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Global Climate Concern and Local Environmental Vulnerability: Comparing Residents of Industrial-Proximity and Greener Neighborhoods in North Carolina

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Abstract

This exploratory mixed-methods study is part of a Department of Energy (DOE) grant that examines whether residents of preselected lower-resource, industrial-proximity neighborhoods differ from residents of higher-resource, greener neighborhoods in (1) broader attitudes toward global warming, and (2) perceptions of local environmental conditions. Focus-group input informed an online survey of 153 respondents across two ZIP-code clusters in North Carolina. Quantitative measures included a five-item global-warming attitude scale (α = .849) and a ten-item perceived environmental conditions scale (α = .922), complemented by open-ended questions about heat coping, green space, behavioral effects, emergency services, and government responsiveness. Independent-samples t tests showed a small difference in global-warming attitudes with residents of industrial-proximity ZIP codes indicating somewhat less concern over issues tied to global warming than residents of greener ZIP codes (M = 2.78 vs. 2.45; t (151) = 1.995, p = .048). In contrast, residents of industrial-proximity ZIP codes reported substantially higher negativity vis-à-vis local environmental conditions (M = 3.059 vs. 1.96; t (141) = 7.236, p < .001). Qualitative responses were consistent with this local-global contrast. While lower-resource respondents expressed high levels of concern over the impact of rising heat, air quality, limited cooling resources, and the lack of responsiveness of local government to the immediate concerns of residents in their communities, higher-resource respondents expressed less concern due to access to air conditioning, tree cover, parks, or private amenities. The findings thus suggest that localized environmental vulnerability and broader climate concern need not move together. Because the sample was community-recruited and not probability-based, results should be interpreted as exploratory rather than population-representative.

INTRODUCTION

2.1 Study Context and Motivation

While public acceptance that *climate change is occurring* has increased over recent decades, substantial disagreement remains regarding causes, urgency, and policy responses (Marquart-Pyatt et al., 2011; Leiserowitz et al., 2013). The most recent Global Warming's Six Americas report, for example, classifies 25% of U.S. adults as *Alarmed* and 27% as *Concerned*, for a combined 52% in these two segments (Leiserowitz et al., 2026). The Alarmed segment increased from 11% in 2015 to 25% in 2025. At the same time, sizable *Disengaged*, *Doubtful*, and *Dismissive* segments persist, underscoring continued heterogeneity in public climate attitudes.

Public opinion, however, is only one level at which people encounter environmental change. Residents also evaluate the quality of the air they breathe, the amount of shade and vegetation around their homes, the intensity of summer heat, the location of industrial activity, and the availability of public or household resources that help them cope with environmental stress. These judgments are more immediate than general beliefs about rising heat as a global phenomenon. The distinction matters because it suggests that while an individual can easily recognize the serious environmental problems that impact his/her

neighborhood, the same individual can, at the same time, remain less engaged with, or more skeptical about, the broader political and scientific language of climate change. Conversely and somewhat paradoxically, a person living in a neighborhood with comparatively greater environmental amenities and fewer daily environmental burdens can express stronger concern about global warming than an individual experiencing more direct impact. Treating these two kinds of judgment as identical can therefore obscure meaningful differences in how environmental risk is experienced and interpreted.

The present study thus examines the opinions of residents representing two preselected, but different resource level ZIP-code clusters in North Carolina that differ in terms of their proximity to industrial activity, their respective level of physical and financial resources, and the level of vegetation and overall greenspace associated with each type neighborhood. These distinctions are believed to be influential in understanding how residents of different neighborhood types develop attitudes toward a macro level issue such as global warming, and their impression of the local impact of global warming. Rather than assuming that greater local environmental burdens automatically produce stronger global climate concern, the current exploratory study separates global concerns from local concerns. Confirmatory findings will thus add credence to environmental-justice research which has long noted the disparity between resource abundant and resource poor neighborhoods in terms of exposure, adaptive resources, and government attention. By comparing broad climate attitudes with perceptions of local heat, air quality, industrial development, and coping resources, the study seeks to clarify whether the people who report the most difficult local environmental conditions are also the people who report the strongest general concern about global warming.

2.2 Purpose And Research Questions

The project concentrated on environmental monitoring and urban heat assessment in preselected neighborhoods associated with high industrial concentration and low tree and green-space density. The sample was drawn from ZIP codes selected for physical monitoring by the climate science team (i.e., the individuals conducting the heat index and air quality assessment). The social science content of the project follows by comparing both the respective generalized ecological attitudes, and, the perceptions of local environmental conditions of the residents represented by the two preselected clusters of ZIP codes used in the assessment of heat index and air quality. The current research hoped to determine whether residents of different neighborhood types as represented by the two ZIP-code clusters (i.e., one type based on proximity to industrial zones and the other in neighborhoods classified as having high levels of greenery, lakes, and tree cover) would differ in their respective perceptions of broader climate-related concerns (i.e., global warming) and perceptions of the prevailing environmental conditions of their neighborhood vis-à-vis rising heat and air quality. The purpose of the present study was therefore twofold: First, the study explored whether the two neighborhood types differ in their broader perceptions regarding general climate-related issues; and second, the study examined whether residents of at-risk industrial communities perceive local environmental conditions differently than residents of the generally higher-resource, greener neighborhoods used in the study. The exploratory nature of the study focused on two primary research questions:

R1: Do residents of lower-resource, industrial-proximity neighborhoods differ from residents of higher-resource, greener neighborhoods in their perceptions of broader climate-related concerns?

R2: Do residents of lower-resource, industrial-proximity neighborhoods perceive local environmental conditions more negatively than residents of higher-resource, greener neighborhoods?

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These questions are exploratory but also consequential. A finding that the two ZIP clusters differ strongly on local environmental conditions but only modestly on broader climate attitudes would suggest that environmental vulnerability and climate-issue salience should be analyzed as related but distinct constructs. While any finding from the current exploratory research should be examined in greater depth, if differences in the two domains are demonstrated, then researchers and policymakers are cautioned against interpreting neighborhood-level environmental concern as indicative of synonymous, ideological agreement with those who prioritize global warming as a major priority. The mixed-methods design uses quantitative scales to establish the direction and magnitude of between-cluster differences on attitudes toward global warming in general, while the open-ended responses hopefully indicate how residents describe heat, green space, coping, emergency services, and government responsiveness.

PAST WORK

3.1 Climate Change Attitudes And Skepticism

Research on climate-change skepticism has examined a number of ideological, socioeconomic, and psychological mechanisms that can shape acceptance of climate science and policy preferences (Bliuc et al., 2015; Cipriani et al., 2024; Gounaridis & Newell, 2024). The literature includes but is certainly not limited to the following themes:

- *Ideological and Political Alignment* includes such areas of study as: *Partisan identity* (Cipriani et al., 2024); *Anti-reflexivity* (Gounaridis & Newell, 2024); and *Free-market fundamentalism* (Bandeali et al., 2025) which encompass individual skepticism based on one's ideological/political alignment and economic orientation.
- *Socioeconomic and Industry Influences* includes such areas of study as: *Vested financial interests* (Bandeali et al., 2025); and, *Regional economic dependency* (Lübke, 2022). This type study

investigates the socioeconomic and industry influence that the fossil-fuel industry potentially exerts over local and regional economies highly dependent on oil and gas exploration and refining operations.

- *Psychological and Cognitive Drivers* type research include the study of: *Identity-protective cognition* (Bandeali et al., 2025); *System Justification* (Wong-Parodi & Feygina, 2020); and *Conspiracist ideation* (Tam & Chan, 2023). This stream of research investigates generalized mistrust of institutional authority and individual or group motivations to defend an existing worldview.

Identity and motivated reasoning provide one explanation for why generalized climate attitudes may remain relatively stable even when people encounter environmental stress. Bliuc et al. (2015), for example, emphasize the role of conflicting socio-political identities, while Wong-Parodi and Feygina (2020) discuss the motivated roots of climate-change denial and the tendency to protect existing values or systems. Tam and Chan's (2023) review further identifies links between one's propensity to accept conspiracy theories and/or tendency toward rejection of contrary evidence, and the development of climate-change beliefs. In other words, while people may not ignore direct experience, the experience itself is often interpreted in a broader context that may include prior identification with trusted social, political and institutional parties. Hence, residents may remain skeptical even though they understand from personal experience that their neighborhood is hotter, less green, or more polluted than other, wealthier neighborhoods—thus refusing to accept opposing climate narratives that conflict with their existing worldview.

3.2 Environmental Justice And Neighborhood Inequality

Environmental-justice scholarship provides a second foundation for the study. A large body of research has examined whether environmental hazards and undesirable land uses are unequally distributed across racial and socioeconomic groups. This stream of research not only documents disparities in exposure to pollution and hazardous facilities but emphasizes the importance of considering both the social composition of communities and the historical processes through which environmental burdens become concentrated (Mohai & Bryant, 1992; Bullard et al., 2008; Mohai & Saha, 2006, 2015; Ringquist, 2005). This literature is therefore directly relevant to industrial-proximity neighborhoods because the presence of industrial facilities, major roads, impervious surfaces, and limited vegetation can create a combination of environmental burdens that residents encounter in everyday life.

Additionally, since the environmental-justice perspective addresses the hazards associated with proximity to industrial areas while simultaneously directing attention to the resource disparity that typically exists between individuals living in different type neighborhoods, the EJ perspective helps aid in explaining why the residents of some neighborhoods are better able to cope with similar weather events and environmental conditions than others. One of the reasons for the disparity might be explained by the fact that neighborhoods often differ substantially in tree canopy, housing quality, access to air conditioning, transportation options, nearby parks, social services, and the ability of residents to absorb higher utility costs—offering further explanation as to why higher resource neighborhood residents are

generally better able to absorb the impact of simultaneously occurring heat events. These differences may also underscore one's perceived level of vulnerability because exposure and coping capacity appear to operate together.

A resident's perception of the local conditions of his/her own neighborhood also likely incorporates direct and simultaneous observations that may include any number of these residents' contact points to include: residents taking note of the level of industrial development and/or the odor emanating from effluents in the air when compared to other areas of the city or urban environments; residents taking notice of the lack of vegetation and tree cover observed in their neighborhoods as compared to other neighborhoods; and, the collective lack of confidence in emergency or municipal services when called on to respond to extreme heat. The *Conditions* measure and the open-ended questions in the present study were thus designed to capture this type localized level of environmental experience.

3.3 Urban Heat Air Quality and Local Vulnerability

The Texas A&M University School of Public Health describes urban heat islands as areas in the city or suburban landscape that are "formed through a combination of land-use changes, infrastructure choices and human activities that alter how cities absorb, retain and release heat" (Texas A&M University School of Public Health, 2026). Many low-income industrial areas are often so named because many exhibit the high concentration of asphalt, concrete, and "dark roofs" associated with the absorption and trapping of solar radiation during the hottest points of the day, only to be released slowly at night. These zones typically have fewer trees, parks, and shaded areas that provide evaporative cooling and are instead subject to factories, heavy machinery, and dense vehicle traffic releasing anthropogenic waste heat directly into the local environment. Heat islands are characterized by loss of vegetation, heat-absorbing materials, dense development, and waste heat from human activity, including air-conditioning (Hsu et al., 2021; Texas A&M University School of Public Health, 2026). From a human-health perspective, residents of such areas face greater risks from extreme heat, degraded air quality, and strain on energy systems during heat events. Because urban heat also tends to be unevenly distributed, low-income and industrial-proximity communities often experience greater heat burdens than better-resourced neighborhoods (Hsu et al., 2021; Texas A&M University School of Public Health, 2026).

The report further argues that residents of industrial neighborhoods may face compounded health risks because heat exposure can overlap with poorer air quality, barriers to healthcare, lower-quality housing, and limited access to cooling resources. Climate change can raise baseline temperatures and increase the frequency, duration, and intensity of heat waves, while urban heat islands can further intensify local heat exposure. Together, these processes can strain infrastructure and public-health systems and increase heat-related vulnerability (Hsu et al., 2021; Texas A&M University School of Public Health, 2026).

Again, because environmental burdens associated with extreme heat are not evenly distributed across urban populations, lower-income households concentrated in urban areas where heat-island effects are the most pronounced often suffer disproportionately when compared to residents of neighborhoods with greater tree and vegetation cover that can reduce heat more effectively than areas dominated by

impervious surfaces (Hsu et al., 2021; Jesdale et al., 2013). Further, residents of neighborhoods with less green space face the compounded effects of being exposed to both heat and air pollution (such as major roadways or industrial facilities). In addition to potential physical health risks, extreme heat can create financial stress for lower-income households, particularly when residents live in less energy-efficient homes that require more energy to cool.

Although the present study measures residents' perceptions rather than clinical outcomes, these overlapping exposures may contribute to greater health vulnerability. On the other hand, given that the distribution of urban heat is shaped by numerous socioeconomic, geographic, and built-environment factors, the present study does not infer that proximity to industrial areas alone causes chronic disease or thermal stress (Hsu et al., 2021).

3.4 Local Environmental Experience And Broader Climate Concern

Research indicates that localized environmental stressors tend to be psychologically immediate and concrete, while broader climate narratives are often abstract or politically mediated (Bliuc et al., 2015; Hamilton & Stampone, 2013; Lowe et al., 2006; Myers et al., 2013; Shao et al., 2016). This sometimes, *dramatic* difference between reality and conceptual or abstract reality may therefore help explain why environmental burden and climate-issue salience do not always align as expected. As example, individuals facing significant localized environmental challenges likely prioritize immediate concerns related to economic stability and affordable housing, access to transportation, or neighborhood safety over broader discussions relating to sometimes esoteric global environmental issues. This may help explain why the stress that often results from exposure to local environmental hazards does not necessarily predict an individual's engagement with broader climate-change concerns.

The role, if any, that an individual's personal experience with severe local weather events plays in the formation of one's attitude on broader climate issues therefore needs further investigation. Although Myers et al. (2013), Hamilton and Stampone (2013) and Shao et al. (2016) indicate that incoming climate/weather information relating to local weather conditions often interacts with broader beliefs about the climate, Lowe, et. al. (2006), notes that having lived through a weather disaster does not automatically translate into sustained public engagement with climate change. Taken together, the current research effort suggests that while experience can influence beliefs, it does not function as a uniform cause in the formation of climate attitudes. Further, the cause assigned to each experience appears dependent on how that experience is interpreted by the individual. In other words, does the individual even interpret the experience as a weather event? If the neighborhood's air quality is considered poor, do the individuals living in that neighborhood attribute the cause to localized industrial pollution, or, could the poor air quality be the result of yet another in a myriad of infrastructure failures resulting from the non-responsiveness and poor planning of local government? Before attributing a harmful weather event to climate change, low resource residents might need to mentally evaluate a litany of other probable causes associated with living in close proximity to an industrial zone.

As previously noted, while experience (with adverse weather conditions) likely *does* play a role in influencing one's position on global warming, it is less robust in explaining how the individual develops his/her overall climate attitude. This uncertainty is particularly important in lower-resource communities since residents who confront multiple day-to-day financial and structural deficits likely concentrate more on the *results* of a weather hazard than on the cause itself (i.e., such as an unaffordable cooling bill, the lack of shade, unpleasant air, or concern about local government response). In contradistinction to their lower resource neighbors, higher resource individuals likely "weather these storms" differently due to the disparity in resources—allowing wealthier neighborhood residents the luxury of focusing on the cause. Hence, while the environmental concerns of lower resource individuals may accurately reflect awareness of the cause of rising heat, they are likely less focused on climate advocacy than their wealthier counterparts. Conversely, it is expected that those who do express stronger generalized climate concerns will also report that household air conditioning, tree cover, parks, or private amenities make local heat more manageable.

The current study therefore treats the possible local-global contrast as an empirical question rather than ranking one type of concern as more authentic than another. We therefore examine whether abstract climate attitudes and localized environmental vulnerability align across the two neighborhood clusters.

3.5 Hypotheses

Two hypotheses were developed. The first concerns broader attitudes toward global warming, whereas the second concerns perceptions of local environmental conditions associated with heat, air quality, industrial proximity, and neighborhood infrastructure. The distinction is important because local environmental burdens and broader climate concern are related but not interchangeable constructs. The hypotheses therefore test whether the two ZIP clusters differ on these two levels of perception.

The first hypothesis investigates each group's Attitude Toward Global Warming (ATTGW) using five climate-skeptical survey items intended to distinguish stronger climate concern from greater climate skepticism. The second hypothesis compares perceptions of local environmental conditions across the two neighborhood clusters.

H1: Residents of lower-resource, industrial-proximity neighborhoods (ZIP Cat 1) will express less concern about global warming than residents of higher-resource, greener neighborhoods (ZIP Cat 2).

H1 is directional because the study anticipated that residents of the lower-resource, industrial-proximity cluster could place comparatively greater emphasis on immediate economic and neighborhood concerns than on generalized global-warming concern. The hypothesis does not imply that ZIP Cat 1 residents reject climate change; the ATTGW scale is interpreted continuously, and the location of both group means relative to the scale midpoint remains important when evaluating the result.

H2 is also directional, but it concerns a different construct. It predicts that residents of the industrial-proximity cluster will evaluate their H2: Residents of lower-resource, industrial-proximity neighborhoods

(ZIP Cat 1) will report more negative local environmental conditions than residents of higher-resource, greener neighborhoods (ZIP Cat 2).

immediate environmental conditions more negatively, reflecting the neighborhood features that motivated the larger project's physical monitoring of heat and air quality. Support for H2 would therefore indicate a perceived local environmental disadvantage, not proof that a particular industrial source caused the reported conditions or that those conditions were caused by global warming.

METHOD

4.1 Research Design And Community Context

The study used an exploratory mixed-methods design in which community focus-group input informed development of an online questionnaire that combined closed-ended scales with open-ended questions. The design was appropriate to the project's central distinction between generalized climate attitudes and localized environmental experience. Closed-ended items provided comparable measures across the two ZIP clusters, whereas open-ended questions allowed respondents to describe coping behavior, green space, behavioral effects of heat, emergency-service availability, and government responsiveness without being limited to the response categories of the quantitative scales. The qualitative component is therefore used to add context to the statistical comparisons rather than to claim a separate population-representative qualitative sample.

4.2 Focus Groups And Survey Development

Three focus-group sessions were held in facilities provided by community partners. Input from those sessions was used to inform the survey, particularly the items dealing with local environmental conditions. This community-informed development process was intended to ensure that the questionnaire addressed neighborhood features residents considered salient, including air quality, industrial concentration, tree cover and green space, concrete and impervious development, truck exhaust, odors, and patterns of industrial zoning. The resulting survey retained a distinction between questions about global warming and questions about the respondent's immediate community. That separation allowed the study to test whether broader climate attitudes and local environmental assessments produced the same or different neighborhood patterns.

4.3 Sample And Recruitment

The survey was disseminated with assistance from local environmental agencies, city council members, and community representatives through community email lists and outreach links. Approximately 30 additional responses were collected at a local Earth Day event. In total, 153 usable surveys were obtained: 89 (58.2%) from ZIP Cat 1 industrial-proximity/lower-resource areas and 64 (41.8%) from ZIP Cat 2 greener/higher-resource areas. Recruitment was community-based rather than probability-based. The resulting sample is therefore appropriate for exploratory comparison within the recruited

respondents but should not be interpreted as a representative estimate of attitudes or environmental conditions for all residents of the selected ZIP codes or for North Carolina more broadly.

The two clusters also differed in respondent and area-level characteristics. ZIP Cat 1 respondents were generally younger and more often identified as African American, while ZIP Cat 2 respondents were older, more often identified as White/Caucasian, and had higher educational attainment. Area-level indicators reported for the ZIP clusters also suggest substantial differences in household income, home values, educational attainment, and poverty. These characteristics are important context for interpretation because the present statistical tests compare cluster means without multivariable adjustment. Consequently, observed differences may reflect a combination of neighborhood environment, socioeconomic context, demographics, recruitment patterns, and other unmeasured factors.

4.4 Measures

The five items composing the Attitude Toward Global Warming (ATTGW) measure were rated on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). Because each item is worded in a “climate-skeptical” direction, higher ATTGW scores indicate greater skepticism/lower climate concern, whereas lower scores indicate greater climate concern:

- Naturally occurring phenomenon such as solar activity and volcanoes, etc., has a much greater impact on increasing greenhouse emissions/global temperatures than anything man is doing.
- We should fully utilize our fossil fuel reserves to bring down the cost of energy.
- Manmade CO2 emissions have had little impact on global temperatures.
- Most news reports about the threat posed by global warming have been drastically overstated.
- Global warming is not one of the issues that “keep me up at night.”

The five ATTGW items produced Cronbach's alpha of .849 in the present sample, indicating strong internal consistency for the combined measure. Because all items are oriented toward skepticism or reduced concern, interpretation of the scale direction is straightforward but counterintuitive relative to many pro-environmental measures: a higher mean represents greater skepticism and a lower mean represents greater climate concern. This coding direction is carried through the results table and discussion to avoid interpreting a numerically higher score as stronger environmental concern.

The Conditions measure assessed respondents’ perceptions of environmental conditions in the community where they live. Items were developed from ZIP Cat 1 focus-group input and were rated on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree), with higher scores indicating more negative perceived local environmental conditions. Cronbach’s alpha for the ten-item measure was .922. The scale was labeled Conditions:

- The air quality in my neighborhood/community is worse than in other parts of the city where I live.

- The concentration of industrial facilities/plants is higher in my community than in other areas of the city where I live.
- I know many individuals in my community who suffer from breathing issues (such as shortness of breath, asthma, chronic coughing).
- The level of tree covering and greenspace in my community seems to be lower than in other, more affluent parts of the city where I live.
- There is generally more concrete (i.e., more highways, parking lots, and more industrial development) in my neighborhood than in most other urban areas of the city where I live.
- There seem to be more industrial facilities in my part of the city than in other parts of the city where I live.
- The air quality seems to be worse where I live than in other areas of the city.
- Residents in my immediate area often have to deal with “smelly” air.
- There seems to be a lot more truck exhaust and industrial air pollution in the area where I live than in other areas of the city where I live.
- Most of the newest development in my area of the city appears to be zoned for industrial use.

The ten Conditions items produced Cronbach's alpha of .922 in the present sample, indicating high internal consistency. The items focus on comparative neighborhood perceptions rather than objective measurements. Several ask respondents to judge their neighborhood relative to other parts of the city, while others address specific observable features such as industrial facilities, truck exhaust, odors, concrete, green space, and perceived industrial zoning. Higher composite scores therefore represent a more negative assessment of local environmental conditions. The scale should be interpreted as perceived neighborhood environment; it is not a substitute for instrument-based air-quality or heat measurements.

4.5 Analytical Approach

Quantitative comparisons between ZIP Cat 1 and ZIP Cat 2 used independent-samples t tests for the ATTGW and Conditions composite measures. Statistical significance was evaluated using the reported p values, and effect-size r was calculated from the reported t statistic and degrees of freedom to provide an indication of the magnitude of the group difference. For ATTGW, the analysis tests whether the cluster means differ in generalized climate skepticism/concern. For Conditions, the analysis tests whether the clusters differ in perceived local environmental quality. Because the design is cross-sectional and observational, these tests identify associations between ZIP-cluster membership and reported perceptions; they do not establish causal effects of industrial proximity, socioeconomic status, or climate change.

RESULTS

5.1 Sample And ZIP Cluster Characteristics

The dataset included two ZIP-code clusters: ZIP Cat 1, representing lower-resource ZIP areas, and ZIP Cat 2, representing higher-resource ZIP areas. In this sample, ZIP Cat 1 respondents were determined to be younger and more often identified as African American. ZIP Cat 2 respondents, on the other hand, were older, more often identified as White/Caucasian and had higher educational attainment.

Respondent-level and area-level characteristics should be distinguished. For ZIP Cat 1 (lower income), the respondent median age was 32.1. At the area level, the combined population was 54,303; median home values ranged from $174,900 to $204,400; median household income was approximately $59,563; and the poverty rate was approximately 20%. The typical ZIP Cat 1 respondent was younger, female, African American, and reported some college education. The sample also contained a larger lower-income share than ZIP Cat 2. ZIP Cat 2 was more suburban and associated with higher home values, higher educational attainment, and lower poverty levels (than ZIP Cat 1).

At the area level, median household income across ZIP Cat 2 ranged from approximately $85,291 to $94,349, and median home values ranged from approximately $338,600 to $494,349. Approximately 64.5% of adults had a bachelor's degree or higher, and the poverty rate was approximately 7.2%.

These characteristics show that the ZIP-cluster comparison is also a comparison of different social and neighborhood contexts. The descriptive contrasts are relevant to both hypotheses but should not be treated as covariate-adjusted explanations for the results. In particular, the present analysis cannot determine whether differences in *ATTGW* or *Conditions* are attributable specifically to industrial proximity, resource level, age, race/ethnicity, education, income, or another correlated feature of the two clusters. The findings below therefore retain the cluster labels rather than assigning causal interpretation to any one characteristic.

5.2 Attitude Toward Global Warming

Cronbach's alpha for the five ATTGW items was .849. An independent-samples t test showed a small difference in ATTGW scores between ZIP Cat 1 ($M = 2.78$) and ZIP Cat 2 ($M = 2.45$), $t(151) = 1.995$, $p = .048$, $r = .16$. Because higher ATTGW scores indicate greater skepticism/lower climate concern, ZIP Cat 1 respondents expressed somewhat less concern about global warming than ZIP Cat 2 respondents. While group means were below the scale midpoint of 3 for both ZIP clusters (indicating overall disagreement with the skeptical statements), the difference was statistically significant. H1 was therefore supported.

The numerical pattern is important for interpreting H1. Although ZIP Cat 1 had a higher skepticism score, neither group mean was above the neutral midpoint of 3.00. Thus, the statistically significant difference is a relative difference between the two groups since both leaned away from the skeptical statements. The effect-size estimate ($r = .16$) is small, indicating that neighborhood-cluster membership accounts for only a modest separation in the ATTGW distributions. The result supports H1 in the predicted direction, but the magnitude does not justify characterizing ZIP Cat 1 respondents as broadly dismissive of global

warming. If anything, the Zip Cat 1 respondents were aware of and concerned with the issue of global warming.

5.3 Perceived Environmental Conditions

An independent-samples t test showed a substantial mean difference in Conditions scores between ZIP Cat 1 (M = 3.059) and ZIP Cat 2 (M = 1.96), t(141) = 7.236, p < .001, r = .52. ZIP Cat 1 respondents reported more negative local environmental conditions than ZIP Cat 2 respondents. H2 was supported.

The Conditions result is substantially larger than the ATTGW difference. The mean for ZIP Cat 1 was more than one scale point higher than the mean for ZIP Cat 2, and the effect-size estimate (r = .52) indicates a strong separation in reported local environmental conditions relative to the first hypothesis. This pattern is consistent with the study's central distinction: the clusters differed much more sharply in perceptions of their immediate neighborhood environment than in their generalized global-warming attitudes. The result supports H2, while remaining a comparison of perceived conditions rather than direct environmental measurements as shown in Table 1.

Table 1
Independent-Samples t-Test Results by ZIP Cluster

Construct	Group Comparison	t	df	p	Mean Difference (effect-size r)
ATTGW (higher = greater skepticism/lower concern)	ZIP Cat 1 (M = 2.78) vs. ZIP Cat 2 (M = 2.45)	1.995	151	.048	0.337 (r = .16)
Perceived Environmental Conditions	ZIP Cat 1 (M = 3.059) vs. ZIP Cat 2 (M = 1.96)	7.236	141	< .001	1.099 (r = .52)

Note. Positive mean differences indicate higher scores in ZIP Cat 1. Effect-size r was computed from the reported t statistic and degrees of freedom.

5.4 Open Ended Findings

In addition to the quantitative items used to test the hypotheses, the questionnaire included open-ended questions intended to elicit respondents' own descriptions of heat exposure, coping resources, neighborhood conditions, emergency services, and government responsiveness. The patterns below are presented as descriptive qualitative summaries by ZIP cluster.

Summer Heat Coping. Question: *Please describe some of the ways people in your immediate community "deal with" rising heat during the summer months. In other words, what type of activities have you observed people in your community engaging in, in order to help offset the impact of rising temperatures?*

ZIP Cat 1 (Industrial-Proximity/Lower-Resource Neighborhoods): More references to pools or water activities, hydration, fans, and public or informal coping. Some mentioned staying indoors, but this appeared less dominant than in ZIP Cat 2. ZIP Cat 2 (Greener/Higher-Resource Neighborhoods): More

references to air conditioning, staying inside, avoiding the hottest part of the day, and using private amenities such as pools or shaded/green neighborhoods.

Parks And Green Space. Question: *In your opinion, are there enough parks and/or sufficient green space available in your immediate area to help residents offset some of the effects of increased heat during the summer? Please elaborate on why you feel as you do.*

ZIP Cat 1 (Industrial-Proximity/Lower-Resource Neighborhoods): Many recognized parks and greenways, but comments more often raised access problems, lack of nearby greenspace, and the need for cooling stations or water access. ZIP Cat 2 (Greener/Higher-Resource Neighborhoods): More likely to describe their immediate area as green, tree-covered, or park-accessible, though some still noted construction, uneven access, or that other, lower-resource neighborhoods are worse off.

Heat Anxiety And Antisocial Behavior. Question: *In your opinion, have the higher temperatures experienced during the summer (over the past few years) increased the level of anxiety/anti-social behavior among the residents of your community? In other words, what behavioral consequences can you attribute to increased heat in your neighborhood during the summer months?*

ZIP Cat 1 (Industrial-Proximity/Lower-Resource Neighborhoods): More likely to connect heat with stress, irritation, anxiety, staying indoors, and less socialization. Some also mentioned anger, frustration, or crime indirectly. ZIP Cat 2 (Greener/Higher-Resource Neighborhoods): More likely to say that they had not observed major behavioral change, or that effects were limited. When effects were mentioned, they focused on irritability, anxiety, or people simply staying inside.

Emergency Services. Question: *In your opinion are there sufficient emergency resources (such as EMS or fire stations) available to people in your community should residents experience a sudden, intense heat wave? Please elaborate.*

ZIP Cat 1 (Industrial-Proximity/Lower-Resource Neighborhoods): Some mixed comments but also somewhat more concrete. Respondents often mentioned lack of EMS, fire stations, hospitals, and poor response times. Some ZIP Cat 1 respondents questioned whether existing government services could handle extreme heat. ZIP Cat 2 (Greener/Higher-Resource Neighborhoods): The comments were mixed, but most respondents said they were unsure about the sufficiency of local government resources. While some respondents indicated that resources were nearby and sufficient, others were unsure of what type services were available. Several respondents acknowledged that low-income neighborhoods may not have the same level of service. Many respondents were unsure of the level of service available because they had never needed or requested assistance.

Government Responsiveness. Question: *In your opinion, is the city government where you live responsive to the needs of people in your neighborhood when it comes to providing climate-related services (e.g., shelters for people who have difficulty coping with extreme heat)? Why do you say that?*

ZIP Cat 1 (Industrial-Proximity/Lower-Resource Neighborhoods): Expressed higher levels of concern about the lack of shelters, the lack of outreach, the impact on homeless and vulnerable residents, and expressed frustration with the perceived lack of city responsiveness. ZIP Cat 2 (Greener/Higher-Resource Neighborhoods): Respondents were more likely to say that they had not observed. ZIP Cat 2 respondents expressed similar levels of skepticism toward government services, but often framed their responses as uncertainty or lack of awareness. Some respondents said government services may exist, but they did not know much about them.

The qualitative patterns were broadly consistent with the quantitative differences in perceived local environmental conditions. These results, however, should be interpreted descriptively rather than as statistically representative. Across open-ended responses, ZIP Cat 1 respondents were more likely to describe heat and air-quality concerns in terms of resident vulnerability, limited resources, and service needs than ZIP cat 2 respondents. ZIP Cat 2 respondents more often described access to household or neighborhood coping resources than ZIP CAT 1 respondents. ZIP Cat 1 respondents more frequently mentioned stress, reduced social activity, limited access to cooling, water, shelter, or transportation, and concerns about emergency or city services. In contrast, ZIP Cat 2 respondents more often referred to access to air conditioning, tree cover, parks, and private amenities. Some ZIP Cat 2 respondents also expressed uncertainty about emergency preparedness and city responsiveness and/or concern for lower-resource neighborhoods.

These differences are best treated as thematic patterns in this sample, not as evidence that all residents in either ZIP cluster share the same views. Overall, the open-ended responses suggest that ZIP Cat 1 respondents were more likely to frame rising heat as a community vulnerability and equity issue, while ZIP Cat 2 respondents were more likely to frame rising heat as a manageable inconvenience that is buffered by household or neighborhood resources.

DISCUSSION

6.1 Summary And Interpretation Of Findings

This study compared broader climate-related attitudes and perceived local environmental conditions across two neighborhood types: lower-resource, industrial-proximity ZIP codes and higher-resource, greener ZIP codes. Respondents from the industrial-proximity cluster reported more negative local environmental conditions and described fewer resources for coping with heat and air-quality concerns. Respondents from the greener cluster reported fewer local environmental burdens and more access to household or neighborhood coping resources. These findings are consistent with environmental-justice research showing that environmental burdens and adaptive resources are unevenly distributed across communities, but the cross-sectional, nonprobability design supports inference about perceptions in this sample rather than causal effects or population-level prevalence.

H1 concerned broader attitudes toward global warming. The ATTGW items were coded so that higher scores reflected greater skepticism/lower climate concern. ZIP Cat 1 respondents had a higher mean ($M = 2.78$) than ZIP Cat 2 respondents ($M = 2.45$), $t(151) = 1.995$, $p = .048$, $r = .16$. The difference was small, and both groups, on average, disagreed with the skeptical statements, indicating general concern about global warming in both groups.

H2 concerned perceived local environmental conditions. ZIP Cat 1 respondents reported more negative conditions than ZIP Cat 2 respondents ($M = 3.059$ vs. 1.96; $t(141) = 7.236$, $p < .001$, $r = .52$). Open-ended responses showed a similar pattern, with ZIP Cat 1 respondents more frequently describing heat, air quality, limited cooling resources, and city-service needs as immediate community concerns. These results should be interpreted as differences in reported perceptions and lived experience rather than as direct evidence that global warming caused the observed local conditions.

Taken together, the findings reveal a clear asymmetry. The largest between-cluster difference concerned the immediate environment, not the abstract climate-attitude measure. ZIP Cat 1 respondents described substantially worse local conditions and more constraints in coping with heat, yet their generalized climate concern differed from ZIP Cat 2 only modestly. This is the local-global contrast at the center of the study. It suggests that environmental vulnerability should not be inferred from climate ideology and, conversely, that climate concern should not be used as a substitute for measuring lived environmental conditions. People can experience and recognize neighborhood environmental burdens while interpreting global climate questions through a different set of political, economic, psychological, or informational considerations.

The H1 result should therefore be interpreted cautiously. A statistically significant p value at .048 indicates evidence of a mean difference in this sample, but the effect size is small and both means remain on the concern side of the scale midpoint. The practical conclusion is not that industrial-proximity residents are unconcerned about global warming. Rather, the data indicate a modest relative difference in endorsement of climate-skeptical statements. Given the demographic and socioeconomic differences between the clusters, as well as the nonprobability recruitment process, the study cannot identify why that difference emerged. Political identity, economic priorities, trust, education, age, recruitment source, and neighborhood context are all plausible correlates that future multivariable research would need to examine directly.

H2 presents a more substantial and internally coherent pattern than was exhibited for H1. ZIP Cat 1 respondents, for example, reported more negative local environmental conditions, and the open-ended responses repeatedly returned to issues related to rising heat, poor air quality, the prevalence of industrial activity, limited access to cooling options, the lack of service access, and comments related to the lack of government responsiveness. This convergence is consistent with environmental-justice research emphasizing unequal distribution of environmental burdens and the lack of adaptive resources (Bullard et al., 2008; Mohai & Bryant, 1992; Mohai & Saha, 2006, 2015; Ringquist, 2005). The findings are also consistent with urban-heat research showing that thermal exposure varies within cities according to

land cover and the urban development environment (Hsu et al., 2021; Jesdale et al., 2013). The study adds a perception-based community perspective to existing literature by showing how residents describe these differences in relation to everyday coping ability.

6.2 Implications For Environmental Justice And Climate Communication

One of the major implications of the research findings relates to the idea that environmental-justice engagement may be more effective if and when it begins with locally recognizable conditions rather than assuming that residents must first endorse a particular global climate narrative. Questions about shade, truck traffic, odors, air quality, utility costs, parks, cooling access, and emergency response may therefore be directly connected to the daily lived experience. This does not require separating local environmental action from climate adaptation, but rather, suggests that communication should build upon the problems residents already identify. Communication should therefore explain how local heat, land use, infrastructure, and broader climate trends interact. Such an approach respects the possibility that people share concerns about their neighborhood problems even if residents may differ in their particular climate ideology or in the language they use to describe their feelings about climate change.

The qualitative results further suggest that one's adaptive capacity is an important part of perceived vulnerability. ZIP Cat 2 respondents more often described resources that can be employed to offset rising heat at the household or neighborhood level, including access to air conditioning, availability of tree cover, parks, shaded environments, and private amenities such as swimming pools. ZIP Cat 1 respondents were more likely to reference individual physical coping mechanism such as the importance of staying hydrated, the use of fans, availability of water activities such as public pools, cooling stations, public transportation assets, homeless shelters, and access to public-services.

The distinction is not simply between people who notice heat versus those who do not, but rather, the disparity in different resource environments for managing heat. While neighborhoods face the same regional temperature conditions, residents experience very different practical consequences due to the differences in available coping mechanisms.

6.3 Practical and Policy Implications

For local governments and community partners, the current research effort points toward interventions that can be evaluated at the neighborhood level. Some of the recommended solutions include expanding available tree canopy and shaded public space, improving access to cooling centers and public drinking fountains, coordinating transportation for residents who cannot easily reach emergency services, strengthening heat-emergency communication, and ensuring that emergency-response capacity is visible and trusted in vulnerable communities. Because respondents also raised concerns about air quality and industrial activity, heat planning should not necessarily be isolated from broader land-use, transportation, and environmental-monitoring strategies. A neighborhood experiencing heavy truck

traffic, limited green space, and high summer heat may benefit from coordinated rather than single-issue interventions.

These policy implications should remain proportional to the evidence. The survey did not evaluate the effectiveness of any specific cooling, tree-planting, emergency-response, or air-quality program, and it did not estimate the health benefit of a particular intervention. Accordingly, the findings identify areas for assessment rather than proving that one policy will solve all the observed disparities. The value of this research effort included identifying which issues residents associated with vulnerability, while pointing to the disparity of coping resources available to wealthier green neighborhood residents versus industrial proximity neighborhoods. These perceptions can assist local decision makers in formulating targeted questions for subsequent objective monitoring and program evaluation.

6.4 Limitations

The principal limitation is the nonprobability, community-based sampling strategy. Although the ZIP-code clusters correspond to areas monitored for air quality and heat, the respondent sample was disproportionately female and may overrepresent residents who are more engaged with community and environmental issues. Recruitment relied on local government agencies, community organizations, and approximately 30 responses obtained at a local Earth Day event; therefore, the sample should not be treated as representative of all residents in the selected ZIP-code clusters. Future research should use probability-based or stratified sampling, report response rates where possible, and test whether the observed differences remain after controlling for age, race/ethnicity, education, income, and gender. Linking respondent perceptions to objective neighborhood-level heat and air-quality measurements would also strengthen inference.

Several additional limitations follow from the measurement strategy. Both primary outcomes are self-reported and were collected in the same questionnaire, so they reflect respondents' perceptions at one point in time. The Conditions scale also includes comparative judgments about other parts of the city, requiring respondents to address statement items that are dependent on each participant's knowledge of places beyond their immediate neighborhood. Some items also tend to overlap conceptually, such as multiple statements related to industrial facilities and air quality. The high internal-consistency estimate is useful, but future work should examine the scale's dimensional structure, convergent validity with objective environmental indicators, and whether the same measurement properties hold across different neighborhoods and demographic groups.

6.5 Future Research

Future research should examine the physical and emotional toll that extreme heat may exert on vulnerable populations and evaluate coping strategies used in lower-income urban neighborhoods. A particularly important next step is to link resident perceptions to objective neighborhood-level heat and air-quality measurements and to test whether differences persist after adjustment for respondent demographics and socioeconomic characteristics. Such analyses could provide more actionable evidence for local policymakers.

A particularly useful next step would be a multilevel design that separates individual and neighborhood influences. Individual-level variables could include age, education, income, race/ethnicity, political orientation, housing characteristics, air-conditioning access, health vulnerability, and length of residence. Neighborhood-level variables could include measured temperature, tree canopy, impervious surface, traffic intensity, distance to industrial facilities, air-quality indicators, park access, and socioeconomic conditions. Modeling both levels simultaneously would help determine whether the observed ZIP-cluster differences remain after accounting for compositional differences between residents and whether objective neighborhood measures explain additional variation in perceived Conditions scores.

Longitudinal and seasonal data would also improve inference. Perceptions collected during or immediately after an extreme heat event may differ from perceptions collected in cooler periods, and repeated observations could show whether local experiences produce durable changes in climate concern or only short-term changes in salience. Linking survey waves to sensor-based heat and air-quality observations would permit researchers to compare perceived and measured environmental conditions directly. Where discrepancies appear, qualitative interviews could investigate why residents perceive risk differently from monitoring instruments, including the possible roles of odor, noise, traffic, past events, health experiences, trust, or neighborhood history.

6.6 Conclusion

The study's principal contribution lies in demonstrating that that broader climate concern and local environmental vulnerability can produce different patterns within the same community comparison. Residents of the industrial-proximity/lower-resource ZIP cluster reported substantially more negative local environmental conditions and described greater concern about heat, air quality, coping resources, and city services than the greener neighborhood cluster. And yet, the difference in generalized climate skepticism was comparatively small. Both cluster averages indicated disagreement with the skeptical ATTGW statements. The findings therefore argue against treating climate belief as a proxy for environmental burden, or assuming that residents who face greater local environmental stress will necessarily frame that stress through global climate narratives.

DECLARATIONS

Author Contribution

George Stone: Principle author. Made substantial contributions to the conception and design of the current research; Was chiefly responsible for the development of the survey instrument, in sample selection, collection and analysis of data, and the writing and editing, and submission of the final version of the document.Marc N. Fiddler: Made substantial contributions to the conception and design of the current research. Assisted in the the development of the survey instrument and assisted in the editing of the the document.Shree Dorestant: Made substantial contributions to the conception and design of the current research; Was chiefly responsible for recruiting participants for three focus group sessions. Assisted in the the development of the survey instrument. Was chiefly responsible for sample selection

and online survey dissemination .Solomon Bililign: PI for the Grant project. Provided financial support for focus group sessions. Assisted in the editing of the paper throughout all stages. Ademe Mekonnen: Made substantial contributions to the conception and design of the current research. Attended all three focus group sessions. Assisted in the the development of the survey instrument. Was actively involved with the editing process.

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Data Availability

Data is available upon request and is stored in an SPSS file on a university laptop.

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AI Statement

Generative AI was used to assist with the organization and language refinement of the qualitative summary. I used the university's licensed Chat Model to edit all drafts and to summarize the paper. I reviewed and edited every edit. All interpretations, conclusions, and final content were reviewed and approved by the authors, who take full responsibility for the manuscript. No confidential data entered any tool. All the statistical analysis was performed and reported by the principal author.

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