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## Socioeconomic, psychological, and informational dynamics in shaping American public opinion perceptions on climate change

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### Abstract

Climate change remains one of the most pressing challenges of the 21st century, invoking a wide spectrum of public opinions and attitudes. In the United States, sociopolitical, economic, and educational factors influence the public's perception of climate change and its science. This study examines the complexities of American public opinion on climate change by analyzing the relationship between various socio-demographic variables and three specific perceptions: belief in the occurrence of climate change, support for a carbon tax, and the convincingness of climate science. Utilizing logistic and linear regression models on survey data, this study identifies significant predictors for each climate change perception metric. The results indicate that political party affiliation, particularly Republican identification, is inversely related to the belief in climate change and the persuasiveness of climate science. Conversely, educational attainment correlates positively with both the belief in climate change and support for carbon taxation, suggesting that higher education levels foster greater acceptance and proactive attitudes towards climate policy. Gender analysis revealed that males are less inclined to find climate science convincing, highlighting the need for gender-sensitive communication strategies. Interestingly, regional factors showed negligible influence on climate change perceptions, challenging common assumptions about geographical determinants. This study contributes to the discourse on environmental policy and public engagement by delineating the demographic contours of climate change belief systems in the U.S., offering insights for targeted educational and communication strategies to bridge the ideological divide and enhance public consensus for climate action.

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### Introduction

Climate change, a phenomenon denoting the long-term alteration of temperature and typical weather patterns, has become a central environmental issue globally. The term encompasses significant changes in global temperatures and weather patterns since the early 20th century, predominantly attributed to human activities such as burning fossil fuels and deforestation (Fahey *et al.* 2017; Riedy 2016; Werndl 2014) <sup>[10, 21, 29]</sup>. Unlike historical climate fluctuations driven by natural factors like volcanic eruptions and solar radiation, the current phase of global warming is marked by its rapid pace and the explicit contribution of human activities. This warming, primarily due to increased greenhouse gases, has led to various environmental consequences, including rising sea levels, intensifying extreme weather events, and shifting ecological dynamics.

The current rate of climate change, unparalleled in human history, poses significant challenges for human and natural systems. The swift pace of climatic changes results in severe environmental and socioeconomic impacts, reinforcing a broad scientific consensus that human activities are the primary driver of current climate change trends (Fahey *et al.* 2017) <sup>[10]</sup>. In the United States, public opinion on climate change is marked by distinct patterns. Surveys reveal widespread acceptance of climate change reality, yet opinions diverge sharply along partisan lines, influenced by socioeconomic factors, geographic location, and psychological traits. This polarization, as highlighted by researchers like (Bolsen and Druckman 2018; Poortinga *et al.* 2019) <sup>[3, 20]</sup>, impedes the development of comprehensive climate policies and international cooperation. Research reveals that while policy support is often polarized, individual behaviors and perceptions are shaped by broader factors beyond partisan affiliations, including personal beliefs, values, demographic characteristics, and regional influences (Maas *et al.* 2020; McCright *et al.* 2016) <sup>[13, 19, 17]</sup>.

The role of social class and information access in shaping climate change awareness underscores the importance of socioeconomic status in public perception (Tiwari *et al.* 2021) <sup>[27]</sup>. In addition, the psychological mechanisms driving public opinion and behavior, such as risk perceptions and psychological adaptation, play a critical role in environmentally relevant behaviors, highlighting the linkages of psychological factors (Bradley *et al.* 2020) <sup>[4]</sup>. Moreover, the interaction between political affiliations and socioeconomic and psychological factors is crucial in understanding public reactions to climate change, with researchers like (Capstick and Pidgeon 2014; Mayer and Smith 2023) <sup>[6, 18]</sup> emphasizing the multifaceted nature of partisanship in this context.

Geographic location also significantly shapes climate change beliefs, with residents in regions vulnerable to climate impacts, such as coastal areas or wildfire-prone regions, expressing more concern. Rural-urban divides influence climate attitudes, with urban populations typically showing stronger support for climate policies (Maas *et al.* 2020; Schmidt, Schmid, and Sewerin 2019) <sup>[19, 17, 22]</sup>. Understanding these diverse factors is crucial in developing effective communication strategies, policy frameworks, and public engagement initiatives to address climate change challenges. The complexity and interplay of these factors underscore the need for multidimensional approaches that consider socioeconomic, psychological, and informational dynamics in shaping public opinion on climate change.

## Review of Existing Literature

### Political Ideology and Climate Change Belief

Research into the impact of political ideology on climate change beliefs, notably by DeNicola and Subramaniam (2014); Gregersen *et al.* (2020); Mayer and Smith (2023); McCright *et al.* (2016) <sup>[9, 19, 18, 13]</sup>, underscores a significant correlation between political affiliations and environmental attitudes. DeNicola and Subramaniam's findings highlight the role of political partisanship in the United States, illustrating how conservative or Republican affiliations often align with skepticism towards climate change. This is reinforced by Mayer and Smith (2023) <sup>[18]</sup> by demonstrating the profound influence of political affiliations on beliefs about climate change. McCright *et al.*'s findings further

identify key variables that shape public opinion, including political affiliation, demographics, and regional differences, which aligns with Gregersen *et al.* (2020) <sup>[13]</sup> who delve into the multifaceted nature of this relationship, showing that political orientation is not only influences beliefs in anthropogenic climate change but also the degree of worry associated with its impacts.

The relationship between political affiliation and perceptions of flood risk and actions related to flood risk adaptation by Aerts *et al.* (2018) <sup>[1]</sup> reveals significant differences between Democrats and Republicans. Using a survey of over 1000 residents in flood-prone areas of New York City, the study finds that Democrats perceive a higher probability of suffering flood damage and are more likely to invest in individual flood protection measures. However, more Democrats than Republicans expect to receive federal disaster relief following a significant flood. These findings highlight the importance of value-based considerations in designing disaster risk management policies.

### Influence of Elite Cues and Political Mobilization on Public Perception

The research by Bolsen and Druckman (2018); Brulle, Carmichael, and Jenkins (2012) <sup>[3, 5]</sup> provides insights into the significant impact of elite cues and politicization on public opinion regarding climate change. Brulle *et al.*'s findings reveal that elite cues and structural economic factors heavily influence public concern, often more than scientific information dissemination or media coverage. Also, Bolsen and Druckman's findings complement this by examining how partisan group identity and the politicization of climate science can reduce the effectiveness of scientific consensus messages on climate change. Their studies collectively suggest the importance of strategic communication in navigating political dynamics and the need for collaboration between scientific communities and political groups.

### Demographics, Socioeconomic Factors, and Climate Change Perception

The role of demographic and socioeconomic factors in shaping climate change perception is extensively explored in literature. Generally, Bergquist *et al.* (2022); Flores *et al.* (2023); Kumar *et al.* (2023); Poortinga *et al.* (2019); Smith, Vallury, and Metcalf (2023) <sup>[2, 12, 15, 20, 18]</sup> highlight how variables like age, gender, education, and income influence public support for climate change policies, revealing interactions between trust, risk perception, and perceived seriousness of climate change. Specifically, Flores *et al.* (2023); Kumar *et al.* (2023) <sup>[12, 15]</sup> focus on the global impact of climate change on health and wellbeing, particularly in low- and middle-income countries, discussing the multifaceted nature of climate change impacts. This was taken further by Smith, Vallury, and Metcalf (2023) <sup>[18]</sup>, who provide insights into how demographic factors influence adaptation strategies, demonstrating the significant impact of demographic characteristics on environmental concerns and policy preferences. In a study by Kabir *et al.* 2016; Van Der Linden (2017) <sup>[14, 28]</sup>, education is a crucial factor in understanding climate change, and its health impacts can be pivotal. The level of knowledge about climate change was average in their study group, but the perception and awareness of climate change-related events and their impact on health were high.

### Regional differences in climate change perceptions

The influence of regional characteristics on climate change perception is generally explored by Maas *et al.* (2020); McCright *et al.* (2016); Schmidt, Schmid, and Sewerin (2019) <sup>[17, 19, 22]</sup>. Their research underscores the importance of regional specificities in shaping public perceptions and adaptation strategies. McCright *et al.* and Schmidt *et al.*'s results highlight the significance of regional differences in climate change risk perception and tolerance. The findings by Maas *et al.* (2020) <sup>[17]</sup> further emphasize the impact of personal experiences and geographic location on individual perceptions of climate change. These suggest the necessity of regionally tailored approaches to effectively address climate change, acknowledging the unique challenges and perspectives of different regions.

### Relationship between demographic factors with regional variations

The relationship between demographic factors and regional variations in climate change perceptions is examined in-depth by Bradley *et al.* (2020); Poortinga *et al.* (2019) <sup>[4, 20]</sup>. They highlight that demographic characteristics such as age, gender, education, and income are crucial in shaping public perceptions of climate change, often more significantly than regional factors. Their research indicates that to fully understand public perception of climate change, both demographic and regional influences must be considered. Poortinga *et al.*'s study focuses on how demographics like older age groups and those with less formal education are more skeptical about anthropogenic climate change. In contrast, Bradley *et al.*'s study discusses the interaction of socio-demographic variables with cognitive and experiential factors in shaping climate change risk perceptions and behaviors.

### Research Gaps and Value Addition to Literature

This research critically addresses how political affiliation influences individuals' beliefs about the occurrence of climate change in the United States. While existing studies like those by DeNicola and Subramaniam (2014); Mayer and Smith (2023); McCright *et al.* (2016) <sup>[9, 19, 18]</sup> have established a connection between political affiliations and climate change beliefs, this study delves deeper into the intricacies of this relationship. It aims to quantify the specific impacts of different political ideologies, particularly within conservative and Republican circles, on beliefs and concerns about climate change. This deeper exploration moves beyond recognizing the general partisan divide, offering a deeper understanding of the variances within these political groups' perceptions and responses to climate change. Such detailed insights are crucial for developing targeted communication and policy strategies to bridge ideological gaps effectively.

This research also seeks to answer how demographic factors, such as age, gender, education, income, and regional differences, affect public support for climate change policies and the perception of climate change science in the United States. Prior research like Bradley *et al.* (2020); Maas *et al.* (2020); Poortinga *et al.* (2019) <sup>[4, 20, 17]</sup> highlights the influence of demographic and regional factors. However, this study uniquely investigates their interplay. This approach acknowledges the diverse nature of climate change perceptions, shaped by an interplay between demographic characteristics and regional contexts. By exploring these dynamics, the research fills a critical gap in understanding

how various factors converge to shape public opinions on climate change, thereby providing vital insights for crafting more effective and inclusive climate policies and communication strategies.

### Social identity theory and its application to political affiliation

Social Identity Theory, conceptualized by Henri Tajfel and John Turner, posits that an individual's identity and behavior are significantly influenced by their affiliation with various social groups, influencing their beliefs Fielding and Hornsey (2016) <sup>[11]</sup>; van den Scott (2023) <sup>[23]</sup>. This theory emphasizes that group membership, such as political parties, shapes personal beliefs and attitudes, as individuals tend to align with the norms and ideologies of their groups. Following this theory, this study hypothesizes a negative statistical relationship between Republican political affiliations and belief in climate change. As individuals identify more strongly with Republican ideologies, their belief in the occurrence of climate change diminishes.

### Value belief norm (VBN) theory and influence on climate policy support

This theory, developed by Paul Stern, provides a framework for understanding how personal values lead to the formation of specific environmental beliefs and norms, which in turn influence behavior, suggesting that an individual's values about the environment shape their beliefs regarding environmental issues, leading to the establishment of personal norms that guide their responses to these issues (Chen 2015; López-Mosquera and Sánchez 2012) <sup>[7, 16]</sup>. Based on VBN theory, this study hypothesizes a positive statistical relationship between demographic factors (such as age and education) and support for climate change tax. This implies that younger individuals and those with higher education levels will demonstrate greater support for climate change taxation.

### Integrated framework for analyzing regional differences

Integrating social identity theory and VBN theory, this research addresses the role of regional differences in shaping climate change perceptions. The integration of these theories allows for a comprehensive understanding of how regional cultural, environmental, and socioeconomic factors influence individuals' beliefs and behaviors. This study hypothesizes that there will be a statistically significant variation in climate change perceptions based on regional differences, positing that individuals living in different regions of the United States will exhibit varied beliefs and understandings about climate change, with these regional factors either positively or negatively influencing their belief in climate change and its scientific consensus.

### Data and Methodology

The data for the study comes from a survey conducted by (The AP-NORC Center for Public Affairs Research 2018) The Associated Press-NORC Center for Public Affairs Research, with funding from The Energy Policy Institute at the University of Chicago (EPIC). This survey, titled "Is the Public Willing to Pay to Help Fix Climate Change?" was carried out between November 14 and 19, 2018. It involved a national sample of 1202 adults in the United States, ensuring a broad and representative demographic coverage. The survey method included telephone interviews and web-

based surveys to gather responses from participants across the 50 states and the District of Columbia. The table below summarizes the data.

**Table 1:** Variables

Variable	Description	Levels/Range
Cc science convince	Respondents' stance on the convincingness of climate change science compared to five years ago.	1 (Less convincing) to 5 (More convincing)
Cc is happening	Whether respondents believe that climate change is occurring, not occurring, or if they are unsure.	0 (Not occurring), 1 (Occurring), Unsure
Support cc tax	Level of support for taxing carbon-based fuels to reduce greenhouse gas emissions.	1 (Strong opposition) to 5 (Strong support)
State	Geographic location of respondents, represented by two-character postal state codes in the U.S.	U.S. State Postal Codes
Republican	Political affiliation of respondents.	1 (Democrat) to 5 (Republican)
Male	Gender of the survey participants.	0 (Female), 1 (Male)
Educ	Highest level of education achieved by respondents.	1 (No H.S. Diploma) to 4 (Bachelor's or above)
Income	Annual income levels of respondents.	1 (Under \$10,000) to 9 (\$150,000 or more)
Age	Age brackets of respondents.	1 (18-29) to 5 (65 or older)
Race	Race/ethnicity of the respondents.	Hispanic, Other, Black, White
Region	Respondents' region in the U.S., derived from state codes.	North, South, East, West

This study's variables capture a comprehensive snapshot of public opinion on climate change. The *ccscienceconvince* variable tracks shifts in the perceived convincingness of climate science, reflecting changing attitudes over time. *ccishappening* directly assesses beliefs about the occurrence of climate change, a crucial metric in understanding public recognition of this issue. The *supportcc tax* variable measures public support for a carbon tax, indicating willingness to accept financial measures against climate change. Demographic variables like age, gender (male), race, income, educ, and geographic location (state, region) provide a deeper understanding of how opinions and beliefs about climate change vary across different segments of the population.

These variables enable a multifaceted analysis of factors influencing public opinion on climate change. The *republican* variable, for instance, sheds light on the impact of political affiliation on climate change beliefs and policy support. By examining the interplay of these variables, the study reveals nuanced insights into the demographic and political drivers of attitudes toward climate change. This rich data *et al* lows for the identification of trends and patterns, offering valuable guidance for policymakers and communicators in crafting targeted strategies to address climate change effectively. The descriptive statistics for the variables are presented in the table below.

**Table 2:** Descriptive Statistics

Variable	Min	Median	Mean	Max	SD	Notes
Republican	1.000	2.000	2.715	5.000	1.6542	Political affiliation
Male	0.0000	0.0000	0.4775	1.0000	0.4997	Gender
Educ	1.000	3.000	3.022	4.000	0.8572	Education level
Income	1.000	6.000	5.324	9.000	2.2907	Annual income
Age	1.000	3.000	3.111	5.000	1.3519	Age group
Cc science convince	1.000	3.000	3.574	5.000	1.1632	Conviction in science
Cc is happening	0.0000	1.0000	0.7245	1.0000	0.4470	Belief in occurrence
Support cc tax	1.000	3.000	3.261	5.000	1.3847	Support for carbon tax

From the table above, Political affiliation (*republican*) shows a wide distribution, hinting at diverse political leanings among respondents. Gender representation (*male*) is nearly balanced, with a slight skew towards female participants. Education levels (*educ*) are fairly distributed, suggesting a varied educational background in the sample. Income levels (*income*) show a median higher than the mean, indicating a

skew towards higher income brackets. Age distribution (*age*) is balanced across groups. Conviction in climate science (*ccscienceconvince*), belief in its occurrence (*ccishappening*), and support for a carbon tax (*supportcc tax*) display a moderate to high level of concern and awareness among participants.

Results and Analyses

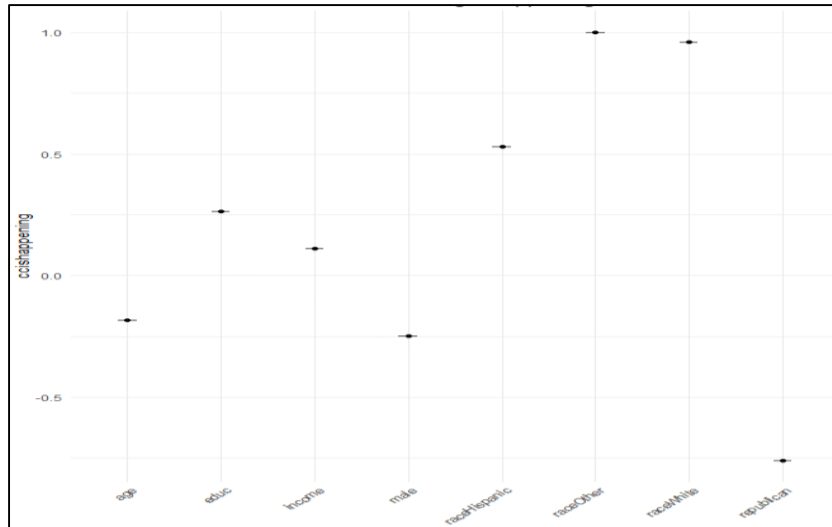


Fig 1: Coefficients for belief in climate change happening

From the figure above, the Republican variable, with a coefficient of -0.59790 (on a 0-1 scale of belief in climate change happening), reveals a significant political divide in climate change perception in the United States. This finding aligns with the broader political landscape in America, where environmental issues often become polarized along party lines. The negative coefficient indicates that individuals with Republican affiliations are less likely to believe in the

occurrence of climate change compared to their Democrat counterparts. This is attributed to ideological differences, party-driven narratives, and varying levels of trust in scientific information. The substantial influence of political ideology on climate change belief in the U.S. is critical for policymakers and communicators who must navigate these partisan divides to foster broader consensus on environmental issues as seen in the plot below.

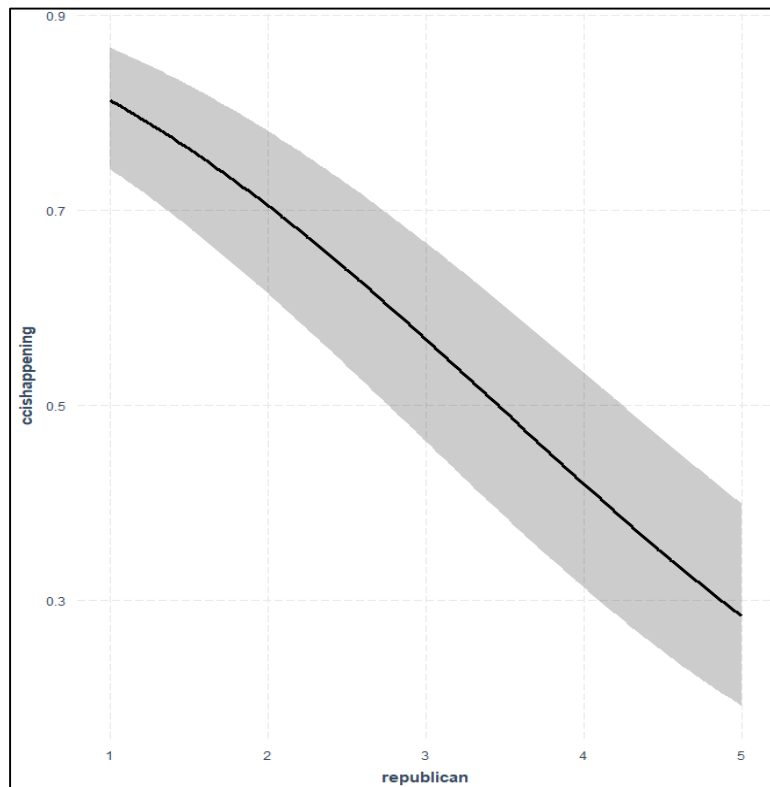


Fig 2: Republican

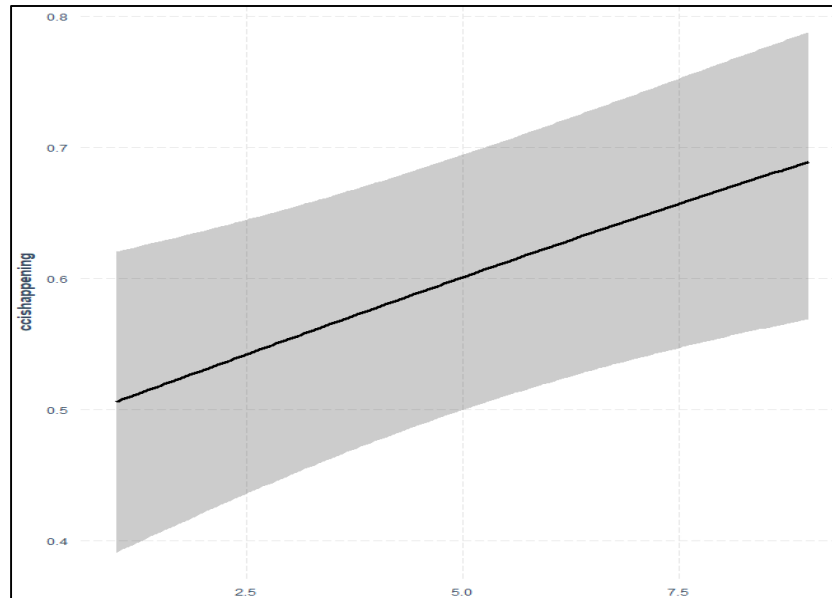
The x-axis represents the spectrum of political affiliation from Democrat to Republican, and the y-axis represents the predicted probability of an individual believing in the occurrence of climate change. A clear negative trend is shown; as individuals identify more

strongly as Republican, the probability of believing in climate change decreases. This pattern is statistically significant and reveals the impact of political party affiliation on climate change perception in the United States. The confidence interval, shown as the shaded area, indicates some

uncertainty around the predictions but does not overlap with the probability of belief in climate change for Democrats, suggesting a distinct difference in belief between the political affiliations. This trend is consistent with the broader national dialogue, where climate change often emerges as a politically polarizing issue.

The positive coefficient of 0.09635 (on a 0-1 scale of belief in climate change happening) for income suggests that in America, individuals with higher income levels are slightly more likely to believe in climate change. This relationship

can be influenced by several factors, including access to education and information, which tend to increase with income. Higher-income groups might also perceive themselves as better equipped to handle the potential economic impacts of climate change policies. However, the modest size of this coefficient indicates that income is not the most dominant factor in shaping climate change beliefs, highlighting the complexity of socioeconomic factors in environmental awareness in the U.S. as seen in the plot below.



**Fig 3:** Income

The plot above depicts the predicted probability of individuals believing that climate change is happening based on their income levels, derived from the model. The upward trend observed in the graph indicates a positive relationship between income and belief in the occurrence of climate change. Specifically, as income increases, so does the likelihood of an individual belief that climate change is real. This relationship is statistically significant, suggesting that higher income levels are associated with greater access to information, higher education levels, or increased engagement with environmental issues, which can influence belief in climate change.

The shaded area around the regression line represents the confidence interval, providing a range for the predicted probabilities that express uncertainty in the estimates. The wider the shaded area, the greater the uncertainty, which is influenced by the variability within the income brackets or other factors not included in the model. As indicated by the confidence interval, the positive association between income and belief in climate change highlights a socioeconomic dimension to the public's environmental consciousness in America. It suggests that economic factors and educational and informational disparities play a significant role in shaping public perception of climate change.

The age variable's negative coefficient of -0.15267 (on a 0-1 scale of belief in climate change happening) points to a generational divide in climate change beliefs in the U.S. Older Americans are less likely to believe in climate change, which is due to various factors such as differing priorities, exposure to different types of media, or a gap in environmental education over the decades. This finding is crucial for environmental advocacy and policy formulation, as it suggests the need for targeted communication strategies to engage older demographics and bridge the gap in awareness and belief about climate change.

The education variable, with a positive coefficient of 0.21362 (on 0-1 scale of belief in climate change happening), underscores the role of education in shaping climate change beliefs in America. This aligns with the notion that higher educational attainment often correlates with greater scientific literacy and a better understanding of climate issues. The significant influence of education suggests that efforts to increase public awareness and understanding of climate change are effective, especially if they focus on educational initiatives. This is particularly relevant in the U.S., where education levels vary widely and can influence how individuals interpret and respond to scientific information, as seen in the plot below.

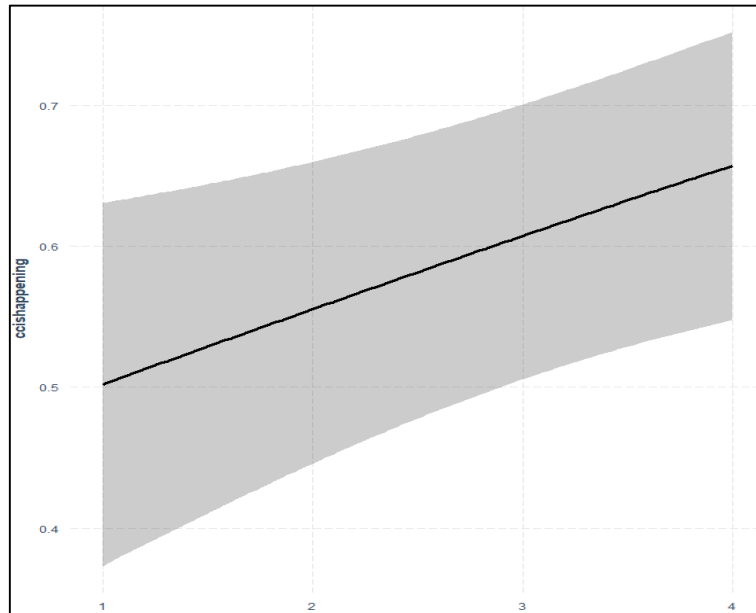


Fig 4: EDUC

The above plot visualizes the relationship between the level of education and the belief in the occurrence of climate change, as determined by a logistic regression model. On the x-axis, education levels range from 1 (No High School diploma) to 4 (Bachelor's degree or above). At the same time, the y-axis indicates the predicted probability that an individual believes climate change is occurring. The upward-sloping line illustrates a positive correlation, supported by the model's significant education coefficient of 0.21362, meaning as education increases, so does the belief in climate change. The shaded area represents the confidence interval, which widens with higher education levels, implying more uncertainty in those predictions. Nonetheless, the trend remains consistent, affirming the model's finding that education significantly influences climate change perception. The coefficient for the male variable is -0.23389 (on 0-1 scale of belief in climate change happening), indicating a trend where men might be slightly less likely than women to believe in climate change, though this finding is not

statistically significant in the model. In the American context, this aligns with some research suggesting gender differences in environmental concern, where women often report higher levels of concern and belief in environmental issues. However, this study's lack of statistical significance suggests that gender is not a primary driver of climate change belief, or other factors might mitigate gender differences in this area. The race variables in the model, notably Hispanic, Other, and White, show a positive association with belief in climate change, with the latter being statistically significant. This indicates that in America, racial and ethnic identity can influence perceptions of climate change. The significant coefficients for other races and Whites suggest that these groups are more likely to believe in climate change than Blacks, as seen in the plot below. This reflects cultural, educational, or socioeconomic factors that vary across racial groups in the U.S. and highlights the importance of understanding these hidden complications when addressing climate change issues in a diverse society.

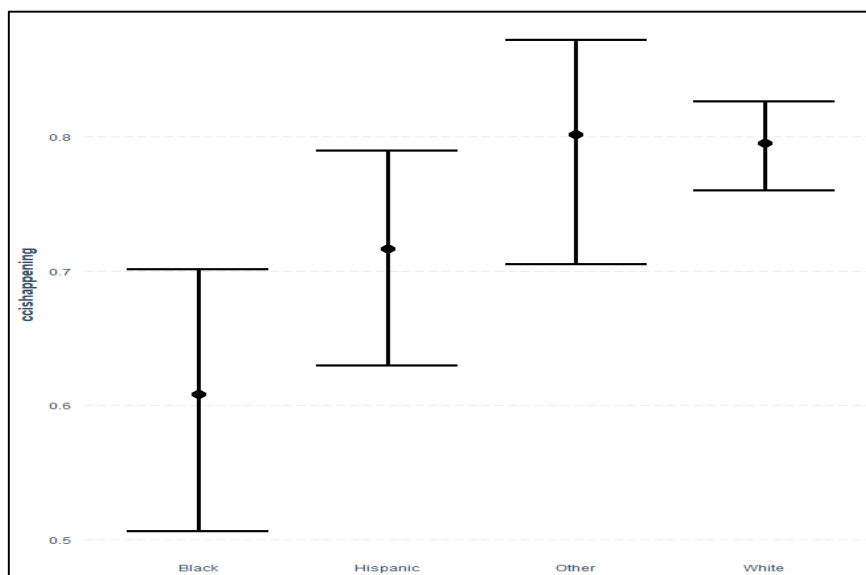
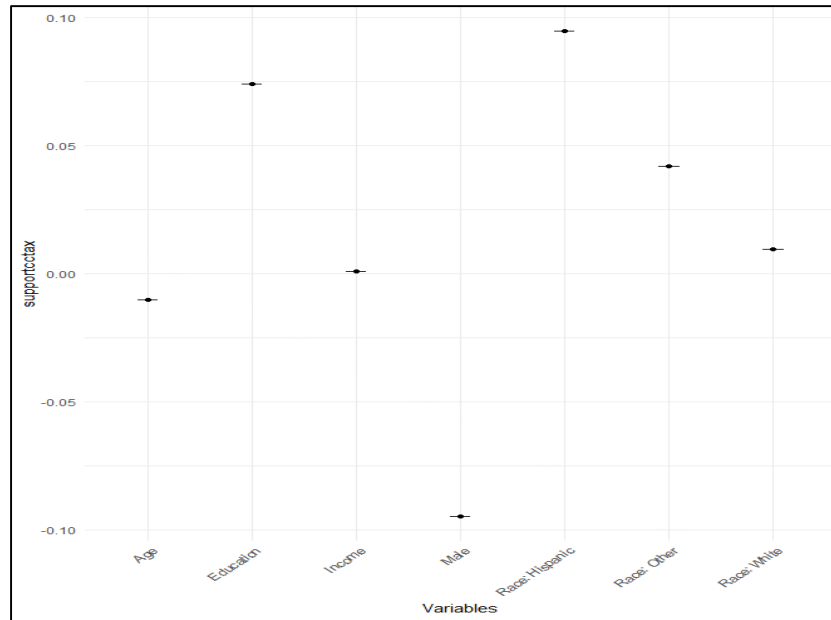


Fig 5: Race

The plot above depicts the predicted probabilities of belief in the occurrence of climate change across different racial groups, aligned with the findings from the logistic regression model. Black respondents have a predicted belief probability around 0.65, Hispanics slightly above 0.7, while those in the 'Other' category near 0.8, with Whites just under this level. The confidence intervals vary in width, with 'Other' and

'Black' categories showing more uncertainty than 'Hispanic' and 'White' groups. Reflecting the model's coefficients, these visualized probabilities affirm that racial identity significantly influences climate change beliefs, with 'White' and 'Other' groups being more inclined to believe in climate change, as indicated by their higher probabilities and the model's significant positive coefficients for these groups.



**Fig 6:** Coefficients for support for carbon Tax

In the model above, the income variable, showing a negligible and statistically insignificant effect (coefficient = 0.004165 on a 1-5 scale of level of support for taxing carbon-based fuels to reduce greenhouse gas emissions), suggests that in the U.S., financial status does not notably influence support for a carbon tax. This finding implies that attitudes towards environmental taxation in America are driven by factors other than personal wealth or income level. It indicates a consensus or disagreement on the carbon tax across various income groups, reflecting a shared perspective that transcends economic status. This insight is particularly relevant for policymakers, highlighting that economic diversity does not significantly divide opinions on carbon tax policies.

The age variable, with a negative coefficient (-0.041167 on a 1-5 scale of level of support for taxing carbon-based fuels to reduce greenhouse gas emissions) that lacks statistical significance, hints at a marginal trend where older Americans might be less supportive of carbon tax initiatives. While not robust in this model, this trend aligns with broader

observations that older generations prioritize economic stability or have different environmental concerns. However, the absence of strong statistical backing suggests that in the U.S., age may not be a decisive factor in determining support for environmental taxation, or it might interact with other variables like political affiliation or education in myriad ways.

The significant positive coefficient for educ (0.296175, on a 1-5 scale of support for taxing carbon-based fuels to reduce greenhouse gas emissions) reveals that higher educational attainment correlates with greater support for a carbon tax in America. This relationship underscores the role of education in shaping environmental consciousness and policy preferences. The finding suggests that educated Americans might better understand the long-term benefits of environmental policies, including taxation to curb carbon emissions. This insight is crucial for environmental advocacy, highlighting the need for educational initiatives to foster understanding and support for climate change mitigation strategies as seen in the plot below.

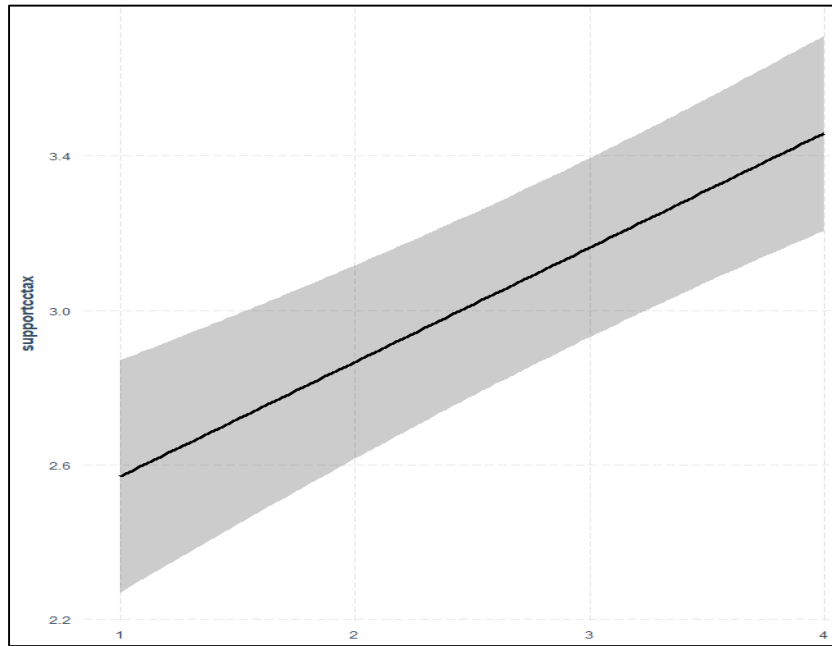


Fig 7: EDUC

The plot above illustrates the positive correlation between education level and support for a carbon tax as indicated by the upward trend of the regression line, which aligns with the model's finding where a higher level of education ('educ') corresponds to greater support for taxing carbon-based fuels ('supportctax'). The levels on the x-axis represent increasing education from no high school diploma to a bachelor's degree or higher, and the y-axis measures the degree of support for the carbon tax. The confidence interval, depicted by the shaded area, remains consistent across education levels, suggesting a stable prediction of support regardless of education level, reinforcing the model's significant positive coefficient for education (0.296175).

The significant negative coefficient for males (-0.379250, on a 1-5 scale of level of support for taxing carbon-based fuels to reduce greenhouse gas emissions) indicates a gender-based difference in the U.S. concerning support for a carbon tax, with men being less likely to support such policies compared to women. This finding reflects broader gender differences in environmental concerns, where women often exhibit greater environmental awareness and proactive attitudes, as seen in the plot below. This gender disparity in policy support should be rooted in differing societal roles, values, or risk perceptions between men and women in American society. Understanding these gender dynamics is crucial for designing inclusive and effective environmental policies.

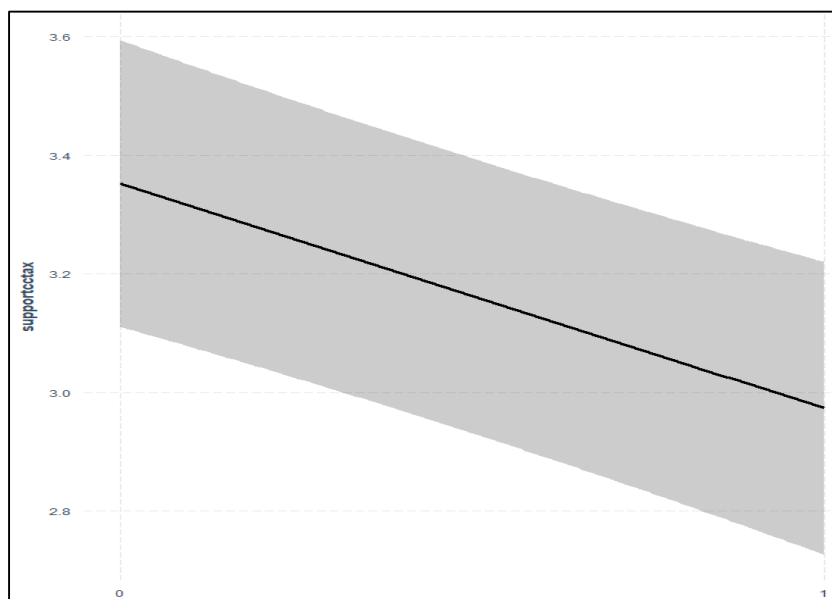


Fig 8: Male

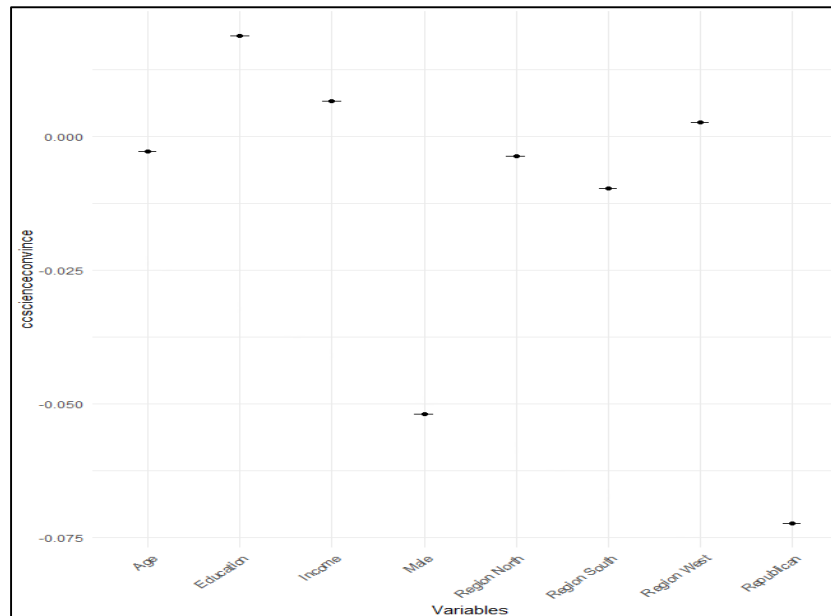
The plot above visualizes the likelihood of supporting a carbon tax decrease for males compared to females, as indicated by the descending trend line. Females, represented by the left end of the x-axis (coded as 0), show higher support

for the carbon tax, while males (coded as 1 on the x-axis) show lower support, as per the negative coefficient for 'male' (-0.379250) in the model. The confidence interval, shaded in the plot, underscores the precision of this prediction,

confirming that gender, being male, is associated with a statistically significant decrease in support for carbon taxation policies.

In terms of race, the Hispanic variable stands out with a significant positive coefficient (0.378755, on a 1-5 scale of level of support for taxing carbon-based fuels to reduce greenhouse gas emissions), suggesting that Hispanic individuals in the U.S. are more inclined to support a carbon tax compared to the baseline race group. This reflects cultural

values, community-level environmental impacts, or other socio-political factors influencing Hispanic Americans' attitudes toward environmental policies. In contrast, the non-significant coefficients for Other races and whites indicate that these racial groups' support for carbon tax is not markedly different from Blacks. These complications in racial and ethnic responses to environmental taxation in the U.S. are vital for understanding and addressing diverse perspectives in climate policy discussions.



**Fig 9:** CC Science convince, Demographic Variables and regional differences

In the context of the scale used for the dependent variable 'ccscienceconvince,' which ranges from 1 to 5, the coefficient for 'republican' (-0.28969) is worthwhile. On this scale, a lower score indicates a stance that climate change science has become less convincing over time, while a higher score suggests the opposite. The significant negative coefficient indicates that individuals with Republican affiliations are likely to rate the convincingness of climate change science lower than their non-Republican counterparts. This suggests that within the spectrum of political beliefs, as one's identification with the Republican party strengthens, there is a marked decrease in the perceived credibility of climate science. This result is crucial, as it quantifies the influence of political ideology on the acceptance of scientific consensus on climate change, underscoring the challenge of communicating climate science across partisan lines.

The 'income' variable, associated with a positive coefficient (0.02644) on a 1 to 5 scale for the convincingness of climate change science, suggests a trend where individuals with higher incomes rate the science as more convincing. However, this trend is not statistically significant at the conventional 0.05 level, although it is close. This coefficient implies a complicated relationship where, as income increases, there is a slight, albeit not statistically concrete, shift towards viewing climate change science as more convincing. The relationship hints at economic status and the perception of climate change science, reflecting differences in access to education, information, or ideological alignments that correlate with income levels.

The variable 'age' shows a small and statistically insignificant negative coefficient (-0.01145) against the 1 to 5 scale

measuring the convincingness of climate change science. This indicates that there is no strong evidence to suggest that age significantly affects one's view of climate change science within this model. On this scale, a negative coefficient suggests that older individuals find the science less convincing, but given the lack of statistical significance, such a conclusion cannot be drawn. The perception of climate change science's convincingness does not systematically increase or decrease with age, pointing to other factors beyond age that are more influential in shaping these perceptions.

The positive coefficient for 'educ' (0.07525) on the 1 to 5 scale, where higher scores reflect a view that climate change science is more convincing and lower scores reflect skepticism, suggests that individuals with higher education levels are somewhat more likely to find climate change science convincing. This coefficient indicates a modest but notable relationship between education and the perception of climate science. As educational attainment increases, so does the likelihood of acknowledging the validity of climate change science. This aligns with the expectation that education fosters greater understanding and acceptance of scientific information. However, the marginal p-value suggests that further research is needed to ascertain this relationship's strength fully.

Gender, represented by the 'male' variable, has a significant negative coefficient (-0.20774). On the scale used for 'ccscienceconvince,' this coefficient suggests that males are likelier to score lower, implying they find climate change science less convincing than females. This finding contributes to the broader discussion on gender differences in

the perception of scientific issues, where males, in this dataset, exhibit greater skepticism towards climate change science. The clear statistical significance of this variable highlights gender as a key demographic factor in climate science communication strategies, with the need to address different levels of receptivity between genders.

The regional variables, 'North,' 'South,' and 'West,' show no significant differences in the convincingness of climate change science on a 1 to 5 scale. This indicates that the region of residence within the United States does not play a

statistically significant role in influencing individuals' views on climate change science. This suggests that irrespective of whether individuals are from the North, South, or West, their ratings on the convincingness of climate change science do not differ significantly from the baseline region (the East). The lack of significant regional variation implies that perceptions of climate science are shaped more by individual characteristics than geographic location, as seen in the plot below.

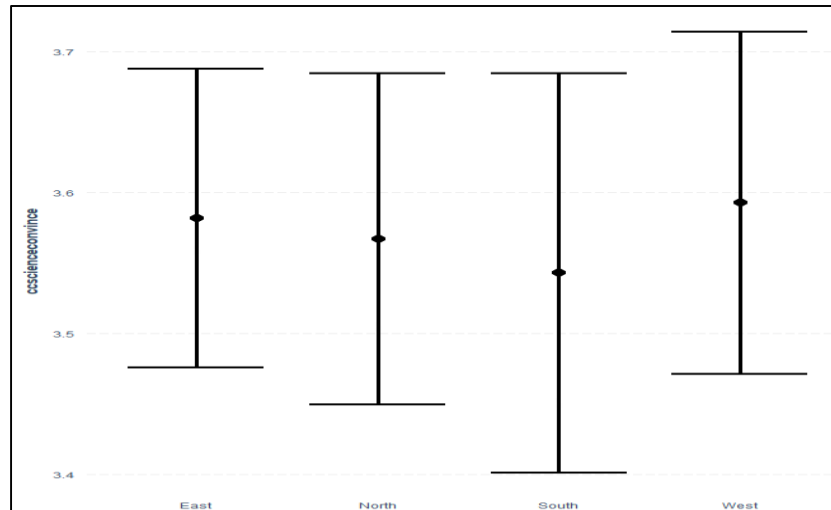


Fig 10: Region

The plot above represents the factors that influence American public opinion on the convincingness of climate change science ('ccscienceconvince'). It shows the mean perceived convincingness across different U.S. regions, with the 'East' region as the reference category. The vertical error bars represent the confidence intervals, indicating the precision of the mean estimates. The overlapping confidence intervals across the regions suggest no significant differences in the convincingness of climate science among these regions.

Individual factors such as political affiliation, gender, and education influence climate change science's perception. However, the plot underscores one of the study's key findings: regional differences within the U.S. do not significantly affect the public's conviction in climate change science. This outcome suggests that geographic boundaries do not distinctly partition public opinions on climate science and that nationwide approaches to climate science communication are as effective as region-specific strategies.

### Conclusion

In examining the interplay of socioeconomic, psychological, and informational dynamics shaping American public opinion on climate change, this study reveals that political affiliation emerges as a dominant factor. The pronounced divide between Republican and non-Republican individuals' perception of climate science's convincingness underscores the politicization of climate issues in the United States. This ideological rift has deep roots in the political landscape and indicates broader societal polarization. As such, efforts to communicate climate science in America must navigate the difficult terrain of political identities, crafting messages that resonate across the spectrum while acknowledging the distinct psychological profiles that political affiliations entail. The significant influence of political affiliation on climate

change perceptions necessitates strategies that bridge ideological divides, as highlighted in the works of (Crawley, Coffé, and Chapman 2020; Skeirytė, Krikštolaitis, and Liobikienė 2022).

Economic status, represented by income, significantly influences climate change perceptions. While higher income levels are associated with a slightly more convincing view of climate science, this relationship is not robustly significant. This nuanced trend hints at the multifaceted nature of economic influence, potentially mediated by factors like access to resources, exposure to different information sources, and social networks. Therefore, while influential, socioeconomic factors do not singularly dictate climate change opinions but interweave with other determinants, including educational background and media engagement.

Educational attainment holds a significant, if modest, influence on perceptions of climate change, with higher levels of education correlating with a greater acceptance of climate science. This relationship underscores the critical role of educational systems in fostering scientific literacy and critical thinking. Enhancing educational outreach and integrating climate science into curricula across all levels is a strategic move to shift public opinion towards a consensus on climate change and its anthropogenic origins.

Gender differences also play a notable role, with males exhibiting more significant skepticism towards climate change science compared to females. This finding indicates the importance of addressing gender-specific biases and barriers in science communication and education. Tailoring communication strategies to effectively engage men with more critical views on climate change science should involve leveraging male peer networks and role models and framing messages that align with values typically more prevalent among men.

Regional differences within the United States have minimal impact on opinions about climate change science, suggesting that personal beliefs transcend geographic boundaries. This is a heartening insight for policymakers and communicators, implying the potential for nationwide initiatives and campaigns to be well-received. However, regional diversities are still relevant regarding specific climate-related risks and experiences and, thus, should be considered in targeted communication efforts. Addressing the challenge of climate change in America requires a multifaceted approach that considers the interplay of socioeconomic status, educational attainment, political ideology, and gender, all pivotal in shaping public opinion. As America grapples with the urgent need for climate action, understanding these underlying drivers is essential for fostering a public consensus and galvanizing collective efforts to mitigate climate change impacts.

### Recommendations

Based on the findings of this study, it is recommended that climate change communication strategies in the United States be tailored to account for the significant impact of political affiliation on climate change perceptions. Communication should bridge the ideological divide, presenting climate science in a way that resonates with values across the political spectrum. This involves bipartisan efforts, engaging stakeholders from all political backgrounds to foster dialogue and understanding. It is crucial to identify and work with influential figures within Republican circles to disseminate climate change information, as this helps to counteract the entrenched skepticism within these communities. Moreover, strategies should leverage common ground, such as the economic benefits of green technology and the patriotic appeal of energy independence, to frame climate action in a way that transcends partisan barriers.

Educational interventions are also critical. Enhancing the climate change curriculum in schools, universities, and adult education programs can elevate the public discourse on climate science. This should focus on disseminating facts and fostering critical thinking skills, enabling individuals to assess the information they encounter critically. Education campaigns should also be inclusive, reaching out to demographics with higher skepticism, such as males, and using diverse communication channels to ensure broad accessibility. In addition, creating community-based programs that encourage dialogue and hands-on experiences related to climate change can help translate abstract concepts into tangible understanding, promoting a shift in perceptions. Lastly, while regional differences did not significantly influence perceptions of climate science in this study, localized approaches to climate change communication and policymaking should not be overlooked. Tailored messages that address specific climate-related risks and appeal to local values can enhance public engagement and support for

climate action. Policymakers should also consider socioeconomic factors, supporting lower-income households to engage in climate-positive behaviors. Collaborations across various sectors, including government, industry, academia, and non-profits, are essential to create a multifaceted response that aligns climate action efforts with the web of factors influencing public opinion on climate change in America.

### Appendix

The "ccscienceconvince" variable assesses respondents' current stance on the convincingness of climate change science compared to five years ago. It ranges from finding the science less convincing to much more convincing. This measure indicates changes in public perception of climate science over time and can reflect shifts in awareness, understanding, or influence of external factors such as media and political discourse.

The "ccishappening" variable evaluates whether respondents believe that climate change is occurring, is not occurring, or if they are unsure. This direct assessment of belief in the occurrence of climate change is pivotal in understanding public acknowledgment of this global issue and readiness to support policies aimed at mitigating it.

The "supports tax" variable measures the level of support for a policy that would reduce greenhouse gas emissions by taxing carbon-based fuels. The responses range from strong opposition to strong support, providing insights into the public's willingness to accept financial measures to combat climate change.

The "state" variable contains the two-character postal state codes for the U.S., representing the geographic location of respondents. This is gotten from (<https://pe.usps.com/text/pub28/28apb.htm>).

The "Republican" variable measures the political affiliation of the respondents. It categorizes individuals into five groups based on their political leanings: Democrat, Lean Democrat, Independent, Lean Republican, and Republican.

The "male" variable represents the gender of the survey participants, coded as 0 for females and 1 for males.

The "educ" variable indicates the highest level of education achieved by the respondents. It is divided into four categories: No High School diploma, High School graduate or equivalent, Some college, and Bachelor's degree or above.

The "income" variable categorizes respondents based on their annual income levels, ranging from under \$10,000 to \$150,000 or more. This gradient of income levels is used to explore how economic status affects perceptions of climate change, willingness to pay for climate policies, and the perceived impact of such policies on personal finances.

The "age" variable groups respondents into age brackets, such as 18-29, 30-39, 40-59, 60-64, and 65 or older.

The "race" indicates the race/ethnicity of the respondents, with categories including Hispanic, Other, Black, and White.

Table 3: Model results

Variable	Belief in Climate Change Happening (0-1)	Support for Carbon Tax (1-5)	Convincingness of Climate Science (0-1)
Intercept	1.49399***	2.561566***	4.13330***
Republican	-0.59790***	NA	-0.28969***
Income	0.09635**	0.004165	0.02644.
Age	-0.15267**	-0.041167	-0.01145
Education	0.21362*	0.296175***	0.07525.
Male	-0.23389	-0.379250***	-0.20774***
Race: Hispanic	0.48706.	0.378755*	N.A.

Race: Other	0.95516**	0.167744	NA
Race: White	0.91618***	0.037940	NA
Region: North	NA	NA	-0.01470
Region: South	NA	NA	-0.03890
Region: West	NA	NA	0.01087

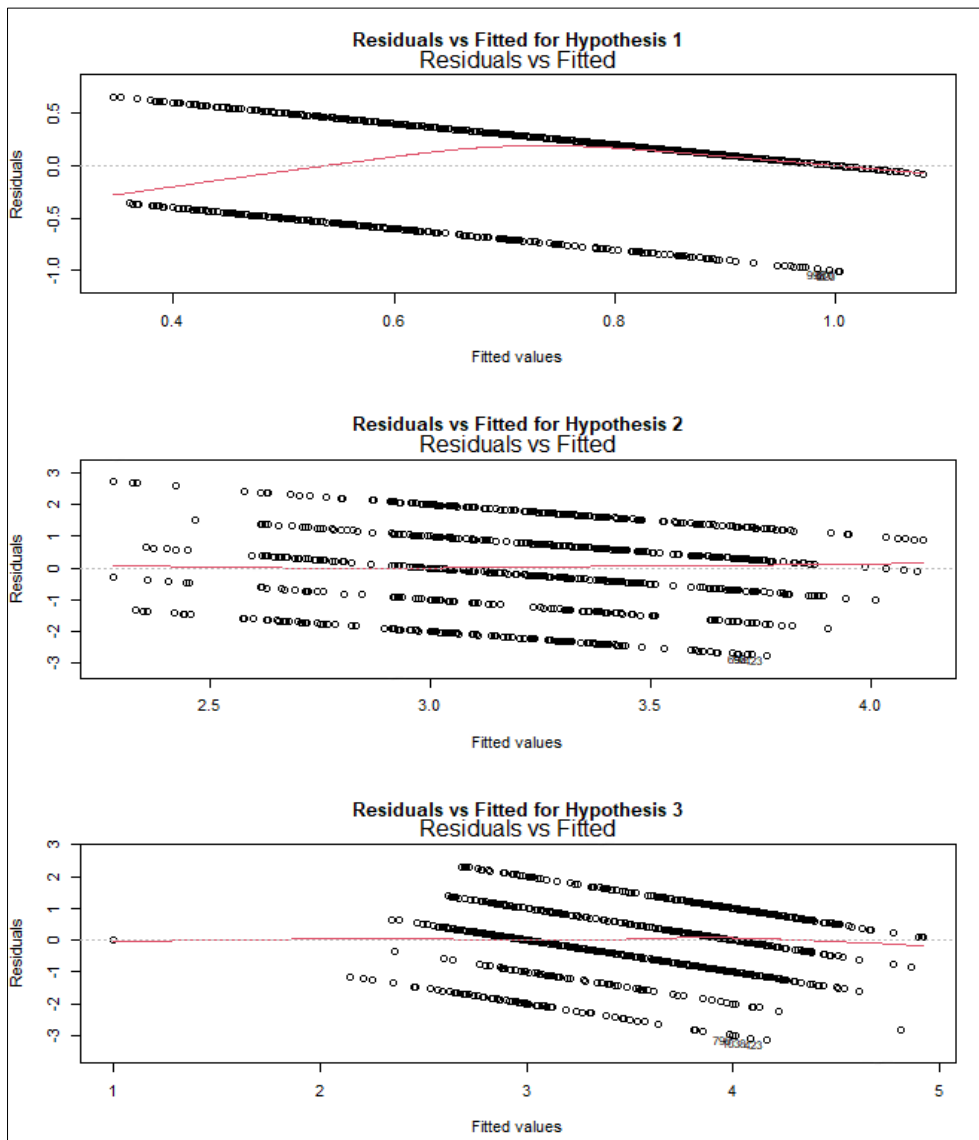
Significance codes: \*\*\*  $p < 0.001$ , \*\*  $p < 0.01$ , \*  $p < 0.05$ ,  $p < 0.1$

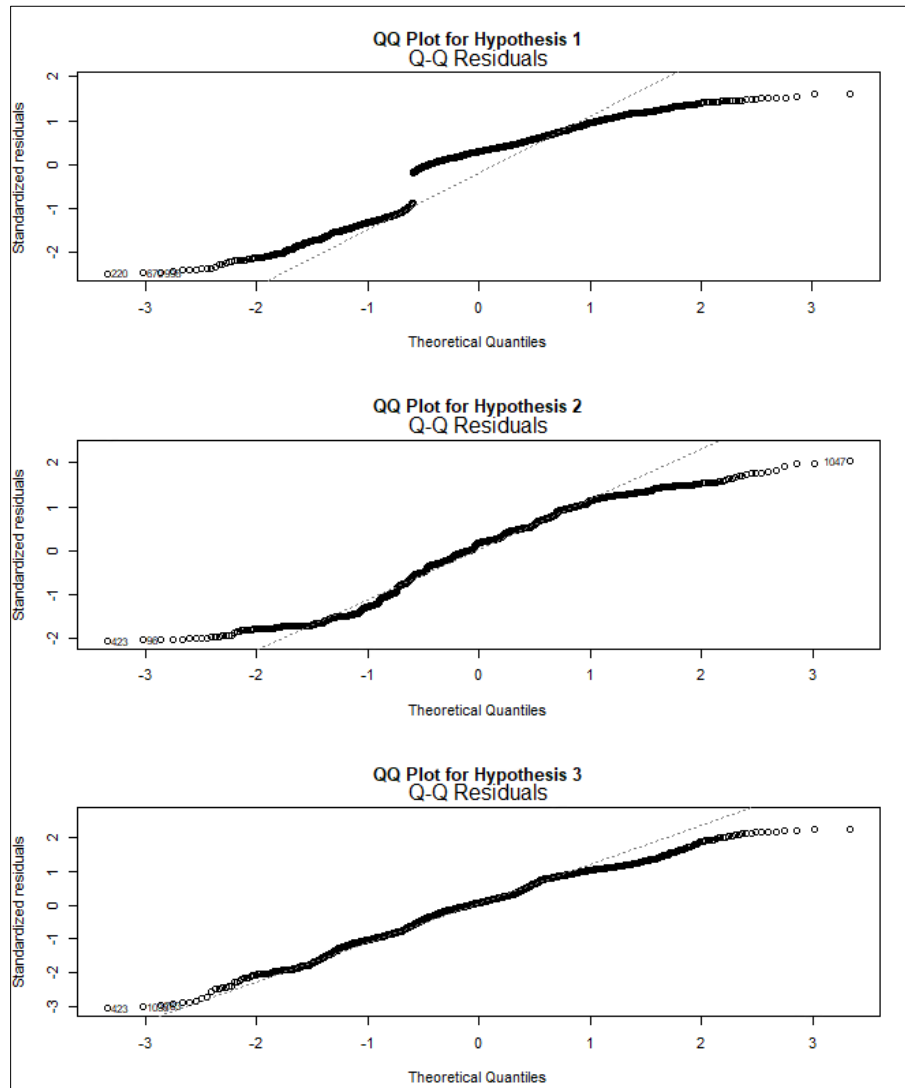
**The Residuals vs. Fitted Values Plot** assesses the assumption of linearity and homoscedasticity in the regression models. By examining the residuals against the fitted values, the plot provides insights into the adequacy of the model fit for each hypothesis. It suggests a good fit as residuals are randomly scattered around the horizontal line.

**The Q.Q. Plot, or Quantile-Quantile Plot**, checks whether the residuals follow a normal distribution, a fundamental assumption of linear regression. The alignment of points

along the reference line in this plot suggests that the residuals are normally distributed.

**The Scale-Location Plot** checks the homoscedasticity of residuals, ensuring equal variances. This plot, displaying the square root of the absolute residuals against the fitted values, is vital for confirming the homogeneity of variance across the levels of predictor variables like 'income', 'education', etc. As seen in the plots, a horizontal pattern with randomly scattered points suggests homoscedasticity.





**Fig 11:** From the plot above, as the points closely follow the lines, there is no multicollinearity, as the shapes depict normality.

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