we should immediately increase government regulation on industries and businesses that produce a great deal of greenhouse emissions". The items were rated on a 7-point scale (1 = strongly disagree to 7 = strongly agree). The five items were averaged ($M = 5.24$, $SD = 1.15$; $\alpha = 0.79$).

The items measuring intention for sustainable behaviors were taken from Gifford and Comeau [30]. The items were rated on a 3-point scale (1 = definitely, 2 = probably, 3 = probably not). An example is "Set thermostat at 68°F or lower in winter". Two other response options were also included (I already do this; does not apply to me) and were treated as missing data. Ratings for the seven items were averaged ($M = 1.77$, $SD = 0.52$; $\alpha = 0.88$).

Intention for participation in activism toward climate change mitigation was measured with eight items adapted from the studies of Dono, Webb and Richardson [31] and Roser-Renouf and Nisbet [32], and Valenzuela [33]. This study also added three new items to assess activism via social media. All of the items were rated on a 3-point scale (1 = definitely, 2 = probably, 3 = probably not). An example of an item is "participate in events organized by environmental groups working for climate change mitigation." Two other options were also included (I already do this; does not apply to me) and were treated as missing data. Ratings for the eight items were averaged ($M = 1.58$, $SD = 0.53$; $\alpha = 0.90$).

Measure of PSR. PSR with a celebrity was measured by ten items based on Rubin and Perse's PSI Scale [34]. This scale, used most frequently in this field, was developed for measuring PSI. Recently, it was revealed that what the scale assesses is PSR [35]. The PSI scale was revised and used to suit the nature of PSR on Twitter. Examples of modified statements are "I feel he is like a friend" and "I look forward to seeing him in any media". The items were rated on a 7-point Likert scale (1 = strongly disagree to 7 = strongly agree). The ten items were averaged ($M = 3.84$, $SD = 1.34$; $\alpha = 0.91$).

Measures of belief. Belief was measured by two items, which assess belief in the validity of climate change and belief in human contributions to climate change. Belief in the validity of climate change was measured by asking respondents to indicate to what extent they agree with the argument that climate change has been happening. Belief in human contributions to climate change addresses whether humans are the primary cause of climate change [29]. These items were rated on a 7-point Likert scale (1 = strongly disagree to 7 = strongly agree). The two items on this scale were averaged ($M = 5.68$, $SD = 1.25$; $\alpha = 0.82$).

Measure of knowledge about climate change. Factual knowledge of respondents with respect to climate change was assessed with six items. Responses to the items were offered as true or false. Among the six items, two items were adapted by Hart and Nisbet's scale [29]. One item was borrowed from the scale of prior knowledge on climate change developed by Braten, Strømsø, and Samuelstuen [36]. This study added three new items that assessed recent news on climate change. The sum of the number of correct answers for these six items on this scale was calculated ($M = 4.15$, $SD = 1.12$).

Measures of background characteristics. Participants' sociodemographic characteristics were measured. Political ideology was measured using a single item on a 7-point scale (1 = very liberal to 7 = very conservative) ($M = 3.32$, $SD = 1.42$). Their parents' college education was also measured using a single item for father and mother on a 7-point scale (1 = did not complete high school, 2 = high school, 3 = some college, 4 = Bachelor's degree, 5 = Master's degree, 6 = Advanced Graduate work or PhD, and 7 = not sure). The average scores of 1–6 were calculated for mother's education ($M = 3.16$, $SD = 1.17$) and father's education ($M = 3.43$, $SD = 1.24$).

Manipulation checks. The respondents in the experimental group reported to what extent they perceived that the tweets conveyed fearful or hopeful emotions associated with climate change mitigation on a 7-point Likert-type scale (1 = none of this feeling to 7 = a lot of this feeling). Respondents rated two items for each emotion (fear and hope). An example of a fear item is: "The tweets I read conveyed feelings of worry about what might happen without mitigating climate change". An example of a hope item is: "The tweets I read conveyed feelings of optimism about combating the climate crisis if we make efforts". Scale reliabilities were high for fear ($\alpha = 0.90$) and hope ($\alpha = 0.87$).

Perceptions of framing of celebrity involvement were measured with three items by asking to what extent respondents perceived that the tweets conveyed information about the celebrity's personal engagement in climate action. An example item is "The tweets I read indicated that [celebrity] is deeply involved in climate change mitigation". Additionally, three items measured respondents' perceptions of public involvement in climate change mitigation in order to ensure that the manipulation did not impact these perceptions. An example of these items is "The tweets I read indicated that many people are involved in climate change mitigation". Responses were measured on a 7-point Likert scale (1 = strongly disagree to 7 = strongly agree). Scale reliabilities were high for both celebrity involvement ($\alpha = 0.81$) and public involvement ($\alpha = 0.90$).

6. Results

6.1. Manipulation Checks

A 2 (emotional framing: fear or hope) \times 2 (framing of celebrity involvement: FPP or NFPP) analysis of variance (ANOVA) was conducted to compare respondents' perceptions of the emotions conveyed by the tweets across the four experimental groups. Age, gender, celebrity, beliefs about climate change, knowledge about climate change, and political ideology were controlled. As anticipated, there was a significant main effect of emotional framing on perceived fear, ($F(1, 515) = 27.805$, $p < 0.001$). Participants who received fear-framed messages reported perceiving the messages as more fearful ($M = 4.69$, $SD = 1.63$) than those who received hope-framed messages ($M = 3.90$, $SD = 1.80$). However, there were no significant differences between fear and hope groups in the level of perceived hope ($F(1, 516) = 2.752$, $p > 0.05$). Fear frame groups ($M = 4.66$, $SD = 1.54$) and hope frame groups ($M = 4.43$,

$SD = 1.65$) were similar in their perception of hope in the tweets. Thus, the manipulation of emotional framing was successful for fear, but not for hope.

Contrary to expectation, the main effect of framing of celebrity involvement was not significant ($F(1, 517) = 0.052, p > 0.05$). FPP groups ($M = 4.41, SD = 1.49$) and NFPP groups ($M = 4.43, SD = 1.40$) reported similar levels of perception on involvement of the celebrity. In addition, no significant interaction effects were observed between emotional framing and framing of celebrity involvement in measures for any of the dependent variables, $p > 0.05$. These results show that the manipulation of framing of celebrity involvement was not effective, but it did not inadvertently influence the perceived public involvement in climate change mitigation.

6.2. Effects of Climate Advocacy Messages on Pro-Environmental Attitudes and Behaviors

Table 2 provides descriptive information about key variables included in this study. To investigate relations among variables, Pearson's correlation analyses were employed and summarized in Table 3.

Table 2. Means and Standard Deviations of Key Variables.

	<i>M</i>	<i>SD</i>	Cronbach's α
Attitude (3 items)	4.44	1.46	0.88
Support for Government Action (5 items)	5.24	1.15	0.79
Sustainable Behavior (7 items)	2.83	0.52	0.88
Participation in Activism (8 items)	1.58	0.53	0.90
Risk Awareness (3 items)	5.44	1.27	0.73
Response Efficacy (5 items)	5.01	1.17	0.85
PSR (10 items)	3.84	1.34	0.91
Political Ideology (1 item)	3.32	1.42	-
Belief in Climate Change (2 items)	5.68	1.25	0.82
Knowledge about Climate Change (6 items)	4.15	1.12	-

Note. All rating scales ranged from 1 to 7 except for sustainable behavior, participation in activism and knowledge. The rating scales for sustainable behavior and participation in activism are from 1 to 3, with higher scores indicating greater intention. Knowledge was the sum of the number of correct answers, so scores could range from 1 to 6. For political ideology, higher scores are more conservative.

To test H1, one-way analyses of covariance (ANCOVA) were conducted. Age, gender, celebrity, beliefs about climate change, knowledge about climate change, and political ideology were controlled. As displayed in Table 4, contrary to H1a, the results showed no significant difference between experimental conditions and control condition for attitude in climate change mitigation ($F(2, 614) = 0.091, p > 0.05$) when adjusted for the covariates.

Contrary to H1b, there was also no significant difference between groups for any of the climate behaviors, including support for government action on climate change mitigation, ($F(2, 615) = 1.258, p > 0.05$), behavioral intention on sustainable behavior ($F(2, 605) = 0.142, p > 0.05$), and behavioral intention to participate in activism ($F(2, 600) = 2.538, p > 0.05$) when adjusted for the covariates.

Table 3. Zero-Order Correlations among Variables.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Age	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2. Gender	0.073	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3. Twitter Use	−0.004	−0.041	-	-	-	-	-	-	-	-	-	-	-	-	-
4. Emotion	−0.059	−0.032	0.034	-	-	-	-	-	-	-	-	-	-	-	-
5. Celebrity Involvement	0.007	−0.116 **	−0.005	0.049	-	-	-	-	-	-	-	-	-	-	-
6. Attitude	0.084 *	0.050	−0.004	−0.024	0.108 *	-	-	-	-	-	-	-	-	-	-
7. Support for Government Action	0.057	−0.051	0.030	−0.019	0.016	0.338 **	-	-	-	-	-	-	-	-	-
8. Sustainable Behavior	0.004	−0.023	0.061	0.051	−0.017	0.034	0.177 **	-	-	-	-	-	-	-	-
9. Activism	0.022	−0.124 **	0.052	0.120 **	0.005	0.110 **	0.308 **	0.543 **	-	-	-	-	-	-	-
10. Risk Awareness	0.041	−0.079 **	0.027	0.020	0.019	0.306 **	0.757 **	0.153 **	0.283 **	-	-	-	-	-	-
11. Response Efficacy	0.068	−0.117 **	0.015	0.012	0.018	0.343 **	0.682 **	0.214 **	0.345 **	0.594 **	-	-	-	-	-
12. PSI	−0.057	−0.055	0.004	0.116 **	0.063	0.185 **	0.194 **	0.081 *	0.234 **	0.166 **	0.276 **	-	-	-	-
13. Celebrity	−0.002	−0.049	−0.028	0.016	0.074	0.029	−0.002	−0.038	−0.040	−0.009	0.006	0.159 **	-	-	-
14. Political Ideology	−0.003	0.073	0.013	0.025	−0.057	−0.177 **	−0.248 **	−0.064	−0.121 **	−0.249 **	−0.125 **	−0.007	−0.071	-	-
15. Belief in Climate Change	0.033	−0.073	0.058	−0.001	−0.011	0.268 **	0.637 **	0.162 **	0.248 **	0.636 **	0.524 **	0.170 **	0.010	−0.211 **	-
16. Knowledge about Climate Change	0.099 *	0.051	−0.006	−0.046	0.026	0.140 **	0.262 **	0.108 **	0.108 **	0.285 **	0.196 **	0.023	0.047	−0.131 **	0.216 **

* $p < 0.05$, ** $p < 0.01$. Note. Dichotomous variables: gender (0: female, 1: male), Twitter use (0: no, 1: yes), emotional framing (0: hope, 1: fear), framing of celebrity involvement (0: non-first-person pronouns [NFPP], 1: first-person singular pronoun [FPP]), celebrity (0: Pharrell Williams, 1: Leonardo DiCaprio). For political ideology, higher scores are more conservative.

Table 4. ANCOVAs Testing the Effects of Climate Advocacy Messages on Climate Attitudes and Behaviors.

Dependent Variable	Fear Experimental Group	Hope Experimental Group	Control Group	F	df	p Value	Power
	M (SE), N	M (SE), N	M (SE), N				
Attitude	4.43 (0.09), 244	4.48 (0.09), 250	4.46 (0.12), 129	0.091	2, 614	0.913	0.064
Government Support	5.17 (0.05), 245	5.23 (0.05), 250	5.32 (0.08), 129	1.258	2, 615	0.285	0.274
Sustainable Behavior	1.78 (0.03), 243	1.75 (0.03), 245	1.75 (0.05), 126	0.142	2, 605	0.868	0.072
Participation in Activism	1.62 (0.03), 240	1.52 (0.03), 244	1.59 (0.05), 125	2.538	2, 600	0.080	0.508

Note. Adjusted means are reported; standard errors are in parentheses. Rating scales for attitude and government support were 1 to 7. Rating scales for sustainable behavior and participation in activism were 1 to 3, with higher scores indicating greater intention.

6.3. Effects of Emotional Framing and Framing of Celebrity Involvement on Pro-environmental Attitudes and Behaviors

To address RQ1 and H4, 2×2 ANCOVAs were conducted to investigate the main effects of emotional framing and framing of celebrity involvement on the four main dependent variables. Age, gender, celebrity, beliefs about climate change, knowledge about climate change, and political ideology were controlled. RQ1 asked whether, in celebrities' climate advocacy via Twitter, one emotional framing (fear or hope) was more effective in driving positive attitudes and behaviors toward climate change. As shown in Table 5, the findings revealed no main effect of emotional framing for attitudes ($F(1, 484) = 0.329, p > 0.05$), support for government action on climate mitigation ($F(1, 485) = 0.550, p > 0.05$), or behavioral intention on sustainable behavior ($F(1, 478) = 1.920, p > 0.05$). There was a significant main effect of emotional framing for behavioral intention to participate in activism, $F(1, 474) = 5.115, p < 0.05$. This suggests that those who read the fear-framed tweets reported a greater intention to participate in activism than did those who read the hope-framed tweets.

Table 5. Effects of Emotional Framing on Climate Attitudes and Behaviors.

Dependent Variable	Fear	Hope	F	df	p Value	Power
	M (SE), N	M (SE), N				
Attitude	4.39 (0.09), 244	4.46 (0.09), 250	0.329	1, 484	0.652	0.088
Government Support	5.14 (0.06), 245	5.20 (0.06), 250	0.550	1, 485	0.459	0.115
Sustainable Behavior	1.78 (0.03), 243	1.75 (0.03), 245	0.380	1, 478	0.538	0.094
Participation in Activism	1.62 (0.03), 240	1.51 (0.03), 244	5.115	1, 474	0.024*	0.617

Note. * $p > 0.05$. Adjusted means are reported; standard errors are in parentheses. The F values are for the main effects of emotional framing. Rating scales for attitude and government support were 1 to 7. Rating scales for sustainable behavior and participation in activism were 1 to 3, with higher scores indicating greater intention.

H4 predicted that compared to messages without FPP, messages containing FPP would lead to greater positive attitudes (H4a) and behaviors (H4b). Table 6 shows that there was a significant main effect of framing of celebrity involvement for attitudes ($F(1, 484) = 5.699, p < 0.05$). Attitudes were more positive among those in the FPP groups than those in the NFPP groups. The partial Eta squared value indicated that 1.2% of the variance in the attitude was explained by framing of celebrity involvement. However, there was no main effect of framing of celebrity involvement for any of the behavioral measures, including support for government action on climate mitigation ($F(1, 485) = 0.135, p > 0.05$), sustainable behavior ($F(1, 478) = 0.133, p > 0.05$), and participation in activism ($F(1, 474) = 0.235, p > 0.05$) when adjusted for the covariates.

Table 6. Effects of Framing of Celebrity Involvement on Climate Attitudes and Behaviors.

Dependent Variable	FPP	NFPP	F	df	p Value	Power
	<i>M (SE), N</i>	<i>M (SE), N</i>				
Attitude	4.58 (0.09), 260	4.28 (0.09), 234	5.699	1, 484	0.017*	0.664
Government Support	5.18 (0.05), 261	5.15 (0.06), 234	0.135	1, 485	0.714	0.066
Sustainable Behavior	1.76 (0.03), 258	1.77 (0.03), 230	0.133	1, 478	0.716	0.065
Participation in Activism	1.55(0.32), 253	1.58 (0.34), 231	0.235	1, 474	0.628	0.077

Note. * $p > 0.05$, Adjusted means are reported; standard errors are in parentheses. The F values are for the main effects of framing of celebrity involvement. Rating scales for attitude and government support were 1 to 7. Rating scales for sustainable behavior and participation in activism were 1 to 3, with higher scores indicating greater intention.

6.4. Process of Role Modeling in Adoption of Pro-Environmental Behaviors

Structural equation modeling (SEM) technique was employed to test a sequential mediation process between emotional framing and pro-environmental behaviors (H2 and H3), the moderating role of PSR on the impact of framing of celebrity involvement (H5), the effect of PSR on pro-environmental attitudes and behaviors (H6), and the mediating role of attitudes on the impact of PSR on behaviors (H7). The control group was not included in SEM analysis.

Figure 1 represents a path diagram of a series of hypotheses tested with SEM. Dummy variables were used to code categorical variables. Model fit indices show that it did not represent a good-fitting model ($\chi^2 = 2441.343$, CMIN: 2441.343, DF: 29, CMIN/Df: 84.184, RMSEA: 0.347, CFI: 0.060, NFI: 0.069, $p < 0.001$). The hypothesized model explained 10.1% variance in attitude, 11.1% variance in support for government action, 0.2% variance in sustainable behavior, and 0.9% variance in intention to participate in activism.

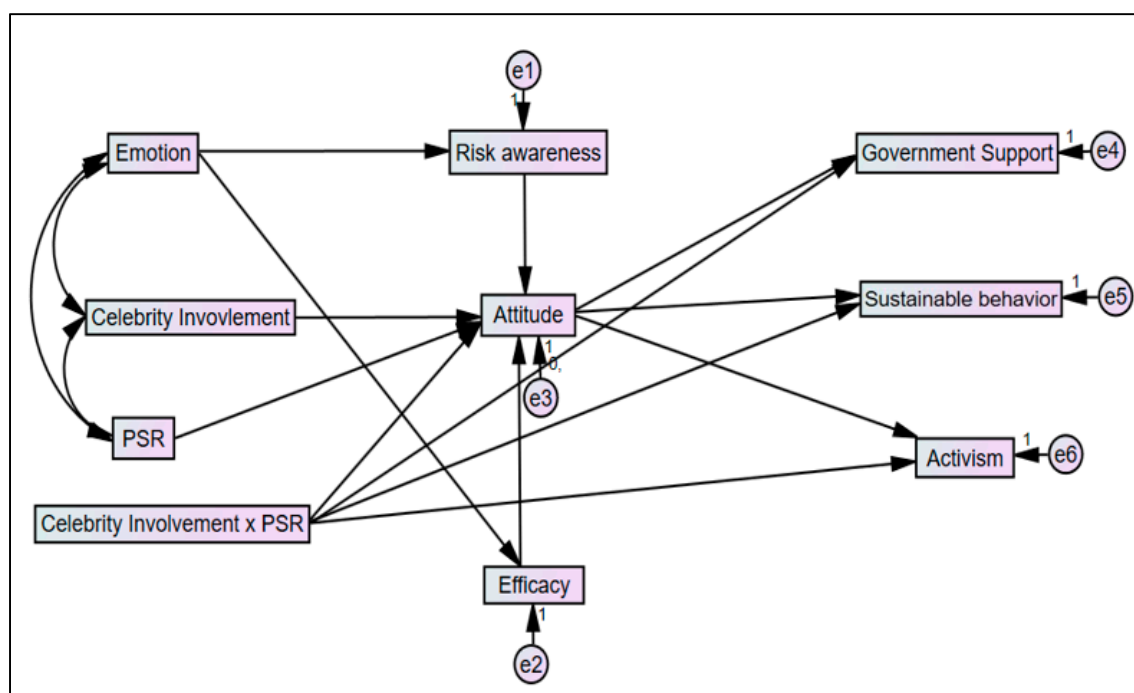


Figure 1. Proposed path model. Note. Dichotomous variables: emotional framing (0: hope, 1: fear) and framing of celebrity involvement (0: non-first-person pronouns [NFPP], 1: first-person singular pronoun [FPP]).

The proposed path model was first modified based on the results of H1ab (the effects of emotional framing) and H4ab (the effects of framing of celebrity involvement) tests to indicate only the significant relations between variables. Then, according to the modification indices (called Lagrange Multiplier or

LM tests in EQS), which are useful and necessary techniques in suggesting fitted model by isolating unpredicted ways [37], correlations between the error terms as well as correlations between the variables and the error terms were added to improve the model fit. As the changes only occurred between the error terms and other variables, the revised path model (see Figure 2) is still in line with the theoretical model proposed in this study.

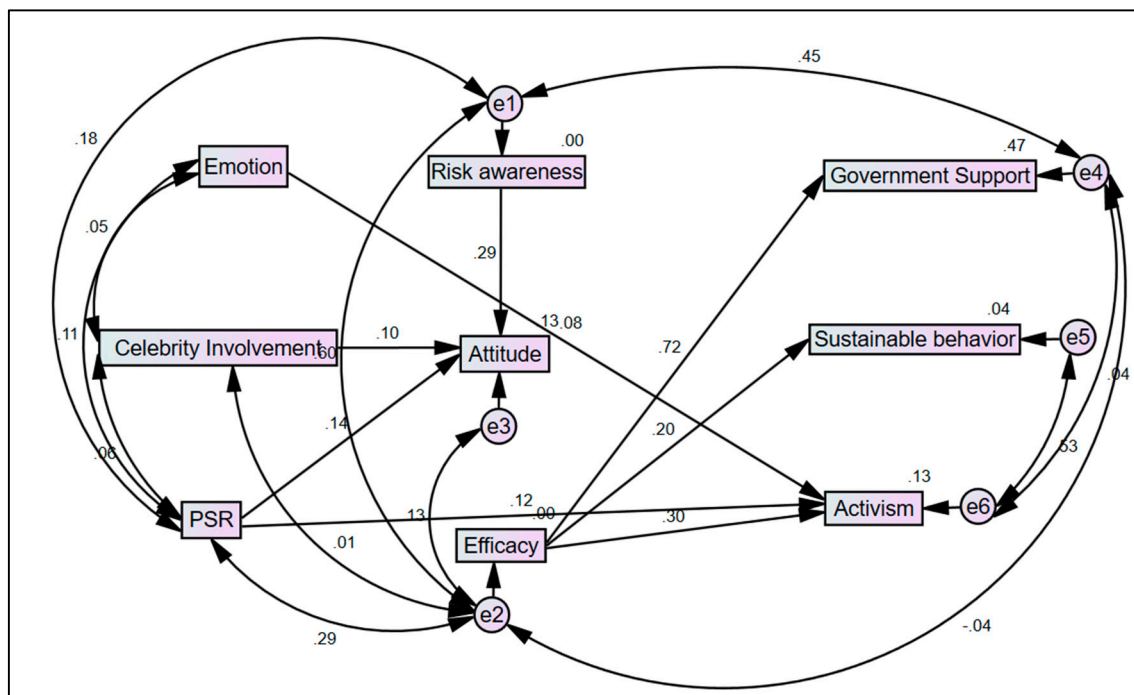


Figure 2. Modified path model. Note. Dichotomous variables: emotional framing (0: hope, 1: fear) and framing of celebrity involvement (0: non-first-person pronouns [NFPP], 1: first-person singular pronoun [FPP]).

After the changes to the model, the results indicate good fit ($\chi^2 = 13.925$, CMIN: 13.925, DF: 16, CMIN/Df: 0.870, RMSEA: 0.000, CFI: 1.000, NFI: 0.989, $p > 0.05$). Figure 2 displays the path diagram of the modified model, showing only significant relationships between the variables with standardized estimates and Table 7 summarizes the results. The modified structural equation model explained 12.9% of the variance in attitude, 47.0% of the variance in support for government action, 3.9% of the variance in sustainable behavior, and 13.3% of the variance in intention to participate in activism.

Table 7. Results of SEM analysis.

Path Analysis		Standardized Estimate	
Participation in Activism	<-	Emotional Framing	0.08*
Attitude	<-	Celebrity Involvement	0.96*
Attitude	<-	PSR	0.14***
Participation in Activism	<-	PSR	0.12***
Attitude	<-	Risk Awareness	0.29***
Support for Government Action	<-	Efficacy	0.72***
Sustainable Behavior	<-	Efficacy	0.20***
Participation in Activism	<-	Efficacy	0.30***

Note. * $p < 0.05$, *** $p < 0.001$.

The indirect path of the effects of fear-framed messages on pro-environmental behaviors via risk awareness and attitude (Fear → Risk awareness → attitude → behaviors) did not occur. Emotional framing was a significant predictor of only intention to participate in activism, not of the other

outcome variables. Fear appeals were more influential than hope appeals in promoting intention to participate in activism (standardized coefficient = 0.080, $p < 0.05$). However, SEM estimated no direct effect of emotional framing on risk awareness ($p > 0.05$). Risk awareness directly affected attitude (standardized coefficient = 0.289, $p < 0.01$), but the effects of attitude on any of the behaviors were not significant ($p > 0.05$). Thus, H2 and H7 that postulated the mediation effect of PSR on behaviors were not supported.

H3 predicted the indirect path of hope-framed messages that influences pro-environmental behaviors (hope \rightarrow response efficacy \rightarrow attitude \rightarrow behaviors). As discussed above, emotional framing was a significant predictor of intention to participate in activism, but emotional framing did not have a direct effect on perceived response efficacy ($p > 0.05$). This does not fulfill the required criteria for the sequential mediation model. Thus, H3 was not supported.

As predicted by H6a, respondents who had a stronger PSR with the celebrity reported more positive attitudes toward climate change (standardized coefficient = 0.143, $p < 0.01$). H5a proposed the beneficial influence of FPP use on positive attitudes would be greater for people who have a stronger PSR with the celebrity. However, PSR did not interact with framing of celebrity involvement in predicting attitude ($p > 0.05$). Therefore, H6a was supported, but H5a was not supported. As expected in H6b, the results suggest that PSR significantly predicted intention to participate in activism (standardized coefficient = 0.124, $p < 0.01$), but did not increase government support and sustainable behaviors ($p > 0.05$). Lastly, contrary to H5b, PSR did not moderate the impact of framing of celebrity involvement on any behaviors ($p > 0.05$). Thus, H6b was partially supported and H5b was not supported.

7. Discussion

As an initial experimental examination of the influence of celebrities' Twitter use on climate attitudes and behaviors, this study extended the discussion of existing studies on which communication strategies are effective. This research demonstrates a novel approach to the verification of star power for climate attitudes and behaviors by applying emotional appeals and linguistic strategies. Although previous research suggests the power of word choice in communicating climate change issues [38], very little empirical research has been conducted in today's social media landscape.

Unexpectedly, this study found no effect of a celebrity's climate change tweets on a celebrity's unrelated messages on pro-environmental attitudes or behaviors. Considering respondents were well aware of Leonardo DiCaprio's and Pharrell Williams's climate advocacy, reading their tweets unrelated to climate change may have reminded people about climate change.

The results demonstrate that a fear appeal was effective for climate advocacy in encouraging participation in activism, but not other individual behaviors such as sustainable behaviors and support for government actions. Participation in activism is more collectivistic and can be perceived as immediately influencing outcomes on the issue. This is in line with the finding of previous studies, indicating that a barrier in taking climate action is that people tended to feel their individual action would have little impact on managing the issue compared with collective action at the larger scale [39]. It could be argued that fear of climate change activates thoughts that some action is required, but may motivate change only when people also believe that those specific actions can counter the danger [40].

The results of SEM showed no evidence of a sequential mediating process between emotional framing and pro-environmental behaviors. Regarding the effects of framing of celebrity involvement, although behavioral impacts were not found, the results revealed that messages with FPP that emphasized celebrity's engagement in climate advocacy led to more positive climate attitudes than messages without celebrity involvement appeals, which supports the influence of first-person language [20]. This finding also reinforces the relevance of framing theory in that language choices mattered in the climate change issue [5]. On Twitter, where a short text message is a primary means of self-disclosure and communication, framing with a subtle linguistic cue may be more prominent, and this may influence audience perceptions.

It is noteworthy that PSR was a strong predictor of both positive attitudes and behavioral intention to participate in activism. These results enhance existing studies about the role of PSR on prosocial behaviors [3,4]. These findings challenge the critical perspective on the role of celebrities in social causes, which argues that they produce hardly any outcomes but distract public attention from the real issue [18].

8. Limitation and Future Studies

First, a major concern of this study is that the manipulation of emotional framing was only partially successful, and framing of celebrity involvement was also not successful, which may have influenced the study results. Thus, caution is needed when interpreting the results of the hope appeals and framing of celebrity involvement. Second, the respondents rated their PSR with the celebrity after reading the celebrity's tweets. Exposure to the environmentally friendly tweets by the celebrity might have affected their perception on PSR. Future studies need to consider measuring PSR with celebrities before showing the celebrities' messages. Third, the participants of the experiment were mostly young adults. Thus, the findings may explain green celebrities' advocacy impacts on young adults. Fourth, the use of an experiment in which participants were assigned to read a set of tweets from a specific celebrity limited the ecological validity of this study. An experimental design was chosen to isolate specific frames while keeping the content of the tweets as similar as possible. The tweets were also made based on actual tweets of the celebrities by revising their advocacy tweets which mostly reflected their thoughts and arguments on climate issues. This minimizes the inherent limitation of an experimental study by creating conditions seemingly like the real world and enhanced the ecological validity. In addition, the students all attended the same university. These factors limited the study results' generalizability. To overcome such limitations, future studies should include older populations and need to consider different celebrities' messages to increase generalizability. The dependent variables such as climate attitudes and behaviors were measured only after the respondents read the celebrities' tweets. Thus, this may not capture the changes in their attitudes and behaviors. Future studies need to measure individuals' attitudes and behaviors before and after respondents' exposure to messages.

Results of this study, indicating that fear was more effective than hope in promoting willingness to participate in activism, call for future studies to verify the presumed link between fear and the perceived value of collective efforts for climate mitigation. Given that PSR is formed and developed over an extended time span, research on the effects of longer-term exposure to eco-celebrity activism is needed [3]. It is also necessary to explore whether social media interaction between eco-celebrities and the public enhances PSR, which in turn strengthens green identity and green lifestyles [25]. Qualitative research on celebrities' social media posts that promote environmentalism and the responses of the public to advocacy [1], and interviews with celebrity followers would contribute useful data for addressing these topics.

This study contributes to the theoretical framework of understanding the role of celebrities in environmental advocacy, which verifies star power when young people have strong psychological attachments to them [11] and the effective message appeals used by them. It is urgent to investigate how to maximize the celebrity effects in climate advocacy, what the effective emotional and language frames are, what key mediators and moderators in strengthening the influence are, and the function of social media in enhancing celebrities' efforts to solve the climate crisis.

9. Conclusions

This research employed mixed theoretical approaches by applying Bandura's social cognitive theory [41] and framing theory [42] in conjunction with emotional appeals to examine the effects of role modeling in promoting attitudes and behaviors toward climate change mitigation. This study discovered that PSR with eco-celebrities was strongly associated with the adoption of attitudes and behaviors related to climate change, verifying star power in social causes [3,11].

In this study, emotional framing was unsuccessful in conveying more hopeful emotion related to climate change via the hope-framed messages (compared to fear-framed messages), and emotional framing was not linked to perceived response efficacy. These findings provide limited support for the value of using discrete emotions as frames, but leave open the question of the role of hope and optimism in motivating attitudes and behaviors related to climate change mitigation. The other key contribution of this study involves the use of social cognitive theory in the context of role modeling in celebrity's climate advocacy.

By uncovering a greater impact of first-person singular pronouns (e.g., I, me, or my) on attitudes (compared to non-first-person pronouns), this study demonstrated that the verbal presentation used by a role model had an impact on the adoption of the models' attitudes on climate advocacy. Based on the findings, this study concludes that it is time to go beyond the dispute on the role of celebrities in environmental communication. It is urgent to investigate how to maximize the effects of using celebrities in climate advocacy, how to effectively design messages evoking optimism in addressing the climate crisis, and what key mediators and moderators in the influence process are.

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Appendix A

Table A1. Measures.

Measures	Items
Risk awareness	1. The consequences of climate change will be severe. 2. Impacts of climate change are likely to be extreme. 3. The effects of climate change are unlikely to be too serious. (Reverse Coded)
Perceived response efficacy	1. I believe my actions can have a beneficial influence on global warming and climate change. 2. My actions to reduce the effects of global warming and climate change in my community will encourage others to reduce the effects of global warming through their own actions. 3. Actions I take personally can help reduce the effects of climate change. 4. Climate change can be averted by mobilising collective effort. 5. If we act collectively, we will be able to minimise the consequences of climate change.
Attitude	1. Overall how do you feel about climate change mitigation? 2. In terms of personal considerations only, do you feel overall positive or negative about climate change mitigation? 3. Thinking about climate change mitigation in social terms, i.e., with regard to being a member of society, do you think that climate change mitigation is overall a positive or a negative thing?
Support for government action on climate mitigation	1. We should immediately increase government regulation on industries and businesses that produce a great deal of greenhouse emissions. 2. We should immediately increase taxes on industries and businesses that produce a great deal of greenhouse emissions. 3. Concern about global climate change is unwarranted and no action is needed (reverse coded). 4. The government should offer economic incentives so that businesses and industries voluntarily reduce greenhouse emissions. 5. The government should enact economic policies that will encourage to reduce greenhouse gas emissions. 6. In terms of personal considerations only, do you feel overall positive or negative about climate change mitigation?

Table A1. Cont.

Measures	Items
Sustainable Behavior	<ol style="list-style-type: none"> 1. Switch off lights when not in use 2. Set thermostat at 68°F or lower in winter. 3. Buy local foods when possible. 4. Eat vegetarian meals. 5. Wash and dry only full loads. 6. Recycle more. 7. Compost.
Participation in activism	<ol style="list-style-type: none"> 1. Participate in events organized by environmental groups working for climate change mitigation. 2. Give financial support to environmental groups working for climate control. 3. Circulate petitions demanding an improvement of government policies regarding climate change mitigation. 4. Participate in protests for mitigating climate change. 5. Punish companies that deny the causes of climate change by not buying their products. 6. Write posts on social media to urge people to take an action for climate change. 7. Join or follow groups or pages on social media that are related to the activism or movement for climate change mitigation. 8. Share information or links on social media that are related to climate change.
PSR	<ol style="list-style-type: none"> 1. I feel he is like a friend 2. I see him as a natural, down-to-earth person. 3. I look forward to seeing him on any media. 4. If he appeared on any media, I would want to watch it. 5. He seems to understand the kinds of things I want to know. 6. If I saw a story about him in a newspaper or magazine, I would want to read it. 7. I would miss him if I could not see him on any media for a while. 8. If I could, I would like to meet him in person. 9. I would feel sorry for him if he made a mistake. 10. I find him to be attractive.
Belief in climate change	<ol style="list-style-type: none"> 1. Belief in the existence of climate change: You may have heard about the idea that the world's temperature may have been going up over the past 100 years, a phenomenon sometimes called 'climate change' or 'global warming'. Please indicate to what extent you agree or disagree that this has been happening. 2. Belief in human contributions to climate change: Please indicate to what extent you agree or disagree with the statement: "global climate change is occurring and we humans are the primary cause"
Knowledge of climate change	<ol style="list-style-type: none"> 1. The hole in the ozone layer is the main cause of global climate change. (F) 2. The average temperature of the earth has increased over the past 100 years. (T) 3. The greenhouse effect is due to Streams of heat that do not get out of the atmosphere. (T) 4. In 2015, a deal was made to limit the rise in global temperatures to less than 2 degrees C has been agreed at the climate change summit in Paris. (T) 5. Obama opposed the global climate change agreement at the 2015 climate change summit in Paris, because he felt it was impractical. (F) 6. The People's Climate March in September 2014 included rallies worldwide to advocate for global action against climate change. (T)



Figure A1. Tweet set #1: Fear appeals with FPP use by Leonardo DiCaprio.



Figure A2. Cont.



Figure A2. Tweet set #2: Fear appeals with NFPP use by Leonardo DiCaprio.



Figure A3. Cont.



Figure A3. Tweet Set #3: Hope appeals with FPP use by Leonardo DiCaprio.



Figure A4. Tweet set #4: Hope appeals with NFPP use by Leonardo DiCaprio.



Figure A5. Tweet set #5: Control group messages by Leonardo DiCaprio.

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