Emotions, Worry, Efficacy, and Climate Change Mitigation Behaviors among a Representative Sample of Texas and Florida Residents

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Abstract

Individual (e.g., eating less meat, electric car use) and collective (e.g., petition signing, donating money to environmental causes) climate change mitigation behaviors are necessary to thwart the worst effects of the escalating climate crisis. Psychological factors including positive and negative emotional states, worry, and efficacy have been implicated as key correlates of these behaviors; however, little research has explored these relationships in representative samples at high risk for exposure to climate-related hazards (e.g., hurricanes, heat waves, flooding). We assessed climate-change mitigation behaviors in an ongoing study of a probability-based representative sample of 1,479 Texas and Florida residents repeatedly exposed to climate-related hazards including hurricanes, heat waves, flooding, and tornadoes. Controlling for demographics, behavior-related positive emotions (PA) and negative emotions (NA) correlated with engagement in performing greater number of collective (PA: IRR = 2.06, $p < .001$; NA: IRR = 1.46, $p = .030$) climate-change mitigation behaviors; individual-level behaviors were associated with PA (IRR = 1.18, $p < .001$). However, NA was fully mediated by worry about climate-related hazards, which in turn was mediated by worry about climate change specifically. PA was fully mediated by efficacy. In fully adjusted models examining individual emotions, hope, worry about climate change, and behavioral efficacy remained statistically significant predictors of performing greater individual and collective climate-change mitigation behaviors (all $ps < .05$). Results suggest worry about the climate crisis may be adaptive and that feelings of hope, relative to other emotions (both positive and negative), may be effective at spurring pro-environmental behaviors. Scalable interventions should explore leveraging these psychological experiences to promote climate-change mitigation behaviors.

1. Introduction

Mitigating the existential threat of climate change necessitates that individuals engage in ongoing climate change mitigation activities to thwart the worst effects of the crisis. These behaviors happen at the level of the individual (Bouman et al. 2020) and collective (Nielsen et al. 2021). Individual-level behaviors generally include lifestyle choices and household decisions associated with a decrease in greenhouse gas emissions and include lowering meat consumption (Poore and Nemecek 2018) or conserving energy (Bouman et al. 2020; Capstick et al. 2014). Estimates of the potential impact of these actions on reducing greenhouse gas emissions may be profound (Nielsen et al. 2021). For example, a relatively modest modification to the typical United Kingdom (UK) diet that reduces animal product consumption and increases the consumption of fruits, vegetables, and cereals could decrease greenhouse gas emissions in the UK by 40% (Green et al. 2015). Collective-level behaviors target community and/or system-level changes in practice or policy that in turn reduce greenhouse gas emissions broadly. These actions include working with pro-environmental organizations, signing a petition, donating money to environmental protection groups, protesting, and voting for pro-environmental political candidates (Latkin et al. 2022). Although it is difficult to quantify the magnitude of such efforts, resulting policies may be transformative if legislation is strong and implemented globally (Eskander and Fankhauser 2020). Yet it is highly unlikely governments will enact such policies without activist pressure from citizens and groups (Roser-Renouf et al. 2014). Meaningful reductions in greenhouse gas emissions will require individual and collective-level behavior to propel societal transformation towards greater sustainability and avert the worst climate change impacts (Bamberg et al. 2018). Thus, it is critical to understand the psychological antecedents guiding these pro-environmental behaviors (Bamberg et al. 2018; Schwartz et al. 2022).

A recent nationally representative survey found vast majority (70%) of adults in the United States (U.S.) are concerned about the climate crisis (Leiserowitz, Maibach, et al. 2021). Yet paradoxically, while many individuals report they are willing to act to reduce climate change impacts (Bell et al. 2021), engagement in many pro-environmental activities is still relatively low (Leiserowitz, Maibach, et al. 2021). For example, while a nationally representative sample of U.S. adults found a majority (69%) who indicated global warming was an important issue reported voting for candidates who support climate change mitigation efforts, only a minority engaged in other forms of climate activism such as donating money (29.8%), signing a petition (32.3%), or contacting government officials (11.9%) (Latkin et al. 2022). Demographic (e.g., gender, political orientation), external (e.g., economic, social, cultural), and internal (e.g., knowledge, motivation) factors can facilitate or dampen the performance of pro-environmental action (Kollmuss and Agyeman 2010; Li et al., 2019), with psychological factors exhibiting particularly strong effects on action (Li et al. 2019). For example, anticipatory hope (Geiger et al. 2021) and preservative cognition like worry (Bouman et al. 2020) have been associated with greater performance of climate change mitigation behavior, while boredom has been negatively correlated with such behaviors (Geiger et al. 2021).

The perceived effectiveness of performing pro-environmental behaviors that promote positive changes may also impact the frequency of performing those activities (Bradley et al. 2020). Given the disconnect between the often-stated importance of climate change and the need to sustain the performance of climate change mitigation behavior, understanding the psychological factors that can encourage or dampen effective action is important for meeting critical targets for greenhouse gas emissions reduction, a key component of halting climate change (Nielsen et al. 2021). Yet little research with representative samples, particularly in communities at high risk for climate-related impacts, have been conducted on the interrelationships between emotions regarding one's ability to act, preservative cognition (i.e., worry) about climate-related impacts, perceived efficacy of behaviors, and performance of climate change-mitigation behaviors. In this report, we leverage representative samples of Texas and Florida residents, two U.S. Gulf Coast states located in a region at elevated risk for climate-related impacts (Sobel et al. 2016), to explore these relationships.

1.1. Emotions and Climate-change Mitigation Behavior

It is well established that emotions are powerful motivators for behaviors. Emotions include experiential (e.g., "feeling") and cognitive components (Solomon 2000) and have substantial impacts on judgments, choices, and behaviors (Loewenstein and Lerner 2003). The intensity of emotions may decrease psychological distance (Van Boven et al. 2010), potentially increasing the relevance of the climate crisis and motivating positive action for change (Chu and Yang, 2019, 2020; Maiella et al., 2020). However, there is debate on the direction of the effect, and whether positive or negative emotions have a stronger relationship with climate change mitigation behavior (Brosch 2021). Further, which emotions are the primary antecedents of climate-mitigation behavior has not been firmly established (Salama and Aboukoura, 2017).

The “broaden and build” theory of positive emotion states that subsets of positive emotions, including joy, interest, and contentment broaden “action repertoires” and support adaptive psychological resources (Fredrickson 1998). Research has extended this work on positive emotions into understanding how emotions impact climate change mitigation behaviors. For example, anticipatory and experienced positive emotions have been associated with pro-environmental behaviors (Brosch 2021; Schneider et al. 2021), likely facilitated by increased motivation, perseverance, and prosocial behavior often linked with positive emotional states (Schneider et al. 2021). More specifically, self-reported feelings of hope were associated with interest in climate protection in a sample of undergraduate students (Chadwick and Chadwick 2015), support for collective climate change action (e.g., supporting a carbon tax) in a sample of Australian adults recruited through social media (Bury et al., 2020), and pro-environmental behaviors (e.g., recycling, walking/bicycle to work, save water, conserving energy) in a sample of young people in Sweden (Ojala 2012). In a large, geographically diverse sample of U.S. adults recruited from information science learning centers (e.g., zoos), feelings of hope were associated with intentions to act on climate change; boredom was a strong predictor of decreased intention to act (Geiger et al. 2021). In an experimental study using MTurk workers, anticipated pride, contrasted with anticipated guilt, prior to making an environmental decision was associated with pro-environmental behavioral intentions (Schneider et al. 2017).

1.2. Worry about the Climate Crisis

Worry is a complex emotional experience related to fear and anxiety, having both cognitive and emotional components (Segerstrom et al., 2003). Worry involves repetitive thinking related to future events, specifically unpleasant stimuli (Sweeny & Dooley, 2017), with more cognitive components than anxiety (Ojala et al., 2021). Prior research on repetitive thought processes and perseverative cognition, like worry, correlate it with reports of depression, anxiety, and impaired physical health (Watkins, 2008). Research with non-representative samples has shown that worry about climate change is common (Gregersen et al., 2020). Yet while climate change-related worry may have detrimental effects (Doherty and Clayton 2011; Ojala et al. 2021; Panu 2020), it may also be a motivator to act (Ojala et al. 2021). Indeed, non-clinical worry may be related to constructive problem solving in response to risk (Ojala et al. 2021), positive coping in response to threat (MacLeod et al. 1991; Sweeny and Dooley 2017), adaptive preparation and anticipatory planning, and health-protective behaviors (Watkins 2008). Worry may orient the individual to find opportunities to act to mitigate adverse events and promote more desirable outcomes (Sweeny & Dooley 2017), especially if there are resources or actions that one can take to mitigate these threats (Ojala et al., 2021). For example, in a sample of 422 Swedish young people, worry was associated with recycling (Ojala 2008); data from a large sample of Europeans (8 countries, N = 44,387) demonstrated that worry about climate change was associated with energy curtailment and energy efficiency behaviors.

1.3. Perceived Efficacy of Climate Change Mitigation Behaviors

Despite widespread concern about the climate crisis and general public agreement that actions are necessary to mitigate its impacts (Bell et al. 2021), many people do not engage in climate mitigation behaviors. One reason for this disconnect may be due to a lack of confidence in the effectiveness of those actions or in one’s ability to effectively perform them. For example, approximately 80% of individuals from advanced economies report they would be willing to make changes to how they live and work to reduce the negative impacts of the climate crisis; concurrently they have low confidence that collective-level climate mitigation actions will effectively mitigate the threat (Bell et al. 2021).

Self-efficacy involves the belief that one is capable of acting to improve one’s welfare (Bandura 1977), while response efficacy is the belief that those actions will be effective at reducing a threat (Witte 1992). In general, perceptions of efficacy are strongly associated with initiating and maintaining adaptive behaviors (Strecher et al, 1986). Prior analyses demonstrated efficacy was associated with preparation for hurricanes [REMOVED FOR REVIEW] which are projected to intensify because of climate change (Bloemendaal et al. 2022; Emanuel 2020). In the context of climate action specifically, perceptions of collective efficacy related to the ability to change the system (Roser-Renouf et al. 2014) and individual efficacy (the extent to which one can mitigate climate change) (Hornsey et al. 2021) are important predictors of climate change-related mitigation behaviors. Indeed, meta-analytic findings indicate efficacy is one of the strongest predictors of climate change adaptation behaviors (van Valkengoed and Steg 2019). Yet, perhaps due to the enormous challenge of addressing the climate crisis, individuals may feel the actions they take will not be effective at reducing the consequences of the crisis (van der Linden et al. 2015). They may also feel unequipped to effectively perform such actions: in a representative sample of U.S. adults, among those who reported climate change was a pressing issue, the most common reason for not engaging in collective action was the perception that others were better at performing such actions (Latkin et al. 2022).

1.4. The Present Study

Here, we explored the relative contribution of emotions, worry, and efficacy on predicting engagement in individual and collective climate change mitigation behavior. We utilized data from a probability-based representative sample of Texas and Florida, two states that have experienced escalating climate threats in recent years including hurricanes, flooding, heat waves, and tornadoes. Prior analyses demonstrated exposure to climate-related hazards (e.g., lost property due to hurricane, hurricane evacuation experience) across the sample was substantial [REMOVED FOR REVIEW]. We asked several research questions:

1. Are there key demographic differences in performance of individual- and collective-level climate change mitigation behaviors?
2. Do positive or negative emotions have a stronger relationship with individual- and collective-level climate change mitigation behaviors?
3. Do individual emotions (e.g., hope, confidence, powerlessness, lacking control) and worry predict performance of individual- and collective-level climate change mitigation behaviors?
4. Controlling for the relationship between emotions, demographics, and behaviors, does efficacy exhibit independent effects on performance of individual and collective-level climate change mitigation behaviors?
5. Are there interaction (i.e., moderation) effects between emotions, worry, and efficacy on performance of individual- and collective-level climate change mitigation behaviors?

2. Method

2.1. Participants

Participants were drawn from the GfK KnowledgePanel. GfK (now Ipsos) uses Address Based Sampling (ABS) to randomly recruit panelists using probability-based sampling methods: the panel is designed to be representative of the United States. ABS uses the Delivery Sequence File (DSF) of the USPS, which improves population coverage relative to traditional random-digit-dialing methods and enables recruitment of harder-to-reach individuals such as younger people or minority groups. Households without an Internet connection are provided a web-enabled device and free Internet services. Once household members are recruited for the panel and assigned to a study sample, they are notified electronically of the opportunity. They can then take the survey through their email link or by visiting their online member page.

Data are from a larger, longitudinal study of responses to hurricanes on the Gulf Coast. The first wave of data was collected between 6 pm 9/8/2017 and 6 am 9/11/2017; all 5,940 eligible KnowledgePanel panelists living in Florida or Texas were invited to participate; 2,774 completed the survey for a response rate of 46.7% during the 60 hours of data collection. The data presented herein are from the fifth wave of data collection, which occurred between 12/2022-1/11/2022. Of 1,766 eligible panelists recruited to participate in Wave 5 (i.e., those who had completed prior waves of data and had agreed to be contacted for future surveys), 1,479 completed the survey for an 83.7% response rate.

2.2. Measures

2.2.1. Climate-change mitigation behaviors

Individual-level climate change mitigation behaviors. Participants were asked to report which of the following behaviors they had engaged in during the past week: 1) “Used public transportation, biked, or walked to work instead of driving”; 2) “Used energy-efficient lightbulbs such as CFLs or LEDs”; 3) “Recycled”; 4) “Taken shorter showers”; 5) “Driven a hybrid or electric vehicle”; 6) “Reduced red meat consumption”; 7) “Ate a more plant-based diet”; 8) “Reduced food waste”; 9) “Composted waste”; 10) “Checked the air in your tires to ensure fuel efficiency”; 11) “Used a smart thermostat”; and 12) “Installed or used low-flow shower heads or faucets”. Items were derived from prior research (Mascatelli et al., 2021). Responses were summed.

Collective-level climate change mitigation behaviors. Participants were asked to indicate which of the following behaviors they had performed in the past year: 1) “Worked with community members to help people prepare for hurricanes or other natural disasters”; 2) “Worked with community members to create green spaces (e.g., plant trees, restore habitat) in my community”; 3) “Signed a petition in support of action to help the environment”; 4) “Signed a petition in support of action on climate change”; 5) “Made a donation in support of action on climate change”. Items were based on prior research (Roser-Renouf et al., 2014). Responses were summed.

2.2.2. Climate change-action emotions

Climate action-related emotions. Respondents were asked, “When you reflect on your ability to take action to address climate change, do you feel”: 1) Hopeful, 2) Confident, 3) Optimistic, 4) Helpless, 5) Powerless, 6) Lacking control, 7) Indifferent, 8) On edge, 9) Uneasy, and 10) Nervous. Respondents reported on each of the 10 emotions. Response options were on a 4-point scale from 1 (*definitely do not feel this*) to 4 (*definitely feel this*). Items were also grouped into two composites of positive (i.e., hopefully, confident, optimistic) and negative (i.e., helpless, powerless, lacking control, on edge, uneasy, nervous). Items were derived from prior work (Geiger et al., 2021).

2.2.3. Worry

Worry regarding climate-related hazards. Respondents were asked “How much do you worry about the following personally affecting you or someone in your family in the future?” and “How often in the past week have you had fears about the possibility of the following affecting the community where you live?” for the following hazards: major flooding, nuisance flooding, hurricanes, heat waves, tornadoes, and sea level rise. Participants responded to each question (12 items total) on a Likert-type scale from 1 (*never*) to 5 (*all the time*). Reliability was excellent α = .90. Of note, consistent with prior research, we combined these items to measure worry as perseverative cognition (e.g., ruminative or repeated thoughts about the future) rather than worry and fear as distinct states (Williams et al. 2022). Items were derived from prior work (Holman et al. 2008; Sweeting et al. 2020; Williams et al. 2022).

Worry regarding climate change. Respondents were asked how much they worried about climate change “personally affecting you or someone in your family in the future?” and how often in the past week they had fears about climate change “affecting the community where you live?” Participants responded to each of the 2 questions on a Likert-type scale from 1 (*never*) to 5 (*all the time*). Reliability was excellent α = .90. Items were derived from prior research (Holman et al. 2008; Sweeting et al. 2020; Williams et al. 2022).

2.2.4. Efficacy

Individual-level climate behavior efficacy. Efficacy regarding individual climate actions was assessed by asking: “Of the actions above that you do, how much will they help reduce the impacts of climate change?” Response options were 1 (*not at all*) to 5 (*completely*). Given the low number of respondents (n = 12) in the highest group, groups 4 and 5 were combined.

Collective-level climate behavior efficacy. Respondents were asked, “Of the actions above that you do, how much will they help reduce the impacts of climate change?” Response options were 1 (*not at all*) to 5 (*completely*). Given the low number of respondents ($n = 10$) in the highest group, groups 4 and 5 were combined.

All study specific measures are included in Supplemental Materials I.

2.3. Analytic Strategy.

First, descriptive statistics were calculated for all key study variables and a correlation matrix was constructed. Second, two multiple Poisson regression analyses (appropriate for count data) examined demographic variables (race/ethnicity, gender, income, age, education [Bachelor’s degree or higher = 1, less than a bachelor’s degree = 0] and political party identification [a 7-item scale ranging from 1 = strong Republican to 7 = strong Democrat]) as predictors of 1) individual-level climate change mitigation behaviors and 2) collective-level pro-climate change mitigation behaviors. Third, for each dependent variable (individual- and collective-level climate change mitigation behaviors), a series of Poisson regressions examined each’s association with specific emotions (hopeful, confident, optimistic, helpless, powerless, lacking control, indifferent, on edge, uneasy, and nervous) related to performing climate change mitigation behaviors. Models were built using a hierarchical variable entry strategy as follows: *Model 1* included demographics and each specific emotion, *Model 2* added worry about climate-related hazards, *Model 3* added worry about climate change, and *Model 4* added efficacy of actions to reduce the impacts of climate change. Fourth, using an identical, four-model approach, a series of Poisson regressions examined the association between 1) individual- and 2) collective-level climate change mitigation behaviors and composite climate-related positive and negative emotions. Interaction terms between positive emotion and self-efficacy and negative emotions and worry were calculated and examined in post-hoc exploratory analyses. Analyses were preregistered on the Open Science Framework (doi:10.17605/OSF.IO/UDG9A). Procedures were approved by [REMOVED FOR REVIEW].

All descriptive and inferential statistics were weighted using study-specific post-stratification weights. These weights were calculated to adjust the final study sample to the demographic compositions of the states of Florida and Texas for adults 18 and older. Weighting benchmarks were based on the U.S. Census Bureau’s Current Population Survey (March 2021 update), and were calculated using the following demographic cells: gender (male, female), by age (18–29, 30–44, 45–59, 60+), race/ethnicity (White/Non-Hispanic, Black/Non-Hispanic, Other/Non-Hispanic, Hispanic, 2 + Races/Non-Hispanic); household income (Under $25,000, $25,000-$49,999, $50,000-$74,999, $75,000-$99,999, $100,000-$149,999, $150,000 and over); metro/non-metro areas, and education (less than high school/high school, some college, Bachelor’s or higher).

3. Results

3.1. Description of the Sample

The sample was 53% ($n = 747$) female; mean age was 51 (SD = 16.31). Racial/ethnic identity was reported as follows: White person (55.01%, $n = 814$), Black, non-Hispanic person (12.06, $n = 178$), other or mixed (2 or more) identified person (5.32%, $n = 78.74$), and Hispanic person (27.6%, $n = 408$). Income was reported as less than $10,000 (5%, $n = 73.98$), $10,000-$24,999 (10.51%, $n = 155$) $25,000-$49,999 (20.87%, $n = 309$), $50,00-$74,999 (18.74%, $n = 277$), $75,000-$99,999 (13.81%, $n = 204$), $100,000-$149,000 (10.82%, $n = 160$), $150,000-$249,999 (5.98%, $n = 88.49$), and $250,000+ (14.26, $n = 211$). Of the sample, 30.72% ($n = 454$) reported obtaining a bachelor’s degree or higher. The sample was politically diverse, identifying as the following: 17.88% ($n = 265$) strong Republican, 13.44% ($n = 199$) not strong Republican, 14.17 ($n = 210$) leans Republican, 6.52% ($n = 96$) undecided, 19.29% ($n = 285$) leans Democrat, 10.70% ($n = 158$) not strong Democrat, and 16.78% ($n = 248$) strong Democrat.

3.2. Descriptive Statistics of Climate Change Mitigation Behaviors, Emotions, Worry, and Efficacy

Overall, many people participated in at least some individual-level climate change mitigation behaviors (M = 3.33, SD = 2.30), with 91% ($n = 1362$) reporting engaging in at least one behavior. The most common behaviors were recycling (67.07%), using energy-efficient lightbulbs (60.71%), taking shorter showers (33.29%), and reducing food waste (33.31%); see Table 1. A substantial minority also reported checking the air in car tires to reduce fuel efficiency (26.17%) and reducing meat consumption (25.74%). Participation in collective-level actions was lower (M = 0.28, SD = 0.77); the vast majority (83.12% $n = 1229$) reported no collective-level behaviors. The most common behavior was signing a petition to help the environment (8.31%) or climate change specifically (6.62%) or donating to an environmental cause (7%). See Fig. 1for distributions of count responses for both individual- and collective-level behaviors.

Table 1

Descriptive statistics of pro-environmental behaviors performed (N = 1,479)

Behavior	%	n
Individual-level actions in response to environmental change		
Used public transportation, biked or walked to work instead of driving	6.93	103
Used energy-efficient lightbulbs such as CFLs or LEDs	60.71	898
Recycled	67.07	992
Taken shorter showers	33.29	478
Driven a hybrid or electric vehicle	6.67	99
Reduced meat consumption	25.74	381
Ate a more plant-based diet	16.79	248
Reduced food waste	33.31	493
Composted waste	10.71	158
Checked the air in your tires to ensure fuel efficiency	26.17	387
Used a smart thermostat	23.94	354
Installed or used low-flow shower heads or faucets	16.46	243
Collective actions taken in response to environmental change		
Worked with community members to help people prepare for hurricanes or other natural disasters	1.26	46
Worked with community members to create green spaces (e.g., plant trees, restore habitat) in my community.	1.26	46
Signed a petition in support of action to help the environment.	8.31	123
Signed a petition in support of action on climate change.	6.62	98
Made a donation in support of action on climate change	7.00	104
Note: weighted Ns and %s presented		

Efficacy of these behaviors to reduce the impacts of climate change was relatively low (see Fig. 2). The mean for efficacy of individual-level behaviors was 2.2 (SD = 0.91), slightly above “just a little.” The mean for efficacy of collective-level behaviors was 1.8 (SD = .096), slightly lower than “just a little”. Emotional responses to performing these behaviors were also low; mean responses for the majority of emotions hovered below the midpoint of 2.5 (between “do not feel like this” and “feel this”.) Mean worry about climate change-related hazards was, on average, also below the scale midpoint (M = 1.81, SD = 0.67). Mean worry about climate change was slightly higher (M = 2.19, SD = 1.16). See Table 2for descriptive statistics of each emotional response regarding one’s ability to act to address climate change.

Table 2

Descriptive statistics for emotions about impacting climate change and fear about natural disasters

	Mean	Standard Deviation	Range
Emotions			1–4
Hopeful	2.27	0.80	1–4
Confident	2.18	0.76	1–4
Optimistic	2.27	0.81	1–4
Helpless	2.06	0.82	1–4
Powerless	2.12	0.84	1–4
Lacking Control	2.16	0.85	1–4
Indifferent	2.10	0.89	1–4
On edge	1.78	0.72	1–4
Uneasy	1.83	0.75	1–4
Nervous	1.77	0.74	1–4
Positive emotions (composite)	2.24	0.74	1–4
Negative emotions (composite)	1.96	0.65	1–4
Worry about climate-related hazards	1.81	0.69	1–5
Worry about climate change	2.19	1.16	1–5
Note: weighted Ns and %s presented			

Table 3presents correlations between key study variables, including individual and collective environmental action, emotions about one's ability to act to address climate change, fear about natural disasters, and efficacy. Responses were highly correlated across most items.

Table 3

Correlations between key study variables: emotions, worry, efficacy, and individual- and collective-level climate-change mitigation behaviors (N = 1,479)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1.00																	
2	**0.35**	1.00																
3	**0.25**	**0.24**	1.00															
4	**0.19**	**0.18**	**0.85**	1.00														
5	**0.19**	**0.18**	**0.81**	**0.82**	1.00													
6	**0.16**	**0.16**	**0.17**	**0.11**	**0.13**	1.00												
7	**0.12**	**0.14**	**0.13**	**0.10**	**0.14**	**0.84**	1.00											
8	**0.15**	**0.15**	**0.14**	**0.09**	**0.15**	**0.76**	**0.83**	1.00										
9	**-0.04**	-0.08**	-0.01	-0.01	0.01	**0.16**	**0.17**	**0.17**	1.00									
10	**0.21**	**0.10**	**0.27**	**0.21**	**0.24**	**0.54**	**0.46**	**0.53**	**0.18**	1.00								
11	**0.17**	**0.09**	**0.25**	**0.20**	**0.23**	**0.56**	**0.51**	**0.57**	**0.13**	**0.80**	1.00							
12	**0.19**	0.06*	**0.24**	**0.21**	**0.22**	**0.47**	**0.42**	**0.50**	**0.13**	**0.76**	**0.81**	1.00						
13	**0.22**	**0.21**	**0.94**	**0.94**	**0.93**	**0.15**	**0.13**	**0.13**	0.00	**0.26**	**0.24**	**0.24**	1.00					
14	**0.20**	**0.14**	**0.24**	**0.18**	**0.22**	**0.85**	**0.83**	**0.86**	**0.19**	**0.81**	**0.84**	**0.78**	**0.23**	1.00				
15	**0.28**	**0.23**	**0.25**	**0.20**	**0.24**	**0.38**	**0.32**	**0.33**	**0.05**	**0.41**	**0.40**	**0.40**	**0.24**	**0.45**	1			
16.	**0.30**	**0.31**	**0.27**	**0.26**	**0.25**	**0.43**	**0.40**	**0.42**	**-0.15**	**0.39**	**0.46**	**0.43**	**0.28**	**0.51**	**0.68**	1.00		
17.	**0.38**	**0.20**	**0.43**	**0.37**	**0.36**	**0.23**	**0.20**	**0.24**	-0.06*	**0.28**	**0.31**	**0.33**	**0.41**	**0.31**	**0.26**	**0.35**	1.00	
18.	**0.28**	**0.30**	**0.41**	**0.39**	**0.37**	**0.13**	**0.11**	**0.13**	**-0.09**	**0.19**	**0.17**	**0.23**	**0.42**	**0.19**	**0.26**	**0.36**	**0.55**	1.00

1. Collective-level climate change mitigation behaviors 2. Individual-level climate change mitigation behaviors 3. Hopeful 4. Confident 5. Optimistic 6. Helpless 7. Powerless 8. Lacking control 9. Indifferent 10. On edge 11. Uneasy 12. Nervous 13. Positive emotion (composite) 14. Negative emotion (composite) 15. Worry about climate-related hazards, 16. Worry about climate change; 17. Collective behavior efficacy 18. Individual behavior efficacy

Bold = p < .001; *p < .05, **p < .01

3.3. Predictors of Individual- and Collective-level Climate Change Mitigation Behaviors

Demographic predictors of performing more individual-level climate change mitigation behaviors in the past week were female gender (IRR = 1.15, 95% CI, 1.02, 1.29, p = .014), older age (IRR = 1.01, 95% CI, 1.002, 1.01, p = .007), obtaining a bachelor's degree or higher (IRR = 1.15, 95% CI, 1.02, 1.29, p = .019), and identifying more strongly as a Democrat compared to a Republican (IRR = 1.06, 95% CI, 1.04, 1.09, p < .001). Demographic predictors of performing more collective behaviors were: younger age (IRR = 1.04, 95% CI0.97, 0.99, p = .033), obtaining a bachelor's degree or higher (IRR = 2.02, 95% CI, 1.28, 3.178, p = .002), and more strongly identifying as a Democrat compared to a Republication (IRR = 1.39, 95% CI, 1.25, 1.54, p < .001). See Supplemental Table 1 for these preliminary models.

Table 4 presents results from Poisson regressions predicting the number of individual-level climate change mitigation behaviors performed in the past week. In Model 1, composite positive and negative emotions were associated with performance of a greater number of individual-level behaviors. This association remained statistically significant after controlling for worry about climate-related hazards, which was also significant (see Model 2). However, as illustrated in Model 3, worry about climate-related hazards was no longer significant after accounting for the significant association between worry about climate change specifically and individual-level climate change mitigation. In Model 4, collective efficacy was significantly associated with individual behaviors and fully accounted for the relationship between positive affect and individual behaviors. In the final model, the only demographic predictors of individual-level climate change mitigation behavior were older age and obtaining a Bachelor's degree or higher. Tests of interaction effects between emotions, worry, and collective efficacy were largely not significant. However, there was a significant interaction between negative emotion and worry about climate-related hazards, such that those reporting high negative emotions and lower worry tended to perform, on average, fewer behaviors (IRR = 0.85, 95% CI, 0.775, 0.96, p = .010).

Table 4

Poisson regression analyses of demographics, positive and negative emotions, worry and efficacy as predictors of individual-level climate change mitigation behaviors

	Model 1 (N = 1,412)				**Model 2 (N = 1,412)**				**Model 3 (N = 1,411)**				**Model 4 (N = 1,408)**			
	IRR	95%CI		*p*	IRR	95%CI		*p*	IRR	95%CI		*p*	IRR	95%		*p*
Ethnicity[a]																
Black, Non-Hispanic	0.90	0.71	1.14	.368	0.86	0.68	1.09	.217	0.89	0.70	1.12	.310	0.85	0.68	1.07	.174
Non-Hispanic, 2 + races	0.96	0.70	1.33	.819	0.94	0.69	1.27	.683	0.94	0.68	1.29	.687	0.94	0.68	1.29	.700
Hispanic	1.00	0.87	1.16	.953	0.94	0.81	1.08	.368	0.93	0.81	1.08	.351	0.92	0.80	1.07	.282
Female gender[b]	**1.12**	**1.00**	**1.25**	**.044**	1.10	0.98	1.22	.096	1.10	0.99	1.23	.067	1.08	0.97	1.20	.160
Income	1.03	0.99	1.06	.115	1.03	0.99	1.06	.108	1.03	0.99	1.06	.144	1.02	0.99	1.05	.255
Age	**1.01**	**1.00**	**1.01**	**.002**	**1.01**	**1.00**	**1.01**	**.004**	**1.01**	**1.00**	**1.01**	**.011**	**1.01**	**1.00**	**1.01**	**.010**
College education[c]	**1.14**	**1.01**	**1.29**	**.032**	**1.17**	**1.04**	**1.32**	**.009**	**1.15**	**1.02**	**1.30**	**.020**	**1.16**	**1.03**	**1.31**	**.015**
Party ID[d]	**1.04**	**1.01**	**1.08**	**.005**	**1.05**	**1.01**	**1.08**	**.005**	1.03	0.99	1.06	.199	1.02	0.98	1.06	.350
Positive emotions	**1.18**	**1.09**	**1.29**	**< .001**	**1.15**	**1.06**	**1.25**	**.001**	**1.14**	**1.05**	**1.24**	**.001**	1.08	0.99	1.19	.084
Negative emotions	1.10	0.99	1.21	.066	1.01	0.91	1.13	.793	0.98	0.88	1.08	.635	0.98	0.89	1.09	.757
Worry about climate hazards					**1.19**	**1.06**	**1.34**	**.003**	1.07	0.91	1.27	.408	1.07	0.91	1.25	.431
Worry about climate change									**1.12**	**1.04**	**1.22**	**.005**	**1.10**	**1.01**	**1.20**	**.021**
Efficacy													**1.15**	**1.07**	**1.24**	**< .001**
Constant	0.91	0.59	1.40	.663	0.85	0.54	1.34	.483	0.99	0.63	1.58	.980	0.92	0.57	1.47	.722
Model statistics	Wald x^2 (10) = 61.73, *p* < .001				Wald x^2 (11) = 70.73 *p* < .001				Wald x^2 (12) = 99.10, *p* < .001				Wald x^2(13) = 114.77, *p*<..001			

Notes: [a]White=0 (reference group); [b]identifies as male = 0 (reference group); [c]less than college education = 0 (reference group); [d]7-item measure, 1 = strong Republican to 7 = strong Democrat. Ns vary due to missing data. p **< .05 highlighted in bold**

Table 5presents the results from Poisson regressions predicting the number of collective climate change mitigation behaviors performed in the past year. In Model 1 both composite positive and negative emotions were significant predictors of collective behaviors; positive emotions remained significant after controlling for the significant association between worry about climate-related hazards and collective climate change mitigation behavior (see Model 2). However, worry about climate hazards was no longer significant after controlling for the significant association between worry about climate change specifically and collective climate change mitigation behavior (see Model 3). In fully adjusted models, collective efficacy was significantly associated with collective actions and fully accounted for the association between positive emotions and collective behaviors (see Model 4). In the final model (Model 4), the following demographic predictors were associated with performing more collective behaviors: White persons compared to Black persons, younger age, and obtaining a Bachelor's degree or higher. No interaction terms reached statistical significance.

Table 5

Poisson regression analyses of demographics, positive and negative emotions, worry and efficacy as predictors of collective-level climate change mitigation behaviors

	Model 1 (N = 1,415)				**Model 2 (N = 1,415)**				**Model 3 (N = 1,414)**				**Model 4 (N = 1,338)**			
	IRR	95%CI		*p*	IRR	95%CI		*p*	IRR	95%CI		*p*	IRR	95%		*p*
Ethnicity[a]																
Black, Non-Hispanic	0.55	0.26	1.18	.126	0.49	0.23	1.05	.066	0.52	0.24	1.11	.093	**0.42**	**0.20**	**0.90**	**.025**
Non-Hispanic, 2 + races	0.48	0.21	1.09	.079	**0.44**	**0.20**	**0.98**	**.044**	**0.42**	**0.19**	**0.93**	**.031**	0.52	0.26	1.02	.058
Hispanic	0.99	0.62	1.59	.973	0.72	0.43	1.19	.203	0.72	0.44	1.17	.185	0.62	0.38	1.01	.052
Female gender[b]	1.35	0.87	2.10	.175	1.18	0.78	1.79	.427	1.27	0.85	1.89	.236	1.22	0.83	1.78	.308
Income	1.02	0.90	1.16	.758	1.00	0.91	1.11	.935	1.01	0.91	1.12	.910	0.96	0.88	1.05	.348
Age	0.99	0.97	1.00	.066	**0.99**	**0.97**	**1.00**	**.035**	0.98	0.97	1.00	**.006**	**0.99**	**0.98**	**1.00**	**.011**
College education[c]	**1.94**	**1.27**	**2.97**	**.002**	**2.21**	**1.45**	**3.37**	**< .001**	2.16	1.41	3.28	**< .001**	**1.88**	**1.26**	**2.83**	**.002**
Party ID[d]	**1.32**	**1.19**	**1.47**	**< .001**	**1.31**	**1.21**	**1.42**	**< .001**	1.25	1.12	1.38	**< .001**	1.20	1.10	1.32	**< .001**
Positive emotions	**2.06**	**1.41**	**3.02**	**< .001**	**1.87**	**1.27**	**2.75**	**.002**	1.82	1.25	2.65	**.002**	1.37	0.93	2.03	.115
Negative emotions	**1.46**	**1.04**	**2.05**	**.030**	1.13	0.80	1.58	.494	0.98	0.71	1.35	.897	0.90	0.66	1.22	.491
Worry about climate hazards					**1.73**	**1.36**	**2.20**	**< .001**	1.32	0.89	1.94	.168	1.29	0.97	1.72	.079
Worry about climate change									**1.44**	**1.15**	**1.82**	**.002**	**1.38**	**1.14**	**1.68**	**.001**
Efficacy													**1.72**	**1.42**	**2.08**	**< .001**
Constant	**0.01**	**0.00**	**0.02**	**< .001**	**0.01**	**0.00**	**0.02**	**< .001**	**0.01**	**0.00**	**0.03**	**< .001**	**0.01**	**0.00**	**0.03**	**< .001**
Model statistics	Wald x^2 (10) = 121.61, *p* < .001				Wald x^2 (11) = 158.75, *p* < .001				Wald x^2 (12) = 206.26 *p* < .001				Wald x^2 (13) = 303.27 *p* < .001			

Notes: [a]White=0 (reference group); [b]identifies as male = 0 (reference group); [c]less than college education = 0 (reference group); [d]7-item measure, 1 = strong Republican to 7 = strong Democrat. Ns vary due to missing data. p **< .05 highlighted in bold.**

Table 6presents results for the relationship between individual emotions regarding one's ability to act to address climate change and a number of individual-level climate change mitigation behaviors performed in the past week. Identifying as White compared to Black and obtaining a bachelor's degree or higher were associated with reporting performance of more individual actions. Worry about climate change fully accounted for the initial positive relationship between worry about climate hazards and performance of individual-level climate change mitigation behaviors (see Models 3 and 2, respectively). In the final model, worry about climate change, collective efficacy, and feeling hopeful and nervous about one's ability to act were statistically significant predictors of performing individual-level behaviors. No interaction terms were significant.

Table 6

Poisson regression of demographics, individual emotions, worry, and efficacy as predictors of individual-level climate change mitigation behaviors

	Model 1 (N = 1,351)				**Model 2 (N = 1,351)**				**Model 3 (N = 1,350)**				**Model 4 (N = 1,348)**			
	IRR	95%CI		*p*	IRR	95%CI		*p*	IRR	95%CI		*p*	IRR	95%		*p*
Ethnicity[a]																
Black, Non-Hispanic	0.87	0.71	1.07	.188	0.83	0.68	1.02	.078	0.85	0.69	1.05	.134	**0.82**	**0.67**	**1.00**	**.048**
Non- Hispanic, 2 + races	1.01	0.72	1.41	.966	0.98	0.71	1.34	.877	0.97	0.70	1.36	.864	0.98	0.71	1.36	.918
Hispanic	1.01	0.88	1.17	.879	0.92	0.80	1.07	.285	0.92	0.80	1.07	.282	0.91	0.79	1.05	.200
Income	1.03	1.00	1.06	.053	1.03	1.00	1.06	.054	1.03	1.00	1.06	.085	1.02	0.99	1.05	.169
Age	**1.01**	**1.00**	**1.01**	**.002**	**1.01**	**1.00**	**1.01**	**.008**	1.00	1.00	1.01	.015	1.00	1.00	1.01	.018
College education[c]	1.13	1.00	1.28	.051	**1.16**	**1.03**	**1.31**	**.015**	**1.15**	**1.02**	**1.30**	**.027**	**1.16**	**1.02**	**1.31**	**.019**
Party ID[d]	**1.04**	**1.01**	**1.08**	**.015**	**1.04**	**1.01**	**1.08**	**.012**	1.03	0.99	1.07	.152	1.02	0.98	1.06	.273
Emotions																
Hopeful	**1.24**	**1.07**	**1.44**	**.005**	**1.21**	**1.06**	**1.38**	**.005**	**1.22**	**1.07**	**1.39**	**.004**	**1.17**	**1.04**	**1.32**	**.008**
Confident	0.95	0.81	1.11	.520	0.96	0.83	1.10	.536	0.94	0.82	1.08	.380	0.93	0.81	1.06	.259
Optimistic	1.01	0.88	1.17	.866	1.00	0.88	1.14	1.00	1.00	0.88	1.14	.961	0.99	0.88	1.13	.932
Helpless	1.06	0.92	1.22	.412	1.03	0.90	1.18	.681	1.03	0.89	1.18	.731	1.03	0.90	1.17	.696
Powerless	1.02	0.88	1.18	.803	1.03	0.89	1.18	.703	1.02	0.89	1.17	.780	1.04	0.91	1.18	.608
Lacking Control	1.06	0.94	1.18	.340	1.05	0.94	1.17	.401	1.03	0.92	1.15	.574	1.02	0.92	1.13	.676
Indifferent	0.94	0.86	1.04	.224	0.94	0.87	1.03	.171	0.97	0.90	1.06	.503	0.97	0.90	1.05	.491
On edge	1.12	0.90	1.38	.309	1.09	0.89	1.34	.382	1.11	0.90	1.36	.323	1.11	0.92	1.33	.282
Uneasy	0.96	0.80	1.16	.671	0.95	0.80	1.13	.557	0.93	0.79	1.10	.414	0.96	0.81	1.12	.588
Nervous	0.89	0.75	1.05	.172	0.87	0.74	1.02	.094	0.86	0.73	1.02	.078	**0.84**	**0.71**	**0.99**	**.033**
Worry about climate hazards					**1.21**	**1.08**	**1.36**	**.001**	1.10	0.95	1.27	.196	1.09	0.95	1.26	.208
Worry about climate change									**1.12**	**1.04**	**1.20**	**.002**	**1.09**	**1.02**	**1.17**	**.016**
Efficacy													**1.17**	**1.09**	**1.26**	**< .001**
Constant	1.00	0.63	1.60	.998	0.94	0.58	1.53	.809	1.02	0.62	1.68	.935	0.93	0.56	1.56	.793
Model statistics	Wald $x^2(18) = 88.33$, $p < .001$				Wald $x^2(19) = 104.29$, $p < .001$				Wald $x^2(20) = 131.99$ $p < .001$				Wald x^2 (21) = 157.34, $p < .001$			

Notes: [a]White=0 (reference group); [b]identifies as male = 0 (reference group); [c]less than college education = 0 (reference group); [d]7-item measure, 1 = strong Republican to 7 = strong Democrat. Ns vary due to missing data.

p **< .05 highlighted in bold**

Table 7presents results for the relationship between individual emotions regarding one's ability to act to address climate change and the number of collective climate change mitigation behaviors performed in the past year. In full models (see Model 4), performing more collective behaviors was predicted by identifying as a White person compared to a Black person, younger age, obtaining a Bachelor's degree or higher, and identifying more strongly as a Democrat compared to a Republican. Worry about climate hazards, worry about climate change, and collective efficacy were significant predictors of performing more behaviors; feeling hopeful and confident remained significant as well. No interaction terms were significant.

Table 7

Poisson regression of demographics, individual emotions, worry, and efficacy as predictors of collective-level climate change mitigation behaviors

	Model 1 (N = 1,353)				**Model 2 (N = 1,353)**				**Model 3 (N = 1,352)**				**Model 4 (N = 1,284)**			
	IRR	95%CI		*p*	IRR	95%CI		*p*	IRR	95%CI		*p*	IRR	95%		*p*
Ethnicity[a]																
Black, Non-Hispanic	**0.48**	**0.25**	**0.93**	**.028**	**0.42**	**0.21**	**0.81**	**.010**	**0.46**	**0.24**	**0.90**	**.022**	**0.38**	**0.20**	**0.73**	**.003**
Non-Hispanic, 2 + races	0.58	0.24	1.39	.221	0.52	0.23	1.19	.122	0.47	0.20	1.10	.081	0.59	0.27	1.28	.182
Hispanic	1.04	0.66	1.65	.862	0.73	0.43	1.23	.242	0.72	0.44	1.20	.208	0.62	0.39	1.00	.052
Female gender[b]	1.32	0.90	1.93	.163	1.19	0.80	1.76	.399	1.23	0.83	1.80	.299	1.22	0.85	1.75	.281
Income	1.01	0.92	1.12	.793	1.00	0.91	1.11	.942	0.99	0.90	1.09	.851	0.97	0.89	1.06	.531
Age	0.99	0.98	1.00	.076	0.99	0.97	1.00	.031	**0.98**	**0.97**	**1.00**	**.013**	**0.99**	**0.97**	**1.00**	**.021**
College education[c]	**1.82**	**1.20**	**2.75**	**.004**	**2.02**	**1.34**	**3.04**	**.001**	**1.95**	**1.31**	**2.92**	**.001**	**1.72**	**1.16**	**2.54**	**.006**
Party ID[d]	**1.27**	**1.15**	**1.41**	**< .001**	**1.26**	**1.15**	**1.37**	**< .001**	**1.21**	**1.10**	**1.32**	< .001	**1.17**	**1.08**	**1.28**	**< .001**
Emotions																
Hopeful	**2.26**	**1.50**	**3.40**	**< .001**	**2.06**	**1.42**	**2.97**	**< .001**	**2.07**	**1.43**	**2.98**	.000	**1.70**	**1.17**	**2.48**	**.005**
Confident	0.88	0.55	1.40	.581	0.97	0.65	1.46	.891	0.92	0.61	1.39	.707	0.90	0.61	1.33	.608
Optimistic	1.08	0.73	1.59	.703	0.98	0.68	1.41	.898	0.99	0.69	1.43	.971	0.92	0.64	1.32	.652
Helpless	1.40	0.83	2.36	.206	1.30	0.76	2.20	.333	1.30	0.79	2.13	.306	1.31	0.79	2.17	.290
Powerless	0.70	0.38	1.31	.269	0.75	0.40	1.38	.349	0.70	0.40	1.24	.225	0.79	0.46	1.35	.387
Lacking Control	1.35	0.89	2.04	.162	1.24	0.83	1.85	.289	1.21	0.83	1.77	.320	1.07	0.73	1.57	.732
Indifferent	0.80	0.60	1.07	.127	0.75	0.58	0.96	.023	0.86	0.66	1.13	.277	0.79	0.61	1.03	.080
On edge	1.46	0.86	2.48	.159	1.33	0.77	2.29	.309	1.32	0.79	2.19	.286	1.30	0.79	2.12	.304
Uneasy	0.74	0.39	1.40	.347	0.73	0.38	1.39	.339	0.71	0.41	1.23	.221	0.73	0.44	1.22	.233
Nervous	1.14	0.74	1.77	.555	1.11	0.69	1.77	.674	1.07	0.68	1.67	.775	0.98	0.63	1.51	.917
Worry about climate hazards					**1.75**	**1.40**	**2.19**	**< .001**	1.31	0.95	1.79	.094	**1.34**	**1.02**	**1.77**	**.036**
Worry about climate change									**1.42**	**1.15**	**1.75**	**.001**	**1.33**	**1.11**	**1.60**	**.002**
Efficacy													**1.74**	**1.42**	**2.14**	**< .001**
Constant	0.01	0.00	0.03	< .001	0.01	0.00	0.03	< .001	0.01	0.00	0.03	**< .001**	**0.01**	**0.00**	**0.04**	**< .001**
Model statistics	Wald x^2 (18) = 229.74 *p* < .001				Wald x^2 (19) = 263.19 *p* < .001				Wald x^2 (20) = 322.42 *p* < .001				Wald x^2 (21) = 390.35 *p* < .001			

Notes: [a]White=0 (reference group); [b]identifies as male = 0 (reference group); [c]less than college education = 0 (reference group); [d]7-item measure, 1 = strong Republican to 7 = strong Democrat. Ns vary due to missing data. p **< .05 highlighted in bold**

See Supplemental Tables 2–6 for multiple regression analyses examining demographic predictors of emotions and worry.

4. Discussion

Results suggest engaging in actions to combat climate change is relatively common: the majority of the sample engaged in at least some individual climate change mitigation behaviors in the past week. Although performing collective action was much less common, a substantial minority engaged in at least one

collective action in the past year, perhaps because many collective actions are typically performed less frequently (e.g., donating money may only semi-annually; signing petitions may only occur during a collective mobilization). In adjusted models, worry about climate change specifically impacting a close other or one's community and the efficacy of climate change mitigation behaviors (both individual and collective) to reduce the impacts of climate change were associated with greater performance of both individual- and collective0level climate change mitigation behaviors. In general, worry about climate change fully accounted for the relationships between both composite negative emotions and worry about climate-related hazards and both individual- and collective-level climate change mitigation behaviors. Efficacy about one's ability to act to reduce climate change fully accounted for the relationship between composite positive emotions surrounding the performance of pro-environmental behaviors and both individual- and collective-level behaviors. However, in models examining specific emotions, hope, and nervousness remained significant predictors of performing individual-level behaviors; hopefulness and confidence remained statistically significant predictors of performing collective-level behaviors.

With few exceptions, emotions, worry, and efficacy had parallel relationships with performance of both individual and collective climate change mitigation behavior. This suggests that similar psychological processes may spur action across types of behavior, increasing the generalizability of findings across behavioral outcomes. Most of the interaction terms tested were not significant, suggesting mediation, rather than moderation. However, the cross-sectional nature of our data precludes true mediation analyses, which requires temporal precedence, where variables are assessed at repeated time points (Kendall et al. 2017).

4.1. Efficacy as an Important Predictor of Climate Change Mitigation Behaviors

Efficacy for both individual and collective climate change mitigation to address the climate crisis were relatively low, in alignment with recent evidence. For example, in a recent Pew survey, 46% of US residents were very/somewhat confident and 52% were not too/not at all confident in the ability of collective action to mitigate the climate crisis (Pew Research Center 2021). Nevertheless, in the present analyses, efficacy was the strongest and most consistent predictor of engagement in both individual- and collective-level climate change mitigation behaviors. This suggests that even if people feel their efforts are only somewhat effective, they may still be willing to perform them. This may be particularly true for actions that are perceived as easy to perform (Bostrom et al. 2019). Interaction effects were not present between efficacy and emotions (positive or negative) nor worry. While prior work suggests that fear appeals, along with efficacy statements, tend to elicit the strongest effects (Tannenbaum et al. 2015), our findings suggest these constructs, as experienced by the individual, may operate in tandem, rather than through an amplification effect. This may also speak to the strength of the relationship between efficacy and climate-mitigation behavior, as evidenced in meta-analytic findings evaluating factors associated with climate change adaptation behavior (van Valkengoed and Steg 2019): even low amounts of efficacy may be helpful for motivating behavior, independent of co-occurring emotions.

4.2. Hope and Climate-related Mitigation Behaviors

Of the specific emotions assessed, hope consistently remained a statistically significant predictor of performing more individual- and collective-level climate change mitigation behaviors in fully adjusted models. This is consistent with other work conducted on individual-level behaviors including recycling (Ojala 2008) and climate change activism that targets the collective level such as a carbon tax (Bury et al. 2020). In the case of collective-level behaviors, confidence was also associated with the performance of more behaviors. These data support the "warm glow effect" of engaging in pro-environmental behaviors described by other scholars (Schneider et al. 2021; Taufik et al. 2015), whereby acting morally leads to positive emotional states (Andreoni 1990). This can occur as both an antecedent of performing pro-environmental behaviors and a result of that performance.

The consistent relationship between hope and behaviors was interesting in light of the overall low efficacy reported by our sample. Prior research demonstrated that hope rose with possibility, rather than probability, of a successful outcome with respect to addressing the climate crisis, which in turn led to greater support for climate change action, suggesting that hope may be particularly motivating when the odds of success of a particular goal are low (Bury et al. 2020). Research suggests hope may function differently than other emotions (e.g., optimism), for possible, but not probable events, such as the ability of climate change mitigation efforts to result in meaningful environmental benefits (Bury et al. 2016). Indeed, our findings support prior work suggesting that hope may be a more effective motivator to promote climate change mitigation behavior compared to negative emotions such as shame or guilt (Markowitz and Shariff, 2012).

4.3. Worry as a Constructive Emotion to Inspire Action

As people experience more natural hazards that are exacerbated by climate change, they may perceive greater risk and in turn become more alarmed, fearful, and worried, which in turn may lead to more pro-environmental decisions and climate change mitigation behavior (Weber 2006). Indeed, as direct impacts from climate-related disasters are more frequently experienced, worry about the climate crisis may spur action (Bouman et al. 2020). Yet our data show that worry about climate hazards alone is likely not enough to encourage environmental actions: Worry specific to the climate crisis' direct impacts on the individual or their community may be a most potent. Our findings align with work suggesting that in the case of the existential threat of climate change, worry may be rational and adaptive; climate change mitigation behaviors may be one way to take personal responsibility and address threat mitigation (Bouman et al. 2020).

Perhaps surprisingly, worry about the direct threat of the "climate crisis", which can seem abstract (van der Linden et al. 2015) was a stronger predictor of climate change mitigation behaviors than worry about climate hazards more generally, an arguably more concrete threat (Spence et al. 2012). Worry about the climate crisis specifically could indicate respondents are making the cognitive connection between climate change impacts and their personal choices to act to prevent such impacts. Such "subjective attribution" (attributing climate change impacts to the climate crisis), has been associated with more collective "climate activism" (support for a carbon tax policy) and behavioral intentions (e.g., electric vehicle purchase) (Wong-Parodi and Berlin 2022). Similarly, prior work found that attributing a climate-related natural disaster (i.e., hurricane) to the climate crisis was associated with more adaptive behaviors (Wong-Parodi and Garfin, 2022). Future research, perhaps integrating both quantitative and qualitative data, could further elucidate these findings.

Similar to prior research, we found some demographic factors associated with performance of climate change mitigation (Bradley et al. 2020), although in general demographic factors were neither strong nor consistent correlates of climate change mitigation behaviors: those older in age were more likely to perform individual-level climate change mitigation behaviors and those younger in age were more likely to perform collective-level mitigation behaviors. Those with a college education reported performing more individual and collective-level climate change mitigation behaviors. While identifying more strongly as a Democrat compared to a Republication was associated with greater performance of individual and collective mitigation behavior in preliminary models, after accounting for psychological factors (i.e., emotions, worry, and efficacy), political identity did not predict individual-level behaviors. This finding aligns with large-scale survey data finding that issues of climate change and the environment are becoming increasingly important, across the political spectrum (Marlon et al. 2022). Moreover, in contrast to global research conducted in Europe (Gregersen et al. 2020), we did not find that worry moderated the association between political identification and behaviors. This suggests communication appeals that focus on non-political psychological responses may be effective at promoting mitigation behaviors across the populace, as more U.S. residents across the political spectrum agree that climate change is anthropogenic and should be addressed (Leiserowitz, Roser-Renouf, et al. 2021).

4.5. Applications

Taken together, our findings suggest that practical appeals that focus on hope, efficacy, and personal relevance may be most helpful at inspiring climate change mitigation behaviors (Ojala et al., 2021), particularly in a political climate of perceived high polarization (Lee 2022). Relatedly, recent qualitative research found greater than expected “common ground” across the political spectrum with respect to emotions and environmentalism (Kennedy and Muzzerall, 2022). Hope appeals can promote greater feelings of self and response efficacy (Chadwick and Chadwick 2015), potentially further motivating change. Concurrently, our research supports the notion that worry and fear, particularly when combined with feelings of efficacy, can be effective at promoting adaptive behaviors (Witte and Allen 2000).

4.6. Limitations

We note several limitations. Although we were able to assess a probability-based, representative sample of Texas and Florida residents, our key variables were assessed cross-sectionally, prohibiting analysis of how these factors play out over time. Our measures of behaviors were self-report; future research should validate self-reports with behavioral observations. Individual actions were assessed in the past week, while collective actions were assessed in the past year, potentially resulting in recall bias. We believe this is the most ecologically valid approach to assessing these constructs since lifestyle behaviors and household decisions (e.g., conserving energy) are generally performed on an ongoing basis and collective behaviors tend to be more sporadic (e.g., annual contributions to environmental groups, helping a community prepare for climate impacts). Similar to prior research (Chu and Yang, 2020), we assessed general “efficacy” and did not separate efficacy by type (e.g., self or response), which may differentially impact climate change mitigation behaviors (Geiger et al. 2017). We assessed a limited number of emotions, there may be emotions that we did not assess that may also be correlated with outcomes.

4.7. Conclusion

Our data suggest that hope, worry, and efficacy are potent predictors of engaging in individual and collective-level climate change mitigation behavior. In general, these effects were evident across demographic groups, including political identification. This suggests that to inspire positive action to address the climate crisis, communications should limit partisanship and convey urgency and risk regarding the crisis, focusing on reducing the psychological distance to the crisis and activating motivating amounts of worry, fear, and ruminative processes, while acknowledging the potential that non-constructive can have negative impacts on functioning (Holman et al. 2020). Concurrently, messages should also focus on hope and inspire efficacy that, despite seemingly dismal odds, engaging in lifestyle choices, household decisions, and climate activism are important behaviors for creating meaningful change.

Declarations

Author Notes

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Author contributions: DRG and GWP jointly contributed to the study conception, design, and funding acquisition. Data analysis was performed by DRG. The first draft of the manuscript was written by DRG. MZ assisted with the literature review and the initial draft. GWP commented on iterative versions of the grant and assisted with editing. All authors provided edits to the final draft and approved of the submission.

Data and analytic codes will be available on the Open Science Framework after publication and are available from the authors by request.

Statements and Disclosures

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References

1. Andreoni J (1990) Impure altruism and donations to public goods: A theory of warm-glow giving. *Econ J 100*(401): 464-477. https://doi.org/10.2307/2234133
2. Bamberg S, Rees J, & Schulte M (2018). Environmental protection through societal change: what psychology knows about collective climate action—and what it needs to find out. In: Clayton S and Manning C (Eds), *Psychology and Climate Change*. Academic Press, pp 185–213. https://doi.org/10.1016/B978-0-12-813130-5.00008-4
3. Bandura A (1977) Self-efficacy: toward a unifying theory of behavioral change. *Psychol Rev 84*(2):191–215. https://doi.org/10.1037/0033-295x.84.2.191
4. Bell J, Poushter J, Fagan M, & Huang C (2021) In response to climate change, citizens in advanced economies are willing to alter how they live and work. *Pew Research Center*. https://www.pewresearch.org/global/2021/09/14/in-response-to-climate-change-citizens-in-advanced-economies-are-willing-to-alter-how-they-live-and-work/?utm_content=buffercde16&utm_medium=social&utm_source=twitter.com&utm_campaign=buffer
5. Bloemendaal N, de Moel H, Martinez AB, Muis S, Haigh ID, van der Wiel K, Haarsma RJ, Ward PJ, Roberts MJ, Dullaart JCM, Aerts JCJH (2022) A globally consistent local-scale assessment of future tropical cyclone risk. *Sci Adv 8*: eabm8438. https://doi.org/10.1126/sciadv.abm8438
6. Bostrom A, Hayes A L, and CrosmanK M (2019) Efficacy, action, and support for reducing climate change risks. *Risk Anal 39*(4):805–828. https://doi.org/10.1111/risa.13210
7. Bouman T, Verschoor M, Albers C, Böhm G, Fisher SD, Poortinga W, Whitmarsh L, Steg L (2020) When worry about climate change leads to climate action: How values, worry and personal responsibility relate to various climate actions. *Global Environ Chang 62*:102061. https://doi.org/10.1016/j.gloenvcha.2020.102061
8. Bradley GL, Babutsidze Z, Chai A, Reser J P (2020) The role of climate change risk perception, response efficacy, and psychological adaptation in pro-environmental behavior: A two nation study. *J Environ Psych 68*:101410. https://doi.org/10.1016/j.jenvp.2020.101410
9. Brosch T (2021) Affect and emotions as drivers of climate change perception and action: a review. *Behav Sci 42*:15–21. https://doi.org/10.1016/j.cobeha.2021.02.001
10. Bury SM, Wenzel M, Woodyatt L (2016) Giving hope a sporting chance: Hope as distinct from optimism when events are possible but not probable. *Motiv Emot 40*(4):588–601. https://doi.org/10.1007/s11031-016-9560-z
11. Bury SM, Wenzel M, Woodyatt L (2020). Against the odds: Hope as an antecedent of support for climate change action. *Br J Soc Psychol 59*:289–310. https://doi.org/10.1111/bjso.12343
12. Capstick S, Lorenzoni I, Corner A, Whitmarsh L (2014) Prospects for radical emissions reduction through behavior and lifestyle change. *Carbon Manag 5*(4): 429–444. https://doi.org/10.1080/17583004.2015.1020011
13. Chadwick AE (2015). Toward a theory of persuasive hope: Effects of cognitive appraisals, hope appeals, and hope in the context of climate. *Health Commun 30*(6):598–611. https://doi.org/10.1080/10410236.2014.916777
14. Chu H, Yang JZ (2019). Emotion and the psychological distance of climate change. *Sci Commun 41*(6):761–789. https://doi.org/10.1177/1075547019889637
15. Chu H, Yang JZ (2020) Risk or efficacy? How psychological distance influences climate change engagement. *Risk Anal 40*(4):758–770. https://doi.org/10.1111/risa.13446
16. Doherty TJ, Clayton S (2011) The psychological impacts of global climate change. *Am Psychol 66*(4):265–276. https://doi.org/10.1037/a0023141
17. Emanuel K (2020) Evidence that hurricanes are getting stronger. *PNAS 117*(24):13194–13195. https://doi.org/10.1073/pnas.2007742117
18. Eskander SMSU, Fankhauser S (2020) Reduction in greenhouse gas emissions from national climate legislation. *Nat Clim Change 10*(8):750–756. https://doi.org/10.1038/s41558-020-0831-z
19. Fredrickson BL (1998) What good are positive emotions? *Rev Gen Psychol 2*(3):300–319. https://doi.org/10.1037/1089-2680.2.3.300
20. Garfin DR, Thompson RR, Holman EA, Wong-Parodi G, Silver RC (2022) Association between repeated exposure to hurricanes and mental health in a representative sample of Florida residents. *JAMA Netw Open 5*(6): e2217251. https://doi.org/10.1001/jamanetworkopen.2022.17251
21. Garfin DR, Thompson RR, Wong-Parodi G (2022) Media exposure, threat processing, and mitigation behaviors in Gulf Coast residents facing the co-occurring threats of COVID-19 and hurricanes. *Risk Anal* 1–17. https://doi.org/10.1111/risa.14032
22. Geiger N, Swim JK, Fraser J (2017) Creating a climate for change: Interventions, efficacy and public discussion about climate change. *J of Environ Psychol 51*:104–116. https://doi.org/10.1016/j.jenvp.2017.03.010
23. Geiger N, Swim JK, Gasper K, Fraser J, Flinner K (2021) How do I feel when I think about taking action? Hope and boredom, not anxiety and helplessness, predict intentions to take climate action. *J of Environ Psychol 76*, 101649. https://doi.org/10.1016/j.jenvp.2021.101649
24. Green R, Milner J, Dangour AD, Haines A, Chalabi Z, Markandya A, Spadaro J, Wilkinson P (2015) The potential to reduce greenhouse gas emissions in the UK through healthy and realistic dietary change. *Clim Change*, *129*:253–265. https://doi.org/10.1007/s10584-015-1329-y
25. Gregersen T, Doran R, Böhm G, Tvinnereim E, Poortinga W (2020) Political orientation moderates the relationship between climate change beliefs and worry about climate change. *Front Psychol 11*:1–12. https://doi.org/10.3389/fpsyg.2020.01573
26. Holman EA, Garfin DR, Lubens P, Silver RC (2020) Media exposure to collective trauma, mental health, and functioning: Does it matter what you see? *Clin Psychol Sci*, *8*(1):111–124. https://doi.org/10.1177/2167702619858300
27. Holman EA, Silver RC, Poulin M, Andersen J, Gil-Rivas V, McIntosh DN (2008) Terrorism, acute stress, and cardiovascular health. *Arch Gen Psychiatry 65*(1):73–80
28. Hornsey MJ, Chapman CM, Oelrichs DM (2021) Ripple effects: Can information about the collective impact of individual actions boost perceived efficacy about climate change? *J Exp Soc Psychol*, *97*:104217. https://doi.org/10.1016/j.jesp.2021.104217

29. Kendall PC, Olino TM, Carper M, Makover H (2017) On the importance of temporal precedence in mediational analyses. *J Consult Clin Psychol 85*(1):80–82. https://doi.org/10.1037/ccp0000152
30. Kennedy EH, Muzzerall P (2022) Morality, emotions, and the ideal environmentalist: Toward a conceptual framework for understanding political polarization. *Am Behav Sci 66*(9):1263–1285. https://doi.org/10.1177/00027642211056258
31. Kollmuss A, Agyeman J (2010) Mind the gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environ Educ Res 8*(3):239–260. https://doi.org/10.1080/13504620220145401
32. Latkin C, Dayton L, Bonneau H, Bhaktaram A (2022) Perceived barriers to climate change activism behaviors in the United States among individuals highly concerned about climate change. *Journal of Prevention*. https://doi.org/10.1007/s10935-022-00704-0
33. Lee Y (2022) Social trust in polarized times: How perceptions of political polarization affect Americans' trust in each other. *Polit Behav*, *44*(3):1533–1554. https://doi.org/10.1007/s11109-022-09787-1
34. Leiserowitz A, Maibach E, Rosenthal S, Kotcher J, Wang X, Carman J, Goldberg M, Lacroix K, Marlon J (2021) *Climate activism: A six Americas analysis, December 2020*. Yale University and George Mason University. New Haven, CT: Yale Program on Climate Change Communication. https://climatecommunication.yale.edu/wp-content/uploads/2021/03/climate-activism-six-americas-december-2020.pdf
35. Leiserowitz A, Roser-Renouf C, Marlon J, Maibach E (2021) Global Warming's Six Americas: a review and recommendations for climate change communication. *Curr Opin Behav Sci 42*:97–103. https://doi.org/10.1016/j.cobeha.2021.04.007
36. Li D, Zhao L, Ma S, Shao S, Zhang L (2019) What influences an individual's pro-environmental behavior? A literature review. *Resources, Conservation & Recycling 146*:28–34. https://doi.org/10.1016/j.resconrec.2019.03.024
37. Loewenstein G, Lerner JS (2003) The role of affect in decision making. In: Davidson RJ, Scherer KR, Goldsmith HH (Eds) *Handbook of Affective Sciences*. Oxford University Press, pp 619–642.
38. MacLeod AK, Williams JM, Bekerian DA (1991) Worry is reasonable: The role of explanations in pessimism about future personal events. *J Abnorm Psychol 100*(4):478–486. https://doi.org/10.1037//0021-843x.100.4.478
39. Maiella R, La Malva P, Marchetti D, Pomarico E, Di Crosta A, Palumbo R, Cetara L, Di Domenico A, Verrocchio MA (2020) The psychological distance and climate change: A systematic review on the mitigation and adaptation behaviors. *Front Psychiatry 11*:568899. https://doi.org/10.3389/fpsyg.2020.568899
40. Markowitz EM, Shariff AF (2012) Climate change and moral judgement. *Nat Clim Change 2*(4):243–247. https://doi.org/10.1038/nclimate1378
41. Marlon JR, Wang X, Bergquist P, Howe PD, Leiserowitz A, Maibach E, Mildenberger M, Rosenthal S (2022) Change in US state-level public opinion about climate change: 2008 – 2020. *Environ Res Lett 17*:124046. https://doi.org/10.1088/1748-9326/aca702
42. Mascatelli K, Otten CD, Piacentini RV, Wong-Parodi G, States SL (2021) Comparisons of sustainability behaviors pre- and early pandemic among botanical garden members. *Front Sustain 3*:1–11. https://doi.org/10.3389/frsc.2021.707380
43. Nielsen KS, Clayton S, Stern PC, Dietz T, Capstick S, Whitmarsh L (2021) How psychology can help limit climate change. *Am Psychol 76*(1):130–144. https://doi.org/10.1037/amp0000624
44. Ojala M (2008) Recycling and ambivalence: Quantitative and qualitative analyses of household recycling among young adults. *Environ Behav 40*(6):777–797.
45. Ojala M (2012) Hope and climate change: the importance of hope for environmental engagement among young people. *Environ Educ Res 18*(5):625–642. https://doi.org/10.1080/13504622.2011.637157
46. Ojala M, Cunsolo A, Ogunbode CA, Middleton J (2021) Anxiety, worry, and grief in a time of environmental and climate crisis: A narrative review. *Annu Rev Environ Resour 46*:35–58. https://doi.org/10.1146/annurev-environ-012220-022716
47. Panu P (2020) Anxiety and the ecological crisis: An analysis of eco-anxiety and climate anxiety. *Sustainability 12*(19). https://doi.org/10.3390/SU12197836
48. Pew Research Center. (2021). *People across world greatly concerned about climate change and willing to make sacrifices to address it, but there is less confidence in efforts to solve the problem*. https://www.pewresearch.org/global/2021/09/14/in-response-to-climate-change-citizens-in-advanced-economies-are-willing-to-alter-how-they-live-and-work/pg_2021-09-14_climate_0-01/
49. Poore J, Nemecek T (2018) Reducing food's environmental impacts through producers and consumers. *Science*, *360*(6392):987–992. https://doi.org/10.1126/science.aaq0216
50. Roser-Renouf C, Maibach EW, Leiserowitz A, Zhao X (2014) The genesis of climate change activism: from key beliefs to political action. *Clim Change 125*(2):163–178. https://doi.org/10.1007/s10584-014-1173-5
51. Salama S, Aboukoura K (2017) Role of emotions in climate change communication. In: W. L. Filho WL, Manolas E, Azul AM, Azeiteiro UM, McGhie H (Eds), *Handbook of Climate Change Communication*. Springer, pp 137-150. https://doi.org/https://doi.org/10.1007/978-3-319-69838-0
52. Schneider CR, Zaval L, Markowitz EM (2021) Positive emotions and climate change. *Curr Opin Behav Sci 42*:114–120. https://doi.org/10.1016/j.cobeha.2021.04.009
53. Schneider CR, Zaval L, Weber EU, Markowitz EM (2017) The influence of anticipated pride and guilt on pro-environmental decision making. *PLoS ONE 12*(11):1–14. https://doi.org/10.1371/journal.pone.0188781
54. Schwartz SEO, Benoit L, Clayton S, Parnes MKF, Swenson L, Lowe SR (2022) Climate change anxiety and mental health: Environmental activism as buffer. *Curr Psychol*. https://doi.org/10.1007/s12144-022-02735-6
55. Segerstrom SC, Stanton AL, Alden LE, Shortridge BE (2003) A multidimensional structure for repetitive thought: What's on your mind, and how, and how much? *J Pers Soc Psychol 85*(5):909–921. https://doi.org/10.1037/0022-3514.85.5.909

56. Sobel AH, Camargo SJ, Hall TM, Lee C, Tippett MK, Wing AA (2016) Human influence on tropical cyclone intensity. *Science 353*(6296): 242–246. https://doi.org/10.1126/science.aaf6574
57. Solomon RC (2000) The philosophy of emotions. In: Lewis M, Haviland-Jones JM (Eds), *Handbook of Emotions*, Guilford, New York, pp 17–29.
58. Spence, A., Poortinga, W., & Pidgeon, N. (2012). The psychological distance of climate change. *Risk Analysis*, *32*(6):957–972. https://doi.org/10.1111/j.1539-6924.2011.01695.x
59. Strecher VJ, Devellis MB, Becker MH, Rosenstock IM (1986) The role of self-efficacy in achieving behavior change. *Health Educ Q 13*(1):73–91
60. Sweeny K, Dooley MD (2017) The surprising upsides of worry. *Soc Pers Psychol Compass 11*(4):e12311. https://doi.org/10.1111/spc3.12311
61. Sweeting JA, Garfin DR, Holman EA, Silver, RC (2020) Associations between exposure to childhood bullying and abuse and adulthood outcomes in a representative national U.S. sample. *Child Abuse Negl 101*:104048. https://doi.org/10.1016/j.chiabu.2019.104048
62. Tannenbaum MB, Hepler J, Zimmerman RS, Saul L, Jacobs S, Wilson K, Albarracín D (2015) Appealing to fear: A meta-analysis of fear appeal effectivness and theories. *Psychol Bull*, *141*(6):1178–1204. http://dx.doi.org/10.1037/a0039729
63. Taufik D, Bolderdijk JW, Steg L (2015) Acting green elicits a literal warm glow. *Nat Clim Change 5*:37–40. https://doi.org/10.1038/NCLIMATE2449
64. van Valkengoed AM, Steg L (2019) Meta-analysis of factors motivating climate change adaptation behaviour. *Nat Clim Change 9*:158–163. https://doi.org/10.1038/s41558-018-0371-y
65. Van Boven L, Kane J, Mcgraw AP, Dale J (2010) Feeling close: Emotional intensity reduces perceived psychological distance. *J Pers Soc Psychol 98*(6):872–885. https://doi.org/10.1037/a0019262
66. van der Linden S, Maibach E, Leiserowitz A (2015) Improving public engagement with climate change: Five "best practice" insights from psychological science. *Perspectives on Psychological Science 10*(6):758–763. https://doi.org/10.1177/1745691615598516
67. Watkins ER (2008) Constructive and unconstructive repetitive thought. *Psychol Bull 134*(2):163–206. https://doi.org/10.1037/0033-2909.134.2.163
68. Weber EU (2006) Experienced-based and description-based perceptions of long-term risk: Why global warming does not scare us (yet). *Clim Change*, *77*:103–120. https://doi.org/10.1007/s10584-006-9060-3
69. Williams DP, Jones NM, Holman EA (2022) Racial and ethnic differences in perseverative cognition at the onset of the COVID-19 pandemic. *Soc Sci Med 306*:115105. https://doi.org/10.1016/j.socscimed.2022.115105
70. Witte K (1992). Putting the fear back into fear appeals: The extended parallel process model. *Commun Monogr 59*(4):329–349. https://doi.org/10.1080/03637759209376276
71. Witte K, Allen M (2000) A meta-analysis of fear appeals: Implications for effective public health campaigns. *Health Educ Behav 27*, 591–615.
72. Wong-Parodi G, Berlin N (2022) Exploring how climate change subjective attribution, personal experience with extremes, concern, and subjective knowledge relate to pro-environmental attitudes and behavioral intentions in the United States. *J Environ Psychol*, *79*:101728. https://doi.org/10.1016/j.jenvp.2021.101728
73. Wong-Parodi G, Garfin, DR (2022) Hurricane adaptation behaviors in Texas and Florida: Exploring the role of negative personal experience and subjective attribution to climate change. *Environ Res Lett 17*:034033. https://doi.org/10.1088/1748-9326/ac4858

Figures

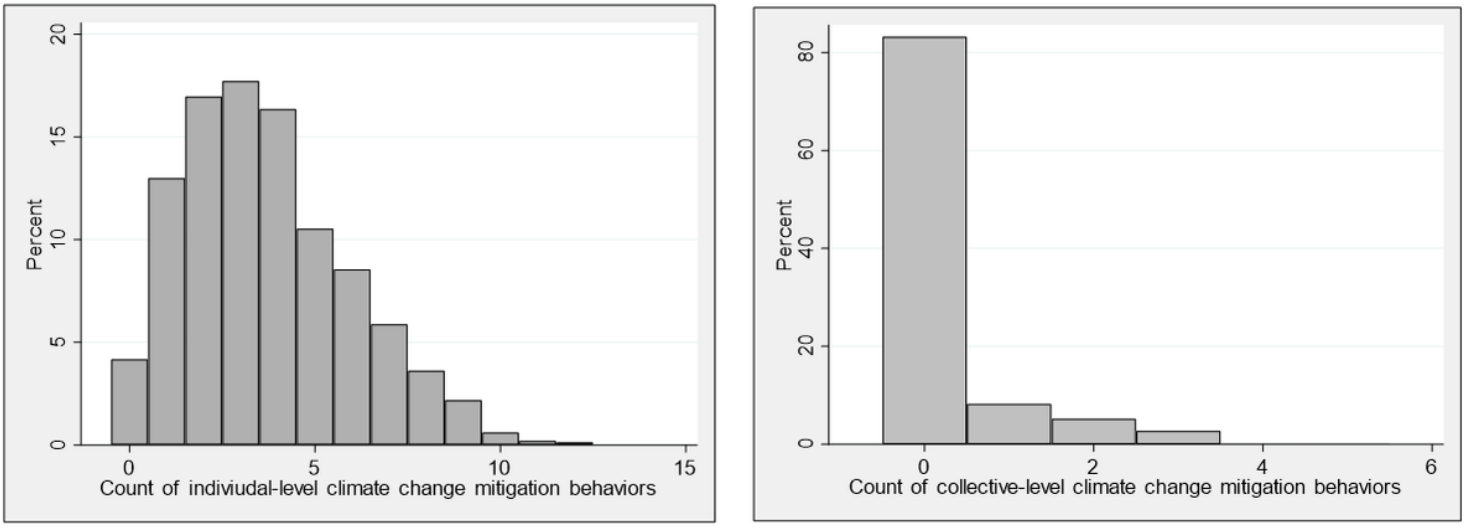

Figure 1

Counts of individual- and collective-level climate change mitigation behaviors

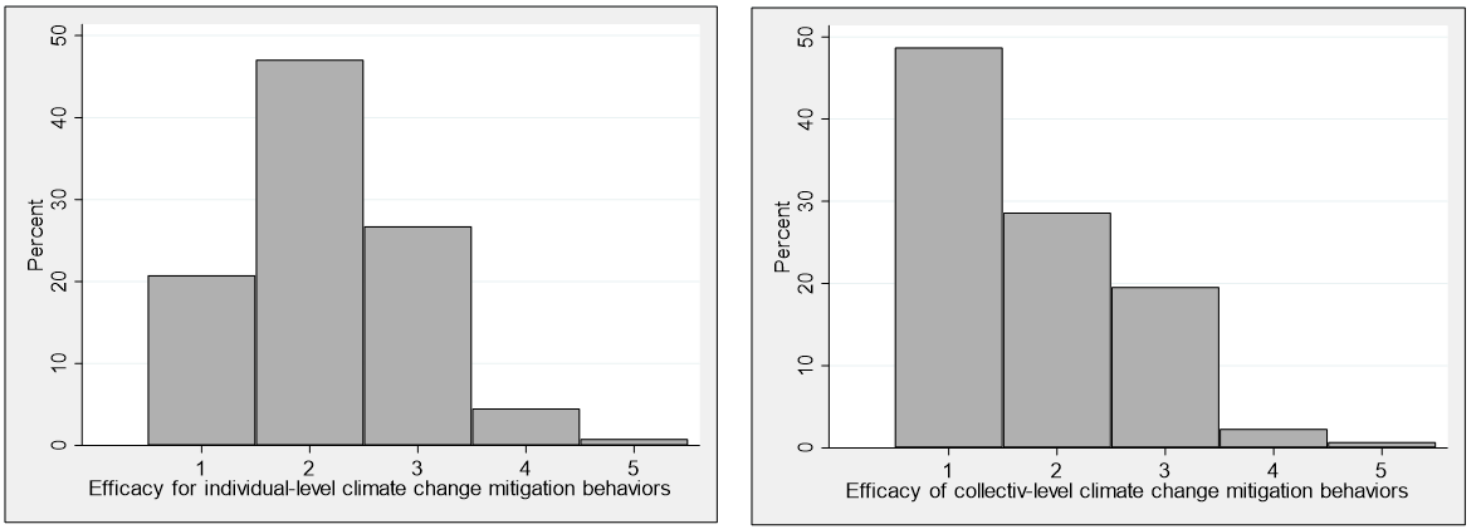

Figure 2

Efficacy regarding individual and collective climate change mitigation behaviors

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