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Exposure to climate risks and youth engagement with climate change

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Effectively mitigating and adapting to the effects of climate change over the coming decades will require the active engagement of today's youth. This research adds to a growing body of work focused on youth climate change engagement by testing whether physical exposure to climate risks influences middle school and high school students' intentions to engage in pro-climate behaviors above and beyond several previously identified social and psychological variables. A total of 222 middle and high school students across 11 states were surveyed to measure cognitive, social, and demographic factors known to influence pro-climate behavior. We combined this survey data with data from a national assessment of climate risks and conducted a hierarchical regression model predicting intentions to engage in pro-climate behaviors. Physical exposure to climate risks was not a significant predictor in our model. Rather, we found that the only significant predictors of behavioral intentions were perceived risks of climate change and frequency of discussions with friends and family. Since the size and geographic distribution of our sample was limited, future research is needed to build on these findings and the role youth may play in mitigating climate change.

KEYWORDS

climate change engagement, youth engagement, exposure to climate risks, climate change discussion, climate action

Introduction

Mitigating and adapting to the worst impacts of climate change requires widespread public engagement among informed citizens (Buckland et al., 2020; Stevenson et al., 2020). While every generation has a role to play in advancing solutions to climate change, the involvement of youth in these efforts may be particularly critical. Not only is there evidence that the youth of today will be disproportionately affected by climate change impacts, but it is also the case that they will inherit the responsibility of addressing these issues over the longer term (UNCF; Thomaes et al., 2023; Pickering et al., 2021). As Thomaes et al. (2023) put it in a recent perspective piece "…young people are not responsible for climate change, [but] many see themselves as part of the solution" (p. 352). Educators and policy makers can help catalyze youth engagement by designing effective educational programs and policies to both motivate and prepare them to tackle the environmental challenges they will face. A comprehensive understanding of the key factors that are likely to influence behavioral engagement with climate change can inform and guide these efforts.

Research has found that, overall, young people tend to be less skeptical that climate change is real and human-caused than older generations (Corner et al., 2015). They also tend to show relatively high levels of knowledge and concern as well as a recognition that their lifestyle choices can play a role in mitigating climate change impacts (Lee et al., 2020; Corner et al., 2015; Hestness et al., 2016; Frappart et al., 2016; Puttick et al., 2015; Baldwin et al., 2023; Pickering et al., 2020). However, as is the case in other behavioral domains, we know that pro-climate attitudes and knowledge do not directly translate into engagement or action (Stevenson et al., 2018; Thomaes et al., 2023). The studies that have investigated drivers of the behavioral aspects of climate change engagement among adolescents have identified a broad set of factors that appear to play a role. Key among these are cognitive variables including knowledge, worldview, perceived risks of climate related impacts, and climate change beliefs (Brügger et al., 2020; D'Uggento et al., 2023; Han et al., 2022; Stevenson et al., 2018; Pickering et al., 2021). Perceived risks of climate change, for example, were found to be a significant explanatory factor in climate action among youth in Switzerland (Brügger et al., 2020), Italy (D'Uggento et al., 2023) and South Korea (Kim et al., 2024).

Another prominent set of factors that emerged from the research on youth climate engagement are those related to social interactions and peer influences including social norms and identity and discussion with friends and family (Brügger et al., 2020; Busch et al., 2019; Lawson et al., 2019; Mead et al., 2012; Ojala, 2022; Wallis and Loy, 2021; Stevenson et al., 2019; Pickering et al., 2021). For example, one study of German youth found that key predictors of participation in the Fridays for Future protests included having friends who were participating and identifying with others in the movement (Wallis and Loy, 2021). Additionally, Lawson et al. (2019) found that family discussions about climate change and parental behaviors significantly influenced climate action among young adolescents.

The literature cited above advances our understanding of the social and psychological factors associated with youth climate action. Often missing from this discussion, however, is the question of how physical exposure to the risks of climate change may also play a role in driving engagement on this issue. Some research with adult samples has found compelling evidence that experiencing local climate impacts such as unusual warming or an extreme weather event can bolster support for climate action and related outcomes (Rudman et al., 2013; Lang and Ryder, 2016; Bergquist et al., 2019; Sloggy et al., 2021). For example, one study found that internet searches for climate change (an information seeking behavior) increased in the two months following the experience of a tropical cyclone (Lang and Ryder, 2016). In a similar vein, Bergquist et al. (2019) found that after experiencing a hurricane, people reported greater concern about climate change and a greater willingness to pay higher taxes in order to protect the environment.

The reality of living with more severe and frequent climate impacts across the United States—from the prevalence of hurricanes and wildfires to extreme heat events or water stress— is becoming more acute. This increase in exposure to climate impacts may influence young people's sense of urgency to act on the issue. However, to our knowledge, exposure to climate risks has yet to be considered in models of youth climate change engagement. This study takes a first step toward filling this gap by testing whether physical exposure to climate risks influences middle school and high schoolers' intentions to engage in pro-climate behaviors above and beyond several previously identified social and psychological variables. In doing so, we generated knowledge that can inform strategies aimed toward improving climate change education and policy. This is because a robust understanding of the key factors that drive engagement can illuminate critical junctures around which educational interventions can be designed and policies can be targeted, thus improving the likelihood that these efforts will foster long-term collective environmental action. For example, a positive and significant relationship between physical exposure to climate change risks and intentions to engage in pro-climate behaviors would highlight the need for educational interventions to focus on these localized impacts—including teaching strategies for risk mitigation and adaptation tailored to the local context.

Methods

Participants

We conducted an online survey[1] of middle school and high school students in the United States. Participants were recruited through a nationwide database of teachers compiled by Oak Ridge Associated Universities. The database of educators was created by an organization that conducts STEM outreach nationwide and contains contact information for teachers who have participated in their programs and events in the past. The database was not inclusive of every teacher across the country. Teachers were selected from the database based on their location aligning with the geographic regions of interest to this research and their grade levels aligning with those of interest to this research. Middle school and high school teachers in the network were contacted via email. A total of 164 teachers were contacted. Of those, 25 agreed to participate, 20 declined, and the remaining 79 did not respond. The response rate was 27%. The positive response rate was 15%. The teachers who agreed to participate represented 11 middle schools and high schools across nine states (New Mexico, Texas, Tennessee, Ohio, Kentucky, Maryland, Pennsylvania, North Carolina, and Georgia).

Participating teachers invited students in their classes to complete the short online survey[2]. We received 226 completed responses to the online survey. We removed four responses due to missing data on key variables, leaving us with a sample of 222 participants. A post-hoc test of achieved power conducted in G*Power indicated that this sample size was sufficient for a multiple regression analysis with 11 predictors to detect a medium-small effect ($f^2 = 0.10$) with 90% power. Our sample was almost evenly split between middle school and high school students (52% high school). The average age of participants was 15 years old (SD = 2.06) with ages ranging from 12–19 years. Just over half of the sample identified as boys (51%), with 45% identifying as girls and 3% as another gender (the remaining 1% (three students) chose not to respond). In terms of race, 70.3% of the sample identified as White or Caucasian. Another 9.9% identified as Hispanic or Latino, 7.2% as Black or African American, 2.7% as American Indian or Alaskan Native, 3.6% as Asian, 2.3% as Multiracial, 0.5% as Native

1 This survey was part of a larger research collaboration between Oak Ridge Associated Universities and Southern Illinois University.

2 All participants received parental consent prior to participation.

Hawaiian or other Pacific Islander and 0.9% as another race (2.7% chose not to respond).

Procedures

Teachers provided students with a link to the online survey in the spring of 2023. The survey was hosted in Qualtrics survey software and took approximately 10 to 15 min to complete (median time = 12.13 min). The survey contained a number of items to measure factors known to influence pro-climate outcomes. These included demographic factors, social factors, and cognitive factors. First, we included three variables to control for basic demographics gender identity (boy = 1, other = 0), age (in years), race (white = 1, other = 0) that have broadly been found to influence climate change attitudes and perceptions among young people, albeit, not always in consistent ways (Stevenson et al., 2014, 2019; Ojala, 2013; Lee et al., 2020; Frappart et al., 2016; Pickering et al., 2021; Baldwin et al., 2023; Naseif et al., 2025).

The social factors were (1) discussions with friends, (2) discussions with family and (3) discussions at school. For these variables, we asked participants how often they discussed climate change with (1) friends outside of class, (2) family, and (3) at school during class. Each of these items were measured on a 5-point scale from 1 = never to 5 = more than five times.

The cognitive factors were (1) risk perceptions (2) beliefs, (3) climate change knowledge, and, (4) worldview. For risk perceptions, participants were asked to indicate on a 7-point scale (from 1 = strongly disagree to 7 = strongly agree) their agreement with eight statements related to the potential for climate change to cause harm to people, plants, animals and groups. Items were averaged to form a scale (Leiserowitz et al., 2023, Cronbach's $\alpha = 0.93$). Climate change beliefs were measured with four items adapted from Leiserowitz et al. (2023). Participants were asked to indicate on a 7-point scale (1 = strongly disagree to 7 = strongly agree) their agreement with four statements assessing their beliefs that climate change is a real phenomenon caused by human actions. Items were averaged to form a scale (Cronbach's $\alpha = 0.87$). Knowledge was measured with six items adapted from Masson-Delmotte et al. (2021) and Reidmiller et al. (2018). The multiple-choice items were designed to gauge students' knowledge of basic climate science facts including climate change causes, impacts and understanding of key terminology. We calculated the sum of correct answers to create a 1–6 scale with higher values indicating more items answered correctly. We measured worldview using the short-form version of Kahan et al. (2012) hierarchy-egalitarianism scale (measured on a 5-point scale from 1 = strongly disagree to 5 = strongly disagree, Cronbach's $\alpha = 0.70$).

Finally, our key dependent variable was a measure of intentions to engage in pro-climate behaviors. This was measured with nine items adapted from Leiserowitz et al. (2023) (Cronbach's $\alpha = 0.90$). Specifically, participants were asked to indicate on a 7-point scale (1 = very unlikely to 7 = very likely) how likely they were to adopt several behaviors in response to climate change (e.g., learn more about climate change mitigation strategies; join a community group involved with climate change education). Items were averaged to form a scale (Cronbach's $\alpha = 0.90$). See the supplemental information for a detailed description of all measures, descriptive statistics (Supplementary Table S1) and bivariate correlations between key variables (Supplementary Table S2)[3].

We combined this survey data with county-level measures of exposure to climate change risks pulled from a national assessment compiled by NOAA National Centers for Environmental Information (2025). The county-level climate risks scores were derived from historical data on hazard frequency combined with socio-economic modeling to capture the current risk of exposure to a number of weather and climate risks (on a scale ranging from 0 to 100). The exposure to climate change risk scores across our sample ranged from a low of 1.44 (in Los Alamos County, NM) to a high of 100.00 (in Harris County, TX). The other counties in our sample fell in between these two end points, including, for example, Perry County, OH with a score of 7.30 and Philadelphia County, PA with a score of 47.58 ($M = 23.35$, SD = 22.59). It is important to note that these risk scores are based on county level data rather than individual level exposures, and therefore, while the scores reflect the current exposure to climate change impacts faced by counties, they do not capture the personal, lived experiences of students regarding climate events.

Results

We ran a hierarchical regression model to test whether physical exposure to climate change risks would explain unique variance in intentions to engage in pro-climate behaviors above and beyond previously identified social and psychological factors. The hierarchical regression model included four blocks with the following independent variables included in each block: (1) demographics (age, gender, race); (2) cognitive factors (worldview, risk perceptions, climate change knowledge, climate change beliefs); (3) social factors (discussion with friends, family, and discussions in class); (4) exposure to climate risks[4].

The full results of the model are presented in Table 1. Model I, with only demographic variables included, was significant ($R^2 = 0.08$, $F(3,218) = 5.85$, $p < 0.001$). However, age was the only significant predictor such that older students reported significantly greater intentions of engaging in pro-climate behaviors than younger students ($b = 0.16$, $p < 0.001$). Adding cognitive variables (Model II) significantly increased the R^2 (R^2 change = 0.24, $p < 0.001$). In this model, the measure of perceived risks of climate change was the only significant predictor ($b = 0.51$, $p < 0.001$), such that students who

3 With the exception of the dependent variable, all variables are listed in the order they appeared in the survey. The dependent variable appeared between the social and cognitive blocks. While we arranged our survey carefully to minimize the risk of ordering effects, the possibility that responding to earlier measures may have influenced participants' responses to later questions cannot be completely ruled out.

4 There was no evidence of multicollinearity with VIF statistics ranging from 1.008 to 2.789 and tolerance statistics ranging from 0.358 to 0.992. Further, the value of the Durbin-Watson test was 1.80, indicating no autocorrelation of residuals. An examination of Cook's Distance, which ranged from 0.000 to 0.095, did not reveal any influential data points. See the supplemental information for the standardized residual plots (Supplementary Figures S1–S3), which indicate that the assumptions of normally distributed residuals and homoscedasticity were not violated.

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TABLE 1 Hierarchical regression models predicting intentions to engage in pro-climate behaviors (N = 222).

	Model I	Model II	Model III	Model IV
Constant	1.50*	1.26	1.50^{+}	1.38
Block 1: Demographics				
Gender (male)	−0.23	−0.21	−0.15	−0.17
Age	0.16***	0.03	−0.01	−0.01
Race (white)	0.34^{+}	0.19	0.08	0.09
Block 2: cognitive variables				
Worldview		−0.09	−0.04	−0.05
Risk perceptions		0.51***	0.36***	0.37***
Knowledge		−0.03	−0.08	−0.07
Beliefs		0.00	−0.02	−0.03
R^2 change		*0.24*		
F (4,214)		*19.12****		
Block 3: social variables				
Discussion…			0.25***	0.25***
With friends			0.17*	0.18**
With family			0.04	0.04
In class			*0.12*	
R^2 change			*14.86****	
F (3, 211)				
Block 4: biophysical variable				
Exposure to climate risks				0.04
R^2 change				*0.004*
F (1, 210)				*1.33*
Omnibus	0.08	0.30	0.44	0.44
R^2	F(3,218) = 5.85***	F(7,214) = 14.27***	F(10,211) = 16.39***	F(11,210) = 15.04***
F (df)				

***$p < 0.001$; **$p < 0.01$; *$p < 0.05$; $^{+}p < 0.10$.

perceived greater risk from climate change were also more inclined to engage in pro-climate behaviors. When accounting for risk perception, age no longer remained significant. Interestingly, the other cognitive variables in the model (knowledge, climate change beliefs, and worldview) were also non-significant predictors of behavioral intentions. Model III, which added variables to capture social interactions around climate change, explained an additional 12% of the variance in intentions to engage in pro-climate behaviors (R^2 change = 0.12, $p < 0.001$). In this model, perceived risks of climate change remained highly significant ($b = 0.36$, $p < 0.001$). However, both discussions with friends ($b = 0.25$, $p < 0.001$) and family ($b = 0.17$, $p = 0.013$) were also significant. Finally, accounting for the influence of exposure to climate risks in Model IV did not explain significantly more variance in the dependent variable (R^2 change = 0.004, $p = 0.251$). In other words, the single measure of exposure to climate risks did not significantly predict intentions to engage in pro-climate behaviors when controlling for the other social and psychological factors known to influence action.

Following the suggestion of an anonymous reviewer, we followed up our regression analysis with a moderation analysis [using SPSS's PROCESS modelling tool, Model 1 (Hayes, 2017)] testing the interaction between exposure to climate risks and risk perceptions, controlling for all other variables in the model. The interaction effect was marginally significant ($b = -0.004$, $p = 0.07$). Follow-up conditional effects tests using the Johnson-Neyman approach (Spiller et al., 2013) found a significant and positive relationship between physical exposure to climate change risks and intentions to engage in pro-climate behavior among those scoring 3.70 or below on the risk perception scale ($ps < 0.05$).

Discussion

The aim of this short research letter was to contribute to the literature on youth climate action by examining the relationship between physical exposure to climate risks and intentions to engage in pro-climate behaviors among middle school and high school students. Understanding the influence of these risks is increasingly important as climate impacts become more severe and pronounced across the globe (IPCC, 2022). We found no evidence that, overall, adolescents in counties facing more severe climate risks expressed greater intentions to take action than those in lower risk counties, when controlling for previously identified demographic, cognitive and social factors. Rather, we found that when all variables were included in the model, the only significant predictors of behavioral intentions were perceived risks of climate change and frequency of discussions with friends and family. These findings align with previous literature highlighting the critical role of risk perception and social influences in motivating climate action (Brügger et al., 2020; D'Uggento et al., 2023; Kim et al., 2024; Busch et al., 2019; Lawson et al., 2019; Mead et al., 2012; Ojala, 2022; Wallis and Loy, 2021; Stevenson et al., 2019). Further, the fact that worldview[5] did not explain unique variance in behavioral intentions when accounting for the other variables in the model adds to prior evidence suggesting that—unlike their older counterparts—young people are not likely to be as highly ideologically motivated on this topic (Stevenson et al., 2014, 2020).

The relative importance of discussion with friends and family, in particular, adds to a growing body of research on the role interactions among family and peers can play in helping young people learn about and take action on climate change (Galway et al., 2021; Lawson et al., 2019; Ojala, 2022; Stevenson et al., 2019; Valdez et al., 2018). For example, Stevenson et al. (2019) found a positive association between discussion of climate change with family and peers and climate change concern. Critically, this result held even when the discussion partner was perceived to be skeptical of climate change. Similarly, Ojala (2013) found that when young people discussed climate change with their family and friends, they were more apt to acknowledge the seriousness of the issue. As mentioned in the introduction, other research has linked talking about climate change at home to individual mitigation behavior among young people (Lawson et al., 2019). Studies using adult samples similarly emphasize importance of discussion (Goldberg et al., 2019; Geiger et al., 2017). Goldberg et al. (2019), for example, found a positive relationship between discussions about climate change with friends and family and climate change concern and beliefs. Taken together, the evidence continues to suggest overwhelmingly that talking about climate change at home and with friends may be one of the most powerful strategies for taking climate action into the mainstream. Despite its importance, evidence suggests that most people do not regularly engage in conversations about climate (Baldwin et al., 2023; Geiger et al., 2017). Therefore, we encourage the continuation of interventions intended to promote such interactions at home and in both formal and informal learning settings (e.g., Lawson et al., 2019; Valdez et al., 2018).

Finally, we are, to our knowledge, the first to incorporate an aggregate measure of exposure to climate risks derived from biophysical data into socially-grounded models of youth climate action. While important to examine, our findings suggest that, overall, broad exposure to climate risks, captured in this aggregate way, do not appear to motivate action on climate change among young people in the same way discrete climate events appear to have influenced adults in previous studies (Rudman et al., 2013; Lang and Ryder, 2016; Bergquist et al., 2019; Sloggy et al., 2021). It's possible that the disruptive, highly visible, and potentially dramatic nature of discrete climate events such as hurricanes or wildfires are more motivating than prolonged, less visible impacts such as water stress. Unfortunately, both the size and geographical distribution of our sample did not allow us to test the relative influence of different types of climate risks, which are regionally variable. Future research is needed to replicate these results using a more geographically dispersed and representative sample that includes more coastal and fire prone regions. Further, including a measure of personal experiences with climate change impacts would strengthen the analysis by more precisely accounting for individual participants' subjective awareness of their exposure to risks.

5 While slightly negatively skewed, ($M = 2.60$, $SD = 0.73$, skewness = −0.14, kurtosis = −0.27), there was a range of worldviews represented in our sample with scores ranging from 1 to 4.5 on a 5-point scale.

Our follow-up moderation analysis testing the interaction between physical exposure to climate risks and risk perceptions points toward a promising next step in this line of research. Unexpectedly, we found significant relationships between physical exposure to climate risks and intentions to engage in pro-climate behaviors only among those scoring *low* on the risk perception scale (scoring 3.70 or below on the 7-point scale). Along similar lines, it is interesting to note that our examination of the correlations between key variables (reported Supplementary Table S2) revealed a significant and *negative* relationship between physical exposure to climate change risks and risk perceptions ($r = -0.23$, $p < 0.001$). This may suggest that other, currently unknown, factors may be driving heightened perceptions of climate change risks among young people in some communities in a way that overrides any influence physical exposure to climate risks may have. Future research can build on our findings by attempting to identify these factors. For example, the current study did not take into account the role of socioeconomic status or urban/rural classification, which are factors that have been found to influence climate action and risk perceptions in adult samples (Eom et al., 2018; Tenbrink and Willcock, 2023).

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by the Southern Illinois University Carbondale Institutional Review Board. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin.

Author contributions

MB: Investigation, Writing – review & editing, Conceptualization, Writing – original draft, Formal analysis, Data curation. KH: Writing – review & editing, Writing – original draft, Data curation, Investigation, Methodology, Funding acquisition, Conceptualization, Project administration, Formal analysis, Supervision. CN: Investigation, Conceptualization, Data curation, Project administration, Writing – review & editing, Funding acquisition, Methodology. RT: Conceptualization, Project administration, Writing – review & editing, Investigation, Data curation, Funding acquisition, Methodology. JT: Data curation, Methodology, Investigation, Funding acquisition, Conceptualization, Project administration, Writing – review & editing.

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Conflict of interest

RT was employed by the 1by4by9 Educational Concepts, LLC.

The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Correction note

A correction has been made to this article. Details can be found at: 10.3389/fclim.2025.1706771.

Generative AI statement

The authors declare that no Gen AI was used in the creation of this manuscript.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fclim.2025.1657820/full#supplementary-material

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