Differentiating emotional pathways to climate change (in)action: An empirical test

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Abstract

Emotions play a substantial but poorly understood role in governing personal responses to climate change. In the current paper, we conceptualize five distinct emotion-cognition pathways that govern different behavioral responses to climate change across publics: Denial, Apathy, Inert, Withdrawal, and Action. This conceptual framework was operationalized with a survey conducted with 4,004 respondents across Canada and the U.S., who were quickly sorted into behavioral groups through the application of a decision tree and then exposed to a mock news article. Results validate the supposition that each of these five groups can be identified by unique emotional responses to climate change. These findings offer significant advances to studies of climate attitudes and behavior which rely primarily upon cognitive and demographic explanations.

Teaser

Variations in personal attitudes and behaviors toward climate change can be attributed to distinct emotional responses to climate change information.

Introduction

Research in the climate social sciences has considerably enhanced understanding of public concern about, and motivation to take action to address, climate change. However, there remain numerous gaps in our understanding of the determinants of behavioral outcomes. What makes one person stubbornly deny climate science and another devote themselves to climate activism, while yet others become overwhelmed and withdraw? Recently, increasing attention has been directed toward the role of emotions in climate and environmental behaviors, which holds promise for substantially advancing the current state of knowledge. This attention has generated multiple empirical findings, albeit with mixed levels of agreement, perhaps due to the lack of theoretically-informed models of the role of emotions in climate behavior. In response, the current study seeks to operationalize an emotion-cognition theoretical model of climate behavior, which conceptualizes distinct emotion-cognition pathways that govern different responses to climate change across publics, including: Denial, Apathy, Inert, Withdrawal, and Action (Davidson and Kecinski, 2022). Using survey data collected from 4,004 Canadian and U.S. publics, statistical and econometric models identify strong support for the emotion-cognition model, offering significant advances to studies of climate attitudes and behavior which rely primarily upon cognitive and demographic explanations.

Previous literature

A large share of social scientific attention to climate change concern and action has been devoted to climate denial. Previous research has indicated that being male, white and conservative, particularly in combination, strongly predicts climate denial (McCright and Dunlap. 2011, Milfont et al., 2015). Associations between political ideology and climate denial appear to be stronger in nations characterized by stark partisanship, like the U.S. and Canada (Boulianne and Belland, 2022). The

prevalence of denial in certain countries (e.g. U.S., U.K., Australia and Canada) has also been attributed in part to the success of powerful actors and organizations seeking to obstruct climate policy by sowing doubt among publics in these regions (Smith and Mayer, 2019).

Many studies also focus on publics who accept the science of climate change yet remain relatively unconcerned and by extension inactive. This work has drawn attention to psychological distancing: a tendency to perceive climate change to be distant from the observer, in time, space, or otherwise, thereby discouraging concern and motivation to act (Leiserowitz, 2005). However, evidence regarding the influence of psychological distancing on the willingness to engage in pro-climate action is mixed, and measures to reduce psychological distance tend not to produce increases in engagement in pro-climate action (van Valkengoed et al., 2023), suggesting the presence of other factors inhibiting concern.

Studies seeking to identify attributes of climate-concerned publics, on the other hand, have highlighted the influence of strong ecological worldviews and norms of responsibility, as well as demographic factors like gender (female), political orientation (liberal), and age (younger) (Milfont et al., 2015; Kácha et al., 2022; Ziegler, 2017; Ross et al., 2019; Smith and Hempel, 2022). Some studies involving international samples have shown that age, gender and political orientation appear to be much less predictive in non-western, non-Anglophone countries (Ziegler, 2017), indicating that the influence of such demographic factors are highly contextual. Even highly concerned individuals may be inclined toward inaction, however, expressing what has been called an Attitude-Behavior gap, or Values-Action gap, due to several barriers such as low efficacy, or perceived powerlessness (Gifford, 2011, Vieira et al., 2023).

Willingness to engage in pro-climate behaviors, finally, tends to be linked to belief in and strong concern about climate change, but also high levels of efficacy: Individuals who express confidence in their own capacity (self efficacy), or society's collective capacity (collective efficacy) to mitigate climate change have been found to be more likely to perform a wide variety of pro-climate actions (van Valkengoed et al., 2024; Jugert et al., 2016; Hensel et al., 2023). However, the interplay between efficacy and climate action can also be affected by one's worldview or identity: Among those with more anthropocentric worldviews, efficacy messaging is found to be less effective in motivating action (Xue et al., 2016).

Emotions and climate change behaviors

Overall, the research summarized above raises as many questions as it answers regarding the drivers of personal concern and behavior in response to climate change. One notable gap in this research record may be attributed to a general lack of attention to emotions. Further insights regarding the factors that influence personal decisions to take climate action or not have been provided by a small but growing number of empirical studies focused on the role of emotionality in personal and collective responses to climate change. Some of these studies attribute inaction among some publics, for example, to the "ostrich effect": avoiding the need to confront an existential crisis by embracing alternative, safer, narratives, particularly when associated with a perceived incapacity to address the crisis, often referred to as soft or implicatory denial (Boulianne and Belland, 2022; Albrecht, 2011, Norgaard, 2011). Similarly, many people may avoid deliberating upon anthropogenic climate change because doing so introduces

ontological insecurity—threats to identities and worldviews—which can be emotionally taxing (Norgaard, 2011). Information about climate change may produce withdrawal as a defensive response among some people, particularly when associated with a perceived incapacity to address the crisis (Albrecht, 2011). The mental health effects that some people experience in response to climate change which may induce such withdrawal include anxiety, post-traumatic stress disorder and depression (Clayton, 2020).

On the other hand, anxiety, a well-recognized adaptive trait that can motivate threat response (Clayton, 2020), can in certain circumstances motivate pro-climate action (Bouman et al., 2020). Several other emotions have been associated with action-taking behavior, including shame, guilt, pride, anger, compassion, joy and hope (Georgiou and Van Lange 2024; Clot-Garrell, 2023; Appadurai, 2013; Kleres and Wettergren, 2017; Maggi et al., 2023). Despite some mixed results in these studies, this body of research nonetheless has shown that exposure to emotion-laden messages, regardless of the specific emotions evoked, tends to motivate higher levels of willingness to support policy or take action compared to non-emotive messaging (Morris et al., 2019), suggestive of the importance of emotional triggers to attention (van Valkengoed and Steg, 2019; Goldberg et al., 2021).

Overall, this emerging body of scholarship has created openings for substantial advances in climate change attitude and behavior studies, but to date this corpus represents disparate and often a-theoretical approaches, which limits its potential to advance our understanding, and to develop strategies to motivate higher levels of pro-climate action. Thus, opportunities remain to advance the role of emotions in governing climate-related action and inaction (Davidson, 2024; Brosch, 2021).

Conceptual Framework and Study Predictions

The current study seeks to advance scholarship on climate change concern and action with an emotion-cognition theoretical lens, informed by the premise that different behavioral responses are shaped by distinct emotion-cognition pathways to personal responses to climate change (Davidson and Kecinski, 2022). Emotions are felt in the body and mind as a result of a rapid subconscious assessment of stimuli, with outcomes such as increased heart rate and feelings of fear quickly informing our relationship with those stimuli, and potential actions in response (Panksep, 1998). In other words, emotions play an essential role in decision-making. Antonio Damasio's somatic marker hypothesis suggests that we are exposed to far more information than we can process, and an individual’s selective attention to certain signals is initiated by emotion triggers that ‘mark’ those signals for further attention and deliberation (Damasio, 1994). We then make decisions and engage in behavioral responses after that marking process.

However, emotions are not strictly a personal, situational affair. Emotional responses to stimuli are shaped by previous encounters, social identities, and personalities, which shape the emotions felt in the present (Thompson, 2007; Brumbaugh et al., 2013). Additionally, social contexts influence how emotions are experienced and expressed. Gender and ethnicity, for example, inform the affective experience of individuals in different ways, depending on the gendered and racialized character of different social contexts (Lupton, 1998). Cultural structures also prescribe which emotions are appropriate in certain

situations and how they should be expressed, while sanctioning deviations from these emotion norms (Moons et al., 2009).

Based on these insights drawn from previous research on emotionality, our emotion-cognition conceptual model consists of the following three components:

(1) An individual is exposed to information about climate change, derived from media, education, and/or through one's personal social networks.

(2) The climate change information then triggers an emotional response leading to cognitive attention, or alternatively, no emotional response is triggered and it is dismissed as not warranting consideration.

(3) The emotionally-triggered individual deliberates upon the information and evaluates response options based on perceived capability and efficacy, and then chooses courses of action or inaction accordingly.

In our study, our key dependent variables are emotions reported by survey respondents following exposure to a climate change stimulus (see Methods section). Starting from the eight emotional sub-scales present within the Discrete Emotions Questionnaire (Harmon-Jones et al., 2016), principal component analysis revealed that these eight sub-scales converged into three larger emotional clusters (for reliability tests of these clusters, see Table S1). The Distress Cluster captures a diverse array of negative emotional reactions to climate change such as anger, sadness and anxiety. The Desire Cluster captures positive, appetitive and high approach emotions relating to potential goals or desires relating to climate change, such as wanting and longing. Finally, the Comfort Cluster captures positive, consummatory, low approach emotions relating to enjoyment and contentment in response to climate change, such as relaxation, happiness, and satisfaction.

In addition to the three emotion clusters, self and collective efficacy were included as dependent variables in our models. Although emotions are highly important in predicting behavioral outcomes, the relationship between emotions and specific outcomes is influenced by perceptions of efficacy, which itself reflects past experiences and social positionality. While one may be highly concerned about climate change, the perception that one's actions are unlikely to produce meaningful change may suppress motivation to engage in pro-climate action. Likewise, a lack of confidence that social institutions have the capacity to response in an efficacious manner can be expected to inhibit pro-climate action.

Previous empirical research has tended to differentiate publics in binary terms: concerned versus unconcerned, active versus inactive, or deniers versus everyone else. Although these binaries can offer analytical clarity, such approaches often fail to capture the nuanced ways in which people feel, think, and act about climate change. To further enable our ability to capture those nuances, our conceptual framework identifies five distinct emotion-cognition pathways in response to climate change: Denial, Apathy, Withdrawal, Inert and Action.

The Denial bin includes people who do not accept the science of climate change and hence can be expected to not take intentional action; to the contrary, these individuals may take action to resist pro-climate policies. Denial describes a behavioral reaction in response to an acute negative emotional response. Psychologists view denial as a coping mechanism, which is invoked when a stimulus to which one is exposed is deemed too overwhelming to acknowledge fully and would otherwise create intense emotional discomfort (Shepherd and Kay, 2012). For many climate deniers, climate change—or perhaps more accurately the *acknowledgement of* climate change—threatens strongly held personal beliefs, worldviews and/or lifestyles, to such a degree that scientific information about climate change is rejected. Hence, individuals in the Denial bin are predicted to express: (a) high emotional distress, (b) low emotional desire, and (c) low emotional comfort in response to climate change information. Because their behavior is guided by the rejection of climate science, self and collective efficacy are not expected to have any bearing on the emotion-cognition pathways of respondents in this group.

The second pathway is Apathy, capturing those individuals who accept the science of climate change, but are not concerned about it, and hence can be expected to not take intentional action. Apathy is conceived as a failure to detect, or 'mark,' those stimuli in one's environment that denote climate change as a concern, because that information is not interpreted as personally relevant, potentially combined with a relatively low level of concern for others who are may be vulnerable. Hence, we predict individuals in the Apathy bin to express: (a) low emotional distress, (b) low emotional desire, and (c) high levels of emotional comfort in response to climate change information. Because their behavior is guided by the absence of an emotional trigger leading to deliberation regarding behavioral response, self and collective efficacy are not expected to have any bearing on the emotion-cognition pathways of respondents in this group.

The Withdrawal bin includes individuals who accept the science of climate change and are highly concerned about it, but may be inclined to withdraw due to low levels of emotional coping capacity, which can manifest as low emotional desire, exacerbated by low self efficacy. While anxiety is by no means an irrational response to the climate emergency, individuals whose affective abilities to respond positively to the situation causing the anxiety have been compromised are more likely to withdraw (Juger et al., 2016; Navarro et al., 2020). Therefore, we predict individuals in the Withdrawal bin to express: (a) high emotional distress, (b) low emotional desire, and (c) low emotional comfort in response to climate change information. We also anticipate these individuals to have (d) low self efficacy and (e) low collective efficacy.

The fourth pathway is Inert, which describes individuals who accept the science of climate change, are highly concerned about it, feel personally capable of doing something about it, and may have strong emotion-coping skills, yet nonetheless choose not to take action. Such individuals may feel they have a lack of information and tools to know how to respond. They may have competing priorities, or they may express low collective efficacy: confidence that one's group, social institutions, or societies have the capacity to coordinate an effective collective response (Bandura, 1997). Or, these individuals may not feel personally responsible for climate action, lacking a strong emotional desire to bear the costs of

performing individual or collective climate action. We therefore predict Inert individuals to express: (a) high emotional distress, (b) low emotional desire, and (c) high emotional comfort in response to climate change information. In addition, we expect individuals in this bin to have (d) high self efficacy but (e) low collective efficacy.

The final pathway is Action, which describes individuals who are highly concerned and commit to taking action on climate change. We expect that these individuals accept the science of climate change; express high concern about climate change and desire for mitigative climate change action, and have a strong sense of confidence that such actions will be beneficial. The following predictions arise for individuals in the Action bin: (a) high emotional distress, (b) high emotional desire, (c) low emotional comfort in response to climate change information, and high levels of (d) self and (e) collective efficacy.

Insert Table 1 Here

Results

To separate our respondents into the five separate behavior bins, we developed a novel decision tree that quickly sorted the sample into the five groups. The decision tree entailed the survey items shown in Figure 1 using a simple agree/disagree choice option. Additional information and explanations about other variables of interest are provided in the Methods section.

Insert Figure 1 Here

Respondents were then presented with a mock news article that described the severity of climate change impacts, followed by items measuring emotionality (see Methods section). Statistical and econometric tests were conducted to assess differences in measures of emotionality (distress, comfort, and desire) and efficacy. Models were computed with and without control variables (age, gender, ethnicity, political affiliation, income and country) and error terms were clustered by individual.

The results were generated from a sample of 4004 respondents from Canada (1153) and the U.S. (2851) (see Table 2). Resonating with previous research, the Denial bin, representing approximately 10% of the sample, is relatively more white, older, male and conservative than other groups, and consisted of a higher proportion of respondents who live in the U.S. The Apathy bin consists of the smallest proportion of the sample overall, with the second highest income, and highest proportion of males. The Withdrawal bin, representing nearly 25% of our sample, is younger on average than all other bins, and has the most liberal political orientation. Respondents in the Inert bin are younger, second only to those in Withdrawal, and have the lowest incomes on average. The Action bin, finally, is the largest bin by a substantial margin, with the highest proportion of females, the highest average incomes, and tends to skew more liberal.

Insert Table 2 Here

The econometric model can be formalized by the following equation: $Y=\beta_0+\beta_k X_k+\beta_j Z_j+\epsilon$, where Y is a vector of dependent variables (emotional distress, emotional comfort, emotional desire, self and collective efficacy), β_0 is the intercept, X_k is a vector of independent variables (representing the behavioral bins); Z_j is a vector of control variables (age, gender, ethnicity, political affiliation, income and country).

We rely on the results from an ordinary least square regression model to identify statistically significant differences between Action and other behavioral bins. Table 3 reports on these differences at the 5% (*), 1% (**) and 0.1% (***) level. Each dependent variable is regressed on the bin responses with and without control variables (M1 and M2). In addition, we used Kruskal-Wallis tests of ranks as a measure of robustness as a result of non-normal distribution of independent variables, unequal variance, and unequal sample sizes (see Methods, Table S2). The vast majority of bins display statistically significant differences ($p < 0.001$) in mean ranks when using Bonferroni-adjusted Dunn tests. Mean ranks for each bin are displayed below, with non-significant differences indicated on the graph (Figure 2, Figure 3).

Insert Table 3 Here

Emotional Distress. We predicted that emotions of distress are high for all bins except the Apathy bin. Respondents in all but the Denial bin conformed to expectations. The Denial bin was not significantly different from the Apathy bin ($p=1.00$), sharing similarly low levels of emotional distress. The Action bin displaying the highest distress scores that were significantly larger than all other groups ($p<0.001$), followed by Withdrawal, and then Inert. These findings are robust to the inclusion of control variables. Ethnicity, political conservatism and U.S. residency have significant and negative impacts on distress, suggesting that conservative white participants living in the US are less emotionally distressed about climate change.

Emotional Comfort. We predicted higher Emotional Comfort for the Apathy and Inert bins, and low comfort for the remaining bins. Participants in the Withdrawal bin ranked the lowest overall in Emotional Comfort followed by Action. Comfort was high among those in the Apathy bin, as predicted, with Inerts falling in the middle of the five bins in terms of mean scores. Predictions about Emotional Comfort among Deniers were not supported, as this group displayed the highest Comfort scores. This group reported the highest levels of Emotional Comfort overall, significantly higher even than those in the Withdrawal, Inert, and Action bins ($p<0.001$). Dunn's tests revealed no significant differences in comfort scores between Apathy and Denial, nor between Inert and Action (see Appendix A). Inclusion of the control variables did not change these findings. However, we did find that age, male gender identity, conservatism, higher household income and U.S. residency had significant and positive impacts on Emotional Comfort.

Emotional Desire. We predicted that Denial, Apathy, Withdrawal and Inert bins would report relatively low Desire scores, while respondents in the Action bin would report higher levels of Desire. Most of these predictions were supported. Scores for Denial and Apathy were similar, and that significantly lower than all other groups. The Inert and Withdrawal bins displayed statistically similar scores for Desire ($p=1.00$),

which were significantly higher than Denial and Apathy ($p<0.001$), but significantly lower than the Desire scores for Action ($p<0.001$). The Action bin displayed the highest mean scores for Desire, with scores significantly larger than all other bins ($p=0.00$). It is interesting to note that, similar to Comfort models, age, male gender identity, and conservatism had significant and positive relationships with Emotional Desire.

Insert Figure 2 here

Self Efficacy. We predicted low self efficacy for respondents in the Withdrawal bin, high self efficacy for the Inert and Action bins, and no effect for self efficacy on Apathy or Denial. As predicted, the lowest level of self efficacy was reported by participants in the Withdrawal bin. Unexpectedly, those in the Action bin did not express comparatively high levels of self efficacy, and Inerts also expressed relatively low self efficacy. Respondents in both Withdrawal and Inert bins reported self efficacy scores that were significantly lower than the Action bin ($p < 0.001$). While we had no predictions regarding levels of self efficacy among those in the Denial and Apathy bins, we find that participants in the Denial bin scored highest in terms of self efficacy, followed by participants in the Apathy bin, with statistically similar scores ($p=1.00$). Findings with respect to self efficacy were robust to the inclusion of the control variables. Additionally, all control variables were significant: individuals who were older, more conservative, had higher household incomes and from the U.S. scored higher in terms of self efficacy. Ethnicity was the only variable with a negative coefficient, suggesting that white respondents' self efficacy is significantly lower than for respondents of color ($p=0.014$).

Collective Efficacy. We predicted higher Collective Efficacy for respondents in the Action bin, low Collective Efficacy for those in the Inert and Withdrawal bins, and no expected effect for respondents in the Apathy or Denial bins. As predicted, the highest Collective Efficacy was found among respondents in the Action bin, with scores significantly higher than all other bins aside from the Inert bin. We predicted low levels of Collective Efficacy among those in the Inert bin; however, Inerts expressed the second highest level of Collective Efficacy, followed by Withdrawal and Apathy ($p<0.001$). Participants in the Denial bin had the lowest level of Collective Efficacy, significantly lower than any Withdrawal, Inert, and Action ($p<0.001$). Findings were robust to the inclusion of control variables, which revealed that only ethnicity had a significant and negative impact on Collective Efficacy, suggesting that white participants had significantly less collective efficacy ($p<0.001$).

Insert Table 4 Here

Insert Figure 3 Here

Summary of Results

Our study supports our expectation that differing personal responses to climate change are marked by distinct emotional expressions. Most of our predictions for the five behavioral bins were supported. Emotional responses to climate change information among respondents in the Apathy bin illustrated

strong confirmation of our predictions, with the lowest levels of Emotional Distress and Desire, and high expression of Emotional Comfort. In line with our predictions, individuals in the Withdrawal bin responded with high levels of Emotional Distress in comparison to other groups, and low levels of Emotional Comfort, as well as low Self Efficacy and Collective Efficacy. Respondents in the Inert bin were distinguishable from Withdrawal in some ways, yet expressing significantly higher levels of Comfort and Collective Efficacy, as well as significantly lower Distress scores. By comparison, and as theorized, respondents in the Action bin expressed the highest scores for Emotional Distress and Desire, in addition to high scores of Self and Collective Efficacy. For the Denial bin, we predicted that participants would be Emotionally Distressed with respect to the subject of climate change, but that did not appear to be the case – the only other bin that was lower in Emotional Distress was Apathy (which we correctly predicted).

Discussion

Emerging research in the climate social sciences has drawn attention to the role of emotions in climate-related perceptions and behaviors among publics. The current study builds upon this extant research, seeking to characterize different climate-related behavioral positions premised on the theory that differences in responses to climate change are associated with distinctive emotion-cognition pathways. Overall, while our empirical analysis was highly exploratory given the lack of theoretical or empirical precedent, our findings confirm that different behavioral responses to climate change are marked by distinctive emotion-cognition pathways. We find particularly strong support for our expectations regarding the emotionality associated with the Action, Withdrawal and Apathy behavior bins. Although findings with respect to the Inert and Denial bins deviated from some of our expectations, findings nonetheless underscore the relevance of emotionality to behavioral responses to climate change.

One of the most unexpected findings among respondents in the Denial bin was a low expression of emotional distress in comparison to those in the Withdrawal, Inert and Action bins. This may suggest the need to approach climate denial differently in survey design, given the expectation for emotional distress among deniers not to the subject of climate change itself, but rather to the confrontation that climate mitigation poses to worldviews and lifestyles. Other surprising findings for this bin include significantly higher levels of self efficacy, combined with low levels of collective efficacy. These findings may suggest a need to further explore the potentially high levels of cynicism among this group (Davidson, 2024).

The emotionality expressed by respondents in the Apathy bin aligned closely with our expectations: this group reported significantly lower distress and desire with respect to climate change, instead feeling relatively comfortable despite acknowledgement of the human causes of climate change and its impacts, and lacking strong feelings of desire relating to climate change mitigation. Those in the Apathy bin also expressed high self efficacy, consistent with viewing climate change itself as a solvable or non-serious problem. Many in this bin could be described as ‘soft deniers’ (Boulianne and Belland, 2022) individuals who resist full contemplation of the implications of climate change and have a tendency toward technological optimism.

The Inert bin captures individuals who are alarmed about climate change and perceive high levels of collective efficacy, but feel a diminished desire with respect to climate change mitigation, feeling 'stuck,' possibly due to low self efficacy. These respondents tended to have mean scores close to those in the Action bin, but were statistically different from Action for all variables aside from emotional comfort and collective efficacy, with significantly lower levels of emotional distress and desire than respondents in the Action bin. These findings suggest the potential presence of competing demands for emotional attention among these individuals.

Withdrawal bin respondents expressed emotionality that corresponded strongly with our expectations. Though highly concerned about climate change, and expressing emotions of distress closest to the levels seen in the Action bin, these individuals face compromises in some form to their emotion-coping capacity, exacerbated by feeling powerless to engage in either personal or collective action to address the problem. Findings with respect to desire among Withdrawal bin respondents suggest that these individuals may be less likely to experience positive feelings with respect to climate change mitigation, perhaps relating to low perceptions of efficacy, or low Desire may reflect emotion states associated with inhibited emotional coping.

Respondents in the Action bin expressed the highest scores for both emotional distress and desire. Emotions of desire, in other words, may be key to overcoming distress emotions, thereby motivating action. Emotions of desire are tied to appetitive, goal-seeking dispositions that motivate purposeful actions, like hope (Swim et al., 2024, Marlon et al., 2019). Action respondents also expressed higher levels of emotional comfort than those in the Withdrawal bin, suggestive of higher emotion-coping capacity. These emotions, in turn, coincided with high levels of personal and collective efficacy. This emotion-cognition pathway facilitated constructive behavioral responses toward the primary cause of that emotional distress and desire—climate change.

Implications for policy and practice

Understanding the associated emotions that can lead to various outcomes opens up new approaches to the study of climate change behavior and, potentially, new pathways to communicate about climate change in ways that encourage constructive social responses. Though these five bins capture distinct emotion-cognition states, those states will have varying degrees of stability. An individual may identify with a withdrawal, inert, or action orientation at different periods in their lives, for example, based on a variety of conditions that inform their emotional stability and perception of efficacy. Although social identities and associated belief systems are relatively stable personal attributes, in other words, any number of factors can cause emotion-cognition pathways to be disrupted, encouraging those in one of the inaction bins to shift toward an action pathway. This research suggests that there remains strong potential to motivate a large majority of publics across Canada and the United States to engage in higher levels of personal and collective climate action.

The most effective way to motivate such action, however, is by 'meeting people where they are.' Those feeling inert may have their motivation enhanced when presented with information emphasizing how

their engagement matters. Apathetic individuals may be affected by new social networks and information environments that facilitate higher levels of emotional distress and desire, leading to more proactive behavioral responses. With their high levels of self efficacy, those in the Apathy bin may be compelled to embrace emerging technologies in particular, becoming role models in their social networks. Those inclined to withdraw require emotional support foremost, to build emotion-coping capacity, and potentially self efficacy as well. Denial--being closely linked to a strong attachment to certain worldviews and belief systems, combined with high levels of distrust of information sources that might challenge those beliefs--is likely to be the most stable of behavioral positions. As related research shows, even direct experience with extreme events may do little to nudge the beliefs of climate deniers (Howe, 2021). On the other hand, even emotion-cognition pathways leading to denial are vulnerable to disruption, through deliberation and engagement (Author name redacted, forthcoming).

The same potential exists, however, for the disruption of climate action pathways, leading to inaction. Nourishing and sustaining climate action pathways demand attentiveness to the emotional pre-requisites of those pathways. This includes, among other things, triggering empathetic responses by highlighting affective connections to the places and the human and non-human beings that are threatened by global warming; creating emotional support networks that nurture coping capacity; and encouraging personal and collective efficacy that can inspire hope.

Limitations of study and future research needs

Although our study elicited important results that advance our understanding of climate emotions, we acknowledge that closed-ended surveys may have limitations in their ability to fully capture something as complex as emotionality. Applying multiple methods including qualitative analysis to the study of climate emotions can offer a more fulsome and rich understanding of climate emotionality. Given the fact that emotionality is closely linked with identities, personalities, and life experiences, additional attention to the interaction of emotions with personality traits and social context will be important. To that point, this study was limited to a North American context, which is unique in many ways, particularly with respect to the political polarization of the issue. Extending this research to other socio-political contexts would be highly beneficial. In addition, our decision tree was designed to define Action as a subjective measure of intention rather than a measure of actual behavior; in other words, we sought to identify those individuals who are motivated to seek opportunities to contribute to climate mitigation. We did not seek to measure behaviors directly, as such evaluations are intrinsically shaped by personal and situational factors, such as income and access to pro-climate options such as public transit, or a favorable political climate for collective action. Future research that seeks to critically examine the interaction of emotions with measurable forms of pro-climate behaviors would be beneficial.

Materials and Methods

Experimental Design

The objectives of this quantitative study were to test how emotions and efficacy variables related to emotion-cognition pathways of climate behavior. Participants were recruited using Prolific's online recruitment platform. We selected Americans and Canadians over the age of 18 for our sample, and used Prolific's function of 'representative sampling' to generate a sample that reflects the demographic characteristics of American and Canadian populations, as well as an equal representation of male and female participants. Participants were paid for their time through Prolific's built-in payment system, and received payment in line with Alberta's minimum wage of $15/hour. Following recruitment, participants were then redirected to the survey platform Qualtrics to complete the survey. Before participating in our survey, participants were provided with an information sheet explaining the objectives of the study, how this information will be used, and how consent and participation could be withdrawn at any time. Following this, we obtained informed consent from our participants for anonymized survey response data to be analyzed and published.

In order to conduct this test within our survey, we developed a decision tree that could capture each of the five theorized pathways (Fig. 1). This decision tree assessed i) belief in anthropogenic climate change; ii) concern regarding climate impacts; iii) belief in their own ability to mitigate climate impacts; and iv) self-assessment that they have taken climate action. From this decision tree, participants were sorted into five groups of Denial, Apathy, Withdrawal, Inert, and Action.

Variables of Interest

Age was captured as a continuous variable, with participants reporting their exact age in years. The youngest participant was 18 years old, while the oldest participant was 86. The mean age of our sample was 38.19 years old.

Household income was captured by asking participants to report their total annual household income before taxes, presented as a series of income brackets (the lowest bracket was 'less than $10,000' and the highest bracket was '$150,000 or more'). Income was captured as a categorical variable but was transformed into a continuous variable in order to compare the incomes of American and Canadian participants. Income was first converted to a continuous variable by assigning the midpoint of each category (e.g. for the category '$20,000 to $29,999', a dollar amount of $25,000 was assigned). Following this assignment, incomes of Canadian participants were multiplied by 0.74 (currency conversion rate at the time of analysis in June 2024) in order to capture comparable dollar values to those of American participants. The mean household income of our sample was $70,943.68 USD.

In our survey, participants were given four choices for their gender identity, with choices of male, female, not listed (please indicate your gender), and prefer not to say. 49.6% of respondents identified as male, 48.4% as female, 1.6% indicated another gender identity, while 0.4% responded that they preferred not to say. In further analysis, gender identity was recoded as a binary variable, with maleness being coded as 1 and all other gender identities being coded as 0.

Ethnicity was collected using a multiple-choice question where respondents selected one of eight ethnoracial categories (e.g. White, African American, Hispanic, East Asian, Indigenous, etc.), or as a unique ethnoracial identity that the respondent could enter. Given the observed differences in climate change perceptions, beliefs, and behavior between white and non-white individuals (Ballew et al., 2021), as well as the fact that many of the eight ethnoracial identities had relatively low sample representation, ethnoracial identity was recoded as 1 indicating whiteness and 0 indicating non-Whiteness. In our sample, 60.2% of participants self-identified as white.

Country of residence was collected through Prolific's user statistics. In our sample, 71.2% of participants identified as American, while 28.8% identified as Canadian.

Political orientation was collected by using the prompt: 'Please indicate the extent to which you identify as liberal (left-wing) or conservative (right-wing)'. Participants' responses were measured on a Likert scale, ranging from 'very liberal' to 'very conservative', with participants selecting the option that best matched their political orientation. In our sample, 'very liberal' was coded as 1, 'moderate or center' was coded as 4, and 'very conservative' was coded as 7.

Self efficacy was measured using an adapted version of the Generalized Self Efficacy Scale (Schwarzer and Jerusalem, 1995). Of the 10 generalized SE questions, 2 were made specific to climate change. These two statements were: 'I am confident that I could deal efficiently with unexpected events related to climate change', and 'I can remain calm when facing difficulties relating to climate change because I can rely on my coping abilities'. Each question was measured with a 5-point Likert scale ranging from 'strongly disagree' to 'strongly agree'. The scores for these 2 statements were then combined into a single measure of self efficacy, with 2 being the lowest possible score and 10 being the highest.

Collective efficacy was measured using a single-item measure developed by Davidson and Stedman, used to capture general belief in society's ability to cooperate to address climate change (Davidson and Stedman, 2019). Respondents were asked to rate their agreement with the statement 'I am confident that people can work together to deal with climate change' on a 5-point Likert scale ranging from 'strongly disagree' to 'strongly agree.'

Emotion variables were captured using the Discrete Emotions Questionnaire (Harmon-Jones et al., 2016). The Discrete Emotions Questionnaire has 32 discrete emotions, made up of 8 sub-scales (anger, disgust, fear, anxiety, sadness, desire, relaxation, and happiness), each of which is comprised of 4 discrete emotion items. In further analysis, scores for negative emotion sub-scales (anger, disgust, fear, anxiety, sadness) were aggregated into one cluster of emotional distress (Cronbach's Alpha = 0.93, Appendix B), scores for comfort (relaxation, happiness) were aggregated into one cluster of emotional comfort (Cronbach's Alpha = 0.75), while the sub-scale of desire was the final emotional cluster (Cronbach's Alpha = 0.82). These items were captured following the presentation of a mock news article (Fig. 4) that described the severity of climate change impacts, and the need for transformative change (Fig. 3). Participants were required to read/examine this article for two minutes before they were allowed to progress through the survey. Following exposure to the climate change stimulus, respondents were

given the prompt, ‘While reading through the news article, to what extent did you experience these emotions?’ and chose their level of emotional experience for each of the 32 discrete emotions. Possible responses fell on a 7-point Likert scale, ranging from ‘not at all’ (coded as 1) to ‘an extreme amount’ (coded as 7).

Insert Fig. 4 here

Statistical Analysis

For our first statistical test, we used an ordinary least square regression model with robust standard errors to identify statistically significant differences between cognitive-emotive groupings. The econometric model of this regression model can be formalized by the following equation: $Y = \beta_0 + \beta_k X_k + \beta_j Z_j + \epsilon$, where Y is a vector of dependent variables (emotional distress, emotional comfort, emotional desire, self and collective efficacy), β_0 is the intercept, X_k is a vector of independent variables (representing the behavioral bins); Z_j is a vector of control variables (age, gender, ethnicity, political affiliation, income and country). Regarding X_k, each emotive-cognitive behavioral grouping was included as a dummy variable, in order to compare against the reference category of the Action group. Finally, each dependent variable is regressed on the bin responses with and without control variables (M1 and M2). Without control variables, sample size for regression models are N = 4002; when control variables are included, sample size is N = 3982. Statistical significance was determined at $p < 0.05$.

We also conducted a Kruskal-Wallis test to compare scores for key variables across behavioral groupings. This test was included to account for the non-normal distribution of scores across variables, significant differences in variance, as well as highly different group sizes in the five behavioral groups (Kruskal, and Wallis, 1952; Chicco et al., 2025). Kruskal-Wallis tests were statistically significant for each variable ($p < 0.001$; N = 4002; Table S3); pairwise Dunn’s tests with Bonferroni adjustment were then conducted to determine which behavioral groups significantly differed from each other for each dependent variable at $p < 0.05$ (Table S2).

Declarations

Acknowledgements

Declaration of conflicting interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Ethical approval and informed consent statements

Ethical approval was granted by the Human Research Ethics Board at the University of Alberta (Approval #Pro00130449), in accordance with the standards established by the Canadian Association of Research Ethics Boards (CAREB). Before participating in our survey, participants were provided with an information sheet explaining the objectives of the study, how this information will be used, and how consent and participation could be withdrawn at any time. Following this, we obtained informed consent from our participants for anonymized survey response data to be analyzed and published.

Data and materials availability: Data protected by the confidentiality requirements for ethical standards in research involving human subjects.

Author Contribution

Debra Davidson and Maik Kecinski were responsible for theoretical development; All authors contributed to research design; Joseph Flesch contributed to data collection; Joseph Flesch, Maik Kecinski and Kyle Nash conducted data analysis; All authors contributed to writing the manuscript; All authors reviewed the manuscript.

Data Availability

The data collected for this research is protected by the confidentiality requirements in accordance with guidelines for the ethical conduct of research involving human subjects at the lead author's institution.

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Tables

Table 1. Summary of response predictions by bin

Behavior Bin	Emotional Distress	Emotional Comfort	Desire	Self Efficacy	Collective Efficacy
Denial	High	Low	Low	-	-
Apathy	Low	High	Low	-	-
Withdrawal	High	Low	Low	Low	Low
Inert	High	High	Low	High	Low
Action	High	Low	High	High	High

Table 2. Demographic characteristics among behavioral bins

Bin	*N*	Mean Age	Mean Income ($ USD) [1]	% male	% white	% USA	Mean Political Orientation [2]
Denial	403	44.75	$67,916.96	57%	74%	82%	5.08
Apathy	190	40.92	$72,110.22	69%	66%	70%	4.46
Withdrawal	951	34.72	$69,361.75	53%	63%	64%	2.82
Inert	310	35.56	$64,792.18	51%	50%	68%	3.38
Action	2150	38.63	$72,986.77	45%	57%	73%	2.9
All Bins	4004						

Table 3. Regression output for emotion variables with and without control variables and clustered error terms

	Emotional Distress		Emotional Comfort		Emotional Desire	
Variable	M1	M2	M1	M2	M1	M2
Action	(omitted)		(omitted)		(omitted)	
Denial	-29.52***	-24.61***	5.65***	3.24***	-2.90***	-3.52***
	(1.05)	(1.26)	(0.51)	(0.56)	(0.20)	(0.25)
Apathy	-30.65***	-27.09***	3.36***	1.57*	-2.85***	-3.36***
	(1.21)	(1.35)	(0.58)	(0.56)	(0.25)	(0.28)
Withdrawal	-4.04***	-4.40***	1.24***	-0.80***	-1.65***	-1.52***
	(1.01)	(1.01)	(0.25)	(0.23)	(0.18)	(0.18)
Inert	-9.84***	-9.25***	0.12	-0.36	-1.40***	-1.58***
	(1.50)	(1.51)	(0.43)	(0.44)	(0.27)	(0.27)
Age		-0.68		0.06***		0.02**
		(0.03)		(0.01)		(0.01)
Ethnicity		-1.75*		-2.33***		-1.12***
		(0.85)		(0.26)		(0.16)
Gender		-2.66**		1.58***		0.42**
		(0.80)		(0.23)		(0.15)
Political Orientation		-1.65***		1.03***		0.30***
		(0.29)		(0.10)		(0.06)
Household Income		0.00***		0.00***		0.00
		(0.00)		(0.00)		(0.00)
US		-3.35***		0.80***		-0.13***
		(0.89)		(0.23)		(0.17)
_cons	61.86***	73.96***	18.05***	6.77**	8.52***	7.46***
	(0.57)	(1.65)	(-0.47)	(0.85)	(0.11)	(0.32)
N	4002	3982	4004	3984	4002	3982
adj. R-sq	0.15	0.16	0.06	0.15	0.05	0.08

Notes: Clustered standard errors in parentheses, * p<0.05, ** p<0.01, *** p<0.001; brackets indicate clustered standard error.

Table 4. Regression output for efficacy variables with and without control variables and clustered error terms

Variable	Self Efficacy		Collective Efficacy	
	M1	M2	M1	M2
Action	(omitted)		(omitted)	
Denial	0.72***	0.21*	-1.08***	-1.08***
	(0.09)	(0.10)	(0.06)	(0.07)
Apathy	-0.51***	0.09	-0.80***	-0.80***
	(0.13)	(0.13)	(0.09)	(0.09)
Withdrawal	-0.75***	-0.71***	-0.78***	-0.77***
	(0.07)	(0.07)	(0.04)	(0.04)
Inert	-0.48***	-0.56*	-0.08	-0.11*
	(0.10)	(0.10)	(0.05)	0.05
Age		0.01***		0.00
		(0.00)		(0.00)
Ethnicity		-0.14*		-0.14***
		(0.06)		(0.03)
Gender		0.51***		-0.06
		(0.05)		(0.03)
Political Orientation		0.19***		0.02
		(0.02)		(0.01)
Household Income		0.00**		0.00
		(0.00)		(0.00)
US		0.22***		0.03
		(0.06)		(0.04)
_cons	6.84***	5.56***	4.00***	4.14***
	(0.04)	(0.11)	(0.02)	(0.07)
N	4004	3984	4004	3984
adj. R-sq	0.06	0.13	0.15	0.15

Notes: Clustered standard errors in parentheses, * p<0.05, ** p<0.01, *** p<0.001; brackets indicate clustered standard error.

Figures

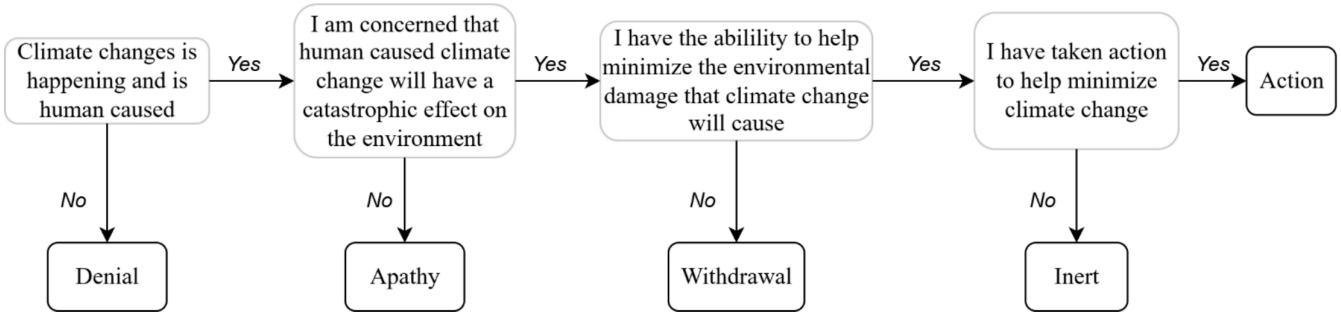

Figure 1

Decision tree used to sort respondents into five behavior bins.

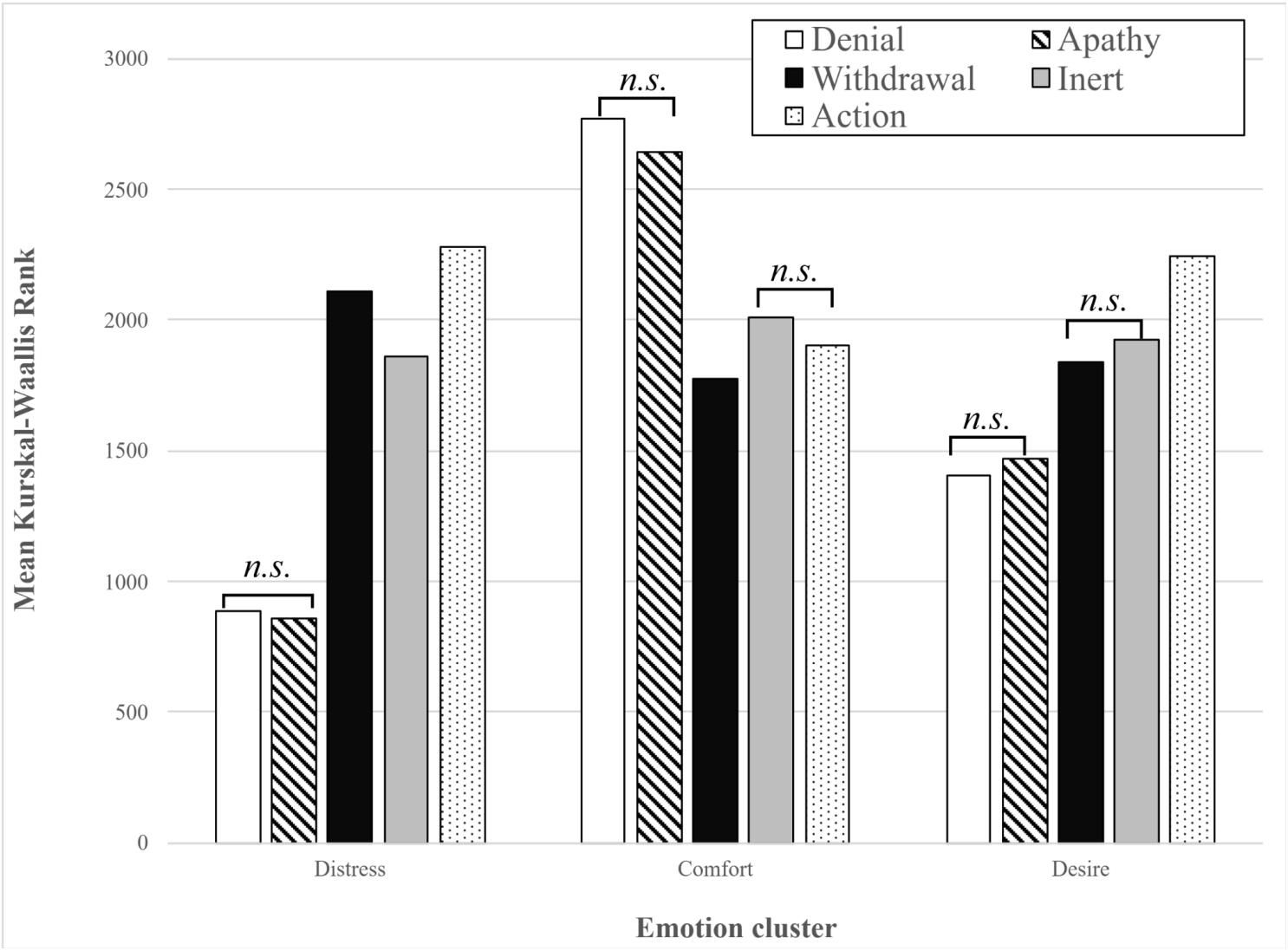

Figure 2

Mean Kruskal-Wallis ranks for emotion clusters across behavioral bins

Note: Non-significant differences between bins are marked by n.s.; all other differences are statistically significant at p<0.05.

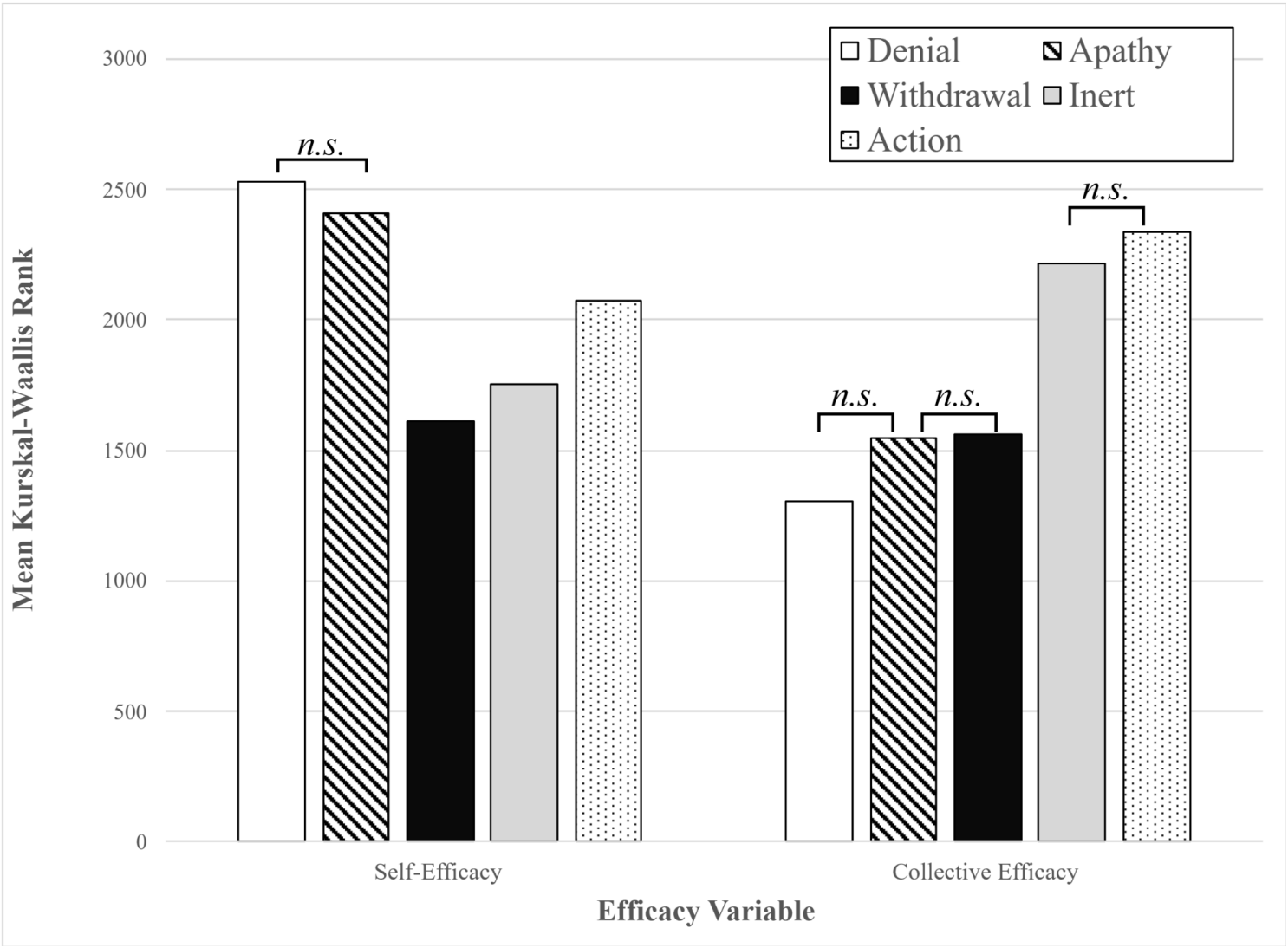

Figure 3

Mean Kruskal-Wallis ranks for efficacy variables across behavioral bins

Note: Non-significant differences between bins are marked by n.s.; all other differences are statistically significant at p<0.05.

“Code Red For Humanity” says Climate Report from UN

World-wide action required now to avoid climate catastrophe.

The latest IPCC report is “a code red for humanity,” says UN Secretary General António Guterres. The report’s authors, all climate science experts, predict increases in intensity and frequency of heat domes, fires, droughts, floods, harvest failures, and an estimated 200 million climate refugees in our lifetimes.

Emissions, which come primarily from the burning of fossil fuels, continue to rise despite decades of policy efforts to reduce them, and projected future emissions are likely to exceed a safe level of warming, even assuming all current national contributions are realized. Levels of CO2 in the atmosphere today are higher than they have been for two million years, generating a climate regime that is outside the range of what the human species has ever experienced. The impacts continue to unfold, but what we do know is this new climate regime will support an increase in intensity and frequency of a host of extreme events.

According to the report, avoiding such a climate catastrophe will require immediate and substantial changes in consumption, and participation in political action to pressure corporations and governments.

Figure 4

Mock news article presented to solicit emotional response

Supplementary Files

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- SupplementaryMaterials.docx