ANALYZING THE RELATIONSHIP BETWEEN GEOGRAPHIC LOCATION AND GREEN BEHAVIOR

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Abstract

This paper examines the disproportionate distribution of climate change effects across the U.S. and how vulnerability differences may shape a person's green behavior. Climate scientists are searching for ways to lessen these effects, and recent studies cite green behavior as a solution and policy tool. Current research focuses on what factors shape a person's willingness to engage in green behavior, including income, values, norms, demographics, exposure to media, and spatial dimensions. However, it fails to explore a relationship between an individual's green behavior and exposure to climate extremes due to their location. Communities within the United States are becoming more vulnerable to the effects, with some being more at risk than others; California faces extreme forest fires and Florida coasts experience flooding due to sea level rise. In this study, college students from four universities around the U.S. with differing levels of vulnerability were given a survey to report their environmental attitudes, behavior, and risk perceptions. Linear regression results suggest a highly statistically significant relationship between attitudes and green behavior. If green behavior can act as a tool to fight the climate crisis and increasing risks, it is crucial to understand how vulnerability may impact behavior.

Contents

1. Introduction

The severity and intensity of climate change impacts are increasing worldwide, resulting in its declaration as a public health crisis by multiple public health organizations (APHA 2019). The CDC has outlined the fact that climate change will intensify and create new risks, such as food insecurity, disease, and injuries or deaths due to extreme weather events (CDC 2021). With reporting on these events becoming more prevalent in the media, the public is gaining a general understanding of the effects associated with the issue (Brody et. al 2008). In February 2021, there was an unprecedented winter storm and "deep freeze" in Texas, leaving millions of citizens without power and heat (Gabbatiss & McSweeney 2021). Coastal communities in cities such as Miami, Florida, are facing "increasing and imminent risks" to flooding due to sea level rise, a climate change effect with heavy anthropogenic, or human-induced, influence (McAlpine and Porter 2018). Research shows that 16 million people living in U.S. coastal areas will be affected by sea level rise by the year 2100.

Although awareness is growing, climate change impacts are clearly not evenly distributed, raising questions about whether people living in less vulnerable areas understand the imperativeness of adopting changes to combat the crisis. Climate vulnerability can be described as exposure to or likelihood of natural disasters due to climate change (ND Global Adaptation Initiative 2018). Within the United States, coastal communities are affected by flooding and sea level rise, while the Midwest experiences less intense impacts, such as warmer temperatures and altering rainfall patterns (ibid.). A relevant example of intensifying climate vulnerability is the recent fire seasons in the state of California. Although forest fires are a natural occurrence, California has experienced a large and abnormal increase in wildfire activity (Williams et. al 2019). In the years 2017 and 2018, extreme forest fires occurred, reaching state records for

largest fires and leading to immense monetary and property losses. Research finds that these increases are predominately due to anthropogenic warming (Williams et. al 2019).

Climate extremes, such as wildfires, impose heavy costs on ecosystems, the economy, and public health. And as these risks continue to grow and affect more people, the more important it will be to find climate solutions. Although past research has focused on government regulations or renewable energy as critical structural solutions, researchers also have been studying "green behavior" activities on an individual level as another tool to fight climate change (Wynes & Nicholas 2017). Green behavior consists of actions that we personally, in our everyday lives, can take to curb the climate crisis. Some green behaviors have become the new normal, such as recycling. Today, researchers want to know what the motivating factors behind green behavior are, and how we get people to engage in it (Peattie 2010). However, current literature has failed to explore the possible connection between vulnerability and green behavior.

This thesis examines how the increase in climate change induced risk or vulnerability may impact green behavior. If a person is more exposed to climate change and its effects due to their geographic location, will they be more motivated to engage in green behavior? While there is limited research here, "researchers argue that public perceptions of risk are driving policy" (Brody et al. 2008).

I address the gap in green behavior and climate vulnerability research by asking: how does climate vulnerability associated with geographic location contribute to a person's willingness to engage in green behavior? Considering the expanding risks of climate change effects, the need to identify solutions, and the efficiency of behavior change to mitigate impacts, I hope to gain a more whole understanding of individual engagement in green behavior in areas of different vulnerability. In order to effectively do so, I have reviewed past literature to define

concepts and conducted a survey on green behavior. Although no statistically significant relationship was found between location and green behavior, data produced meaningful findings regarding attitudes and perceptions of vulnerability.

2. Relevant literature

2.1 Climate change and behavior change

Although focusing on behavior change as a tool to fight climate change is a relatively new idea, research on environmental behavior began as early as the 1970s (Peattie 2010). Then, it mainly studied what humans were putting out (pollution) via cars or fossil fuel consumption or minimizing waste through recycling and energy saving. As time went on and the world began to see the danger of environmental impacts, people became motivated to take action and make personal changes to lessen their direct impact (ibid.). Researchers and scientists want to know more about how this issue will affect us, what solutions exist, and how they can be put in place to combat the crisis.

Current research focuses on policies as a tool to fight the climate crisis. Researchers explore what government action is needed to curb the effects, such as committing to keeping temperature rise below 2 degrees Celsius or reaching net-zero carbon emissions by 2050. However, more recent and progressive studies explain how this method of tackling the climate crisis is inefficient. Implementing policy solutions, especially in countries that depend heavily on fossil fuels or are heavily polarized, can be an extremely long and difficult process (Wynes & Nicholas 2017).

Researchers want to examine the link between environmental damage and attitudes of consumers, and how these attitudes then contribute to environmental impact (Joseph 2019). Furthermore, they want to look at what the motivating factors are and what causes someone to

participate in “green behavior”. Another study takes it a step further, offering a new perspective in which government regulations and individual behavior should go hand in hand. While there is a gap between the two, crafting government policy and regulations can target individual behavior, contributing to more efficient solutions (Wynes & Nicholas 2017). Overall, green behavior research is growing, but there is still much more to be explored in terms of what specific factors can motivate people to engage in pro-environmental behaviors, and to what extent.

2.2 Green behavior: concepts, definitions, and motivations

Considering there is more research to be done on “green behavior”, there is no single, designated phrase or word to describe this concept perfectly. In many of the literature I found, authors would refer to it as “green consumption behavior” (Pagiaslis & Krontalis 2014), “sustainable consumption” (Jackson 2005), “pro-environmental behavior” (Joseph 2019), and more. For the purposes of this study, the terms “green behavior” and “pro-environmental behavior” will be used. In a 2010 Annual Review piece, Peattie defines green behavior as actions that are “oriented towards sustainable development”. Joseph (2019) defines pro-environmental behavior as “intrinsic and extrinsic deliberate responsive actions by individuals to protect the environment”. Using a more detailed definition, the UN Environment Programme’s describes sustainable consumption as:

“... a number of key issues, such as meeting needs, enhancing quality of life, improving efficiency, minimizing waste, taking a life cycle perspective and taking into account the equity dimension, for both current and future generations, while continually reducing environmental damage and the risk to human health” (UNEP 2001).

With both general and detailed definitions of green behavior, it is still difficult to completely understand. Still, researchers have multiple ways of measuring an individual's "green behavior".

One issue with attempting to measure this concept is that so many different factors go into living a sustainable lifestyle. For example, Wynes and Nicholas (2017) measure a person's sustainable behavior by looking at 4 simple, well-defined actions: having one fewer child, living a car-free lifestyle, avoiding airplane travel, and eating a plant-based diet. Here, green behavior is action-based and the authors believe only the most effective behaviors should be examined (Wynes & Nicholas 2017). In another study (Barr, Gilg, & Ford 2005), the authors chose to look at behavior in three clusters: purchase decisions (shopping, composting, and reusing), habits (water and energy use), and recycling. Rees and Wackernagel (1994) engaged in an ecological footprint analysis, which is an "aggregated indicator of the impacts of consumption", and this can be looked at for a city, a country, or even one single person. Although there is no regular definition provided in existing literature, categorizing green behavior and offering specific behavior changes as examples help to make this variable more measurable.

Just as different authors provide different definitions and ways to measure green behavior, they also provide different analyses of what motivates someone to engage in those changes. Joseph outlines the complexity of factors by dividing them into elements inside of a person's life and control (intrinsic) and elements outside of a person's control (extrinsic). Intrinsic motivators include psychology, education, values, and attitudes while extrinsic motivators include income, time, what effort is needed to engage in a behavior change, and societal relations or norms (Joseph 2019). Jackson (2005) suggests that in order for a person to engage in green behavior, they need incentive structures, institutional rules, access to pro-environmental actions, education, and reflective actions or policies by the government.

Peattie measures a wide range of motivating factors, from economic rationality, income, and "perceived consumer effectiveness", to environmental knowledge, attitudes, beliefs, values, lifestyle/habits, and social norms, to demographics, spatial dimensions, and exposure to the media. "Perceived consumer effectiveness", which is "the extent to which consumers believe that any action they can take has a meaningful impact on a particular issue" (Peattie 2010), is a popularly analyzed concept in green behavior studies, making contributions to understanding environmental psychology.

2.3 Geographic location and climate vulnerability

Prior research has mainly analyzed personal values, beliefs, norms, morals, and habits (Joseph 2019; Jackson 2005; Peattie 2010; Pagiaslis & Krontalis 2014) and their effect on consumer or green behavior. Thereafter, they study how to motivate people now, whether it be through education, persuasion, and habit changes (Jackson 2005), or through government action and policy recommendations (Wynes & Nicholas 2017). Elements such as age, sex, race, and location can be determinants of a person's willingness to engage in behavior changes.

Few sources (Peattie 2010) discuss geographic location and spatial analysis, and suggest that geography is a factor in pro-environmental behavior. There are noticeable differences in personal attitudes depending on what country they live in and what is provided there, the culture of their area, if they live in an urban or rural space, if they are far from a city and have to drive often, and more. However, there seems to be little research on to what extent a person's physical environment, location, and surroundings can contribute to their behavior.

We know that climate change is worsening, and research has shown that worldwide, overall vulnerability to climate change impacts has been increasing (IPCC 2012). These vulnerabilities can impose risks on human health, such as drought resulting in food insecurity

(Butler 2018). Because this risk is growing and people are becoming more aware of it, researchers study how humans perceive and react to this increase in vulnerability (Brody et. al 2008). It is a part of human nature to respond to risk or vulnerability. When we are aware of danger, we attempt to reduce our risk through behavior changes. Although there are limited studies focusing on green behavior and vulnerability together, there are many useful references analyzing how risk can play a role in human behavior and decision making. Risk perception is essentially how a person understands and weighs possible consequences of any action or issue (Cho & Lee 2006). In terms of climate change, a person's risk perception would then be their understanding of how climate change effects can and will put themselves in danger. Cho and Lee (2006) found that "when facing a high level of perceived risk, consumers make behavioral choices that will lower their vulnerability to potentially negative outcomes". From these findings, we can then think about how a person's perception of risk to climate change can affect their behavior choices and adjustments.

One study in particular concludes that place and proximity to climate change effects do lead to an increase in public perceptions of climate change impacts (Brody et. al 2008). This is an extremely important finding, as the author goes on to state that "researchers argue that public perceptions of risk are driving policy as much as technological and scientific risk assessments". And considering we need solutions to the climate crisis- possibly policy solutions targeting green behavior (Wynes & Nicholas 2017)- fully understanding vulnerability, perceptions of climate change impacts, and their relationship with green behavior motivation is crucial.

3. Methods

In order to test my hypothesis that green behavior would be higher in areas more vulnerable to climate change effects, I conducted a survey to measure green behavior

engagement. This data collection method was chosen because behavior is self-reported and measured on an individual basis. The survey asked respondents a series of questions regarding their personal green behavior and attitudes, as well as perceptions of their vulnerability to climate change effects. I targeted respondents from different locations with varying risks to climate change, so responses could be compared in order to evaluate how behavior and attitudes changed with varying vulnerability. The same survey questions were asked amongst respondents in each area.

Since this study focuses on vulnerability tied to location, the independent variable can also be referred to as geographic vulnerability. Geographic location was defined as an individual's position or residence and was measured using cities. Cities were chosen based on vulnerability to climate change effects using the University of Notre Dame's Global Adaptation Initiative (2018). The initiative includes a city matrix, where cities across the United States are ranked based on their climate risks and readiness. Here, "the vertical axis highlights a city's risk score and the horizontal axis highlights its readiness score" (ND Global Adaptation Initiative 2018). This source defines risk as a "city's vulnerability to climate change", and the assessment of risk includes exposure, sensitivity, and adaptive capacity. Exposure refers to the number of individuals and infrastructure endangered, which is geographic. Sensitivity refers to the extent to which this population can be affected. Adaptive capacity describes the city's ability to respond, and since this study only focuses on vulnerability and how it might affect green behavior, readiness or adaptive capacity was not addressed. Therefore, cities were chosen based only on their risk score and where they were located on the vertical axis.

Vulnerability is measured using five extremes: flood, heat, cold, sea level rise, and drought. Each indicator was evaluated separately, and scored from 1-100, with lower scores

meaning less vulnerability. In order to evaluate behavior across a range of vulnerabilities, two cities of high climate vulnerability were chosen: Long Beach, California, and Beaumont, Texas. Then, two cities of low vulnerability were chosen: Huntsville, Alabama, and Indianapolis, Indiana. Risk scores and indicators for each city can be seen in Appendix B.

Considering there are so many factors that contribute to green behavior, two specific variables were controlled for to result in a simpler sampling frame and more efficient comparisons. First, the survey was given only to college students because universities are easily broken up by geography, and younger generations tend to pay more attention to the climate crisis (Ballew et al. 2019). Second, political leaning was addressed by using a four-square design, seen in Appendix A. Prior studies have shown that those with Democratic or liberal ideologies have higher engagement in green behavior and pro-environmental attitudes (Dunlap 1975). Therefore, if results showed that there is higher engagement in green behavior in a highly vulnerable, conservative area than a low vulnerable area, this would be meaningful. After choosing cities from the ND Climate Adaptation Initiative city matrix, public universities in these cities were selected using *Niche,* an American ranking and review website containing data on colleges, K-12 schools, companies, and places to live. *Niche* contains survey data on student's political leanings and summarizes this information to determine overall university political leaning.

The dependent variable in the study was green behavior. This can be defined as "intrinsic and extrinsic deliberate responsive actions by individuals to protect the environment" (Joseph 2019). Some behaviors include recycling, reusing, reducing, composting, eating plant-based, cutting down on energy or water use, making your home more energy efficient, driving an electric car, and more. Because there are so many green behaviors and it would be impossible to study all of them, a few from the literature were focused on. I chose the highest impact behaviors

that were the easiest to understand and communicate via a survey. Wynes and Nicholas (2017) emphasized having one fewer child, living car-free, avoiding airplane travel, and eating a plant-based diet as being the most high-impact actions. The Minnesota Report Card for Environmental Literacy was also used, focusing on energy and water use (Murphy 2004). From these sources, the following green behaviors were focused on in this study's survey: driving, reducing animal product consumption, purchase decisions, reducing energy and water use, and recycling.

In this study, individual green behavior was measured using a Likert scale of frequency. Responses were on a scale of 1 to 5, 1 meaning they never engage in that certain behavior, and 5 meaning they always engage. Responses were then averaged and compared amongst respondents and universities. The survey also asked questions on other competing variables, such as attitudes and demographics. Finally, respondents were asked about their perception of personal vulnerability to climate change and specific climate change effects, so that these could be compared to the Notre Dame Climate Adaptation Initiative's risk scores. All explanatory variables are listed in Appendix C.

I created a linear mixed-effects mode, using R statistical software package lmer. I treated the university variable as a fixed effect, since the university represented the vulnerability score assigned by ND's Climate Adaptation Initiative matrix, and thus, would not vary across any student responses within the same school.

Due to limited time, behavior beyond the U.S. could not be explored, which would have been beneficial when considering that other countries face more extreme vulnerabilities than we do here. Limited time also contributed to conducting a survey as the data collection method, when close observations or interviews might have avoided bias in survey responses. Finally, the

biggest challenge faced was obtaining responses from IUPUI in Indianapolis. Only a few responses from this university were collected, and therefore this data was omitted from the study.

4. Results

4.1. Demographics

Overall, I collected 230 survey responses from college students: 102 respondents from Lamar University in Texas, 22 from California State Long Beach, and 96 from the University of Alabama in Huntsville. The remaining responses from IUPUI in Indianapolis, Indiana, were omitted from the study due to not gaining enough responses meeting sample criteria. Because the response rate from California was also very low, analysis focused mainly on Lamar University and the University of Alabama.

The data collected included each student's attitude towards pro-environmental behavior statements, perceptions of their individual vulnerability to climate change effects, green behavior engagement, and demographics. This data allowed me to evaluate what variables contribute to engagement in green behavior, with a specific focus on how green behaviors varied across the 3 locations of different vulnerability levels.

In order to evaluate competing variables, responses were broken down according to gender, age, race, income, and political party. 68 respondents identified as male and 137 respondents identified as female. Age of the respondents ranged from 16 to 45 years old, with 89% in the 16-24 range. 29% of students were 19 years old, making up the largest age group, followed by 20 years (22%) and 18 years (16%). While most respondents grew up in their university state, 30% of Alabama respondents were from other states (Ohio, Tennessee, Florida, Kentucky, and more). In terms of race, 46% of respondents were white, 18% Black or African American, 14% Hispanic or Latino, and 10% Asian or Pacific Islander. While Alabama and

Texas had similar political party distribution and a decent number of conservative respondents, all university's leaned liberal.

University	Conservative	Moderate	Liberal	Prefer not to say	Other
Lamar University (TX)	19%	25%	36%	13%	7%
California State Long Beach (CA)	5%	11%	63%	5%	16%
University of Alabama in Huntsville (AL)	18%	25%	28%	23%	6%

**Figure 1: Political breakdown amongst university respondents*

4.2 Descriptive statistics

Responses were first analyzed descriptively, using mean values to compare attitudes, vulnerability perceptions, and green behavior engagement. For attitudes, mean scores were created for each pro-environmental statement for each university. As expected, California had the highest pro-environmental attitudes overall. Surprisingly, Alabama had the highest score for Attitude1 ("every action we take as humans affects the environment"). However, in the remaining attitude statements, Texas scores higher than Alabama.

	Lamar University (TX)	California State University Long Beach (CA)	University of Alabama Huntsville (AL)
Every action we take affects the environment	1.63	1.62	**1.60**
Environmental issues directly affect everyday life	**2.05**	1.71	2.19
I am concerned about climate change	**1.77**	1.14	2.08

I consider myself an environmentalist	**2.67**	1.81	2.91
Climate change has or will affect me	**1.84**	1.14	2.01
I do what is right for the environment	**2.62**	2.10	2.91

*Figure 2: mean scores for attitude (**closer to 1**=more pro-environmental)*

Vulnerability perceptions were also analyzed using mean values, which were created per indicator and compared with real vulnerability scores. Values show that vulnerable areas have a better understanding of climate change risks. Overall, Texas respondents had higher perceptions of vulnerability, especially when evaluating risks to drought and sea level rise. Alabama respondents severely overestimated their vulnerability to heat, cold, and sea level rise.

University	Flood	Drought	Sea level rise	Heat	Cold
Lamar University (TX)	8.38 (6.25)	3.94 (4.16)	5.72 (6.96)	7.87 (3.28)	6.15 (3.21)
California State Long Beach (CA)	4.48 (3.13)	8.24 (7.54)	6.95 (3.23)	8.19 (7.88)	4.76 (7.43)
University of Alabama in Huntsville (AL)	4.10 (3.02)	4.11 (2.85)	2.05 (0)	7.28 (2.29)	6.10 (2.22)

**Figure 3: mean values for vulnerability perceptions for each indicator (with real vulnerability in parentheses)*

Finally, mean values were created to examine how green behavior engagement varied on average across the different universities. Texas had on average higher green behavior engagement than Alabama in 5/8 behaviors. However, values show that Alabama's engagement is not far behind that of Texas, and even scored higher on the following green behaviors: sorting for recycling, conserving water through short showers, and using forms of transportation other than driving a car. This is especially interesting considering some Alabama respondents noted

the need to drive because they live in rural areas, and many Texas respondents reported not having a car. Clearly, response differences are not outstanding enough to say that Texas respondents, who are more vulnerable, engage in more green behavior.

	Lamar University (TX)	California State University Long Beach (CA)	University of Alabama in Huntsville (AL)
Recycling (gbv1)	2.69	4	**3.25**
Conserving water (gbv2)	2.58	3.16	**2.71**
Turning off lights (gbv3)	**4.14**	4.32	4.07
Unplug appliances (gbv4)	**3.12**	3.11	2.86
Avoid driving (gbv5)	2.18	3.05	**2.28**
Avoid purchasing harmful products (gbv6)	**2.89**	3.58	2.82
Exclude meat (gbv7)	**2.03**	2.84	1.91
Exclude dairy (gbv8)	**1.91**	2.68	1.84

Figure 4: mean green behavior values (higher scores**=more pro-environmental)*

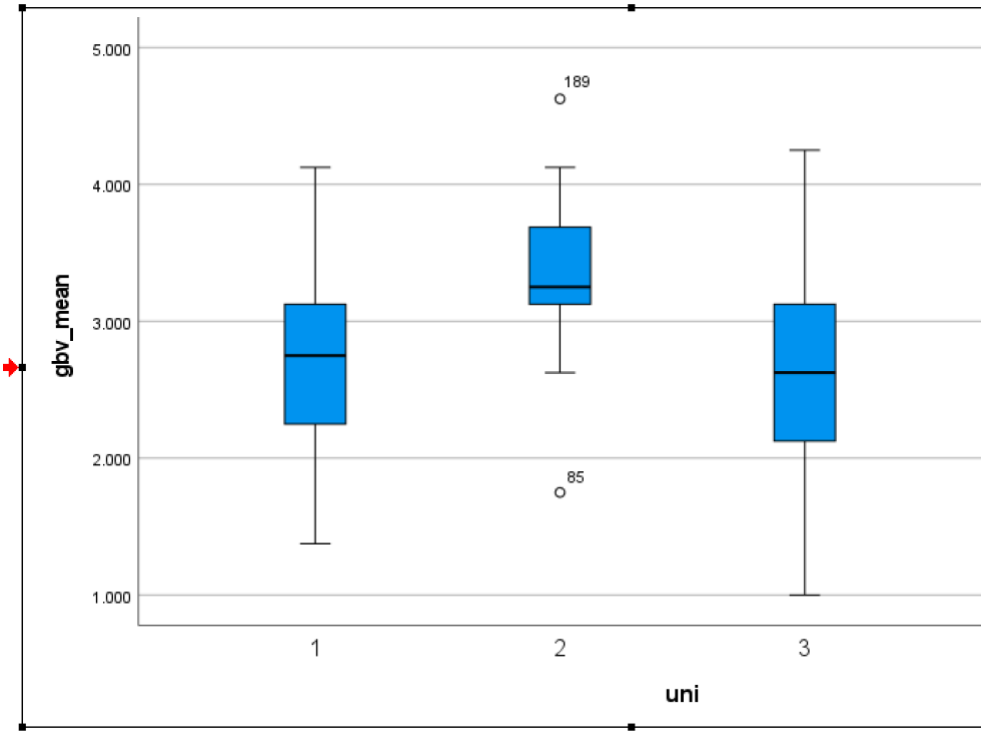
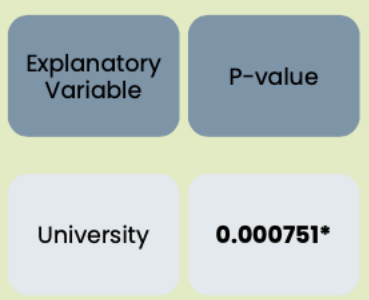


**Figure 5: boxplot of mean green behavior across the different universities (1-Alabama Huntsville, 2-California State Long Beach, 3-Lamar University)*

4.3 Linear regression

The first step in the linear mixed-effects model is to test whether geographic location and green behavior are independent from one another. Since universities do not change with the students within that university, I expected that the vulnerability score assigned to each university's city would not be independent from student's responses within each university. The model was fit by restricted maximum likelihood (REML) estimators, using Satterthwaite's degrees of freedom methods to calculate p-values, written as: *mean green behavior ~ 1 + (1 | university).* The model resulted in a highly statistically significant P-value of 0.000751 for the intercept. This means that our mixed-effects model is appropriate, since responses are highly influenced based on the university the respondent attends.



**Model 1: geographic location and green behavior (gbv_mean~1 + (1|uni)*

I then included the lower-level independent variables in the model, written as: *Green behavior ~ vulnerability perception + perception accuracy + mean attitude + race + age + gender + political ideology + income + (1 | university).* In contrast to my hypothesis that high geographic vulnerability would explain green behavior, geographic location and perceptions of vulnerability are not shown to have a statistically significant effect on green behavior. A high level of significance was found between attitudes and behavior, with a P-value near 0. Being Hispanic or Latino was also found to be statistically significant, with a P-value of .00728. Also, being Native American or Native Alaskan was also found to be significant, with a P-value of 0.02636. However, only 2 respondents reported identifying as Native American or Native Alaskan.

Explanatory variable	***P-value***
University	*0.20814*
Perception	*0.76614*
Attitude	***2.22e-08 ******
Race (Hispanic)	***0.00728 *****
Race (Black)	*0.174652*
Race (Native American)	***0.02636****
Race (white)	*0.13829*
Age	*0.61063*
Gender (female)	*0.95089*
Gender (male)	*0.75889*
Political party (lib)	*0.15339*
Political party (cons)	*0.31129*
Income	*0.09782.*

**Model 2: fixed effects model for all variables (gbv_mean~1 + perception + perception_overunder + att_mean + race + age +gender + polparty + income + (1|uni)*

4.4 T-test

Vulnerability perceptions between AL and TX respondents were analyzed using a Welsh two sample t-test. This model resulted in a highly significant P-value of 6.72e-13. This statistically significant difference shows that mean perception values of vulnerability were not the same among these two groups, and TX respondents believe they are more vulnerable than students in AL. The mean value for AL respondents was 4.731250, while the mean value for TX respondents was 6.411765.

Variable	P-value
Perception by university	**6.72e-13*****

**Model 3: Welsh two sample t-test (AL and TX)*

5. Discussion

Overall, this study cannot support my hypothesis that living in a more vulnerable area will lead to higher engagement in green behavior. There is no statistically significant finding between geographic risk and green behavior, according to the linear regression model. However, through analyzing risk perception literature and descriptive statistics from my study, location and vulnerability may play a role, but are not as significant as other factors such as attitudes. The linear regression model suggests that attitudes are extremely significant in determining green behavior. Although this has been evident through past literature, it provides a strong understanding of green behavior motivations in comparison to other variables studied. The linear regression model also did not find a statistically significant relationship between green behavior and political party affiliation, in contrast to previous literature.

In terms of vulnerability perceptions, meaningful conclusions were reached. From analyzing descriptive statistics alone, it is easy to see that Texas respondents, who are much more vulnerable, had more accurate perceptions of climate risks than those of Alabama. Alabama respondents severely overestimated their risk scores to all indicators. The t-test also confirms this, showing a strong P-value and statistically significant relationship between vulnerability perceptions and university or geographic location.

5.1 Limitations

The biggest limitation of this study was the low response rates from the liberal leaning universities: California State University Long Beach and IUPUI in Indianapolis. If the study was run again with a more compete sample and higher response rates, differences amongst the varying locations may have been clearer.

Due to limited time, some descriptive data could not be explored. The survey included a follow-up question to the behavior portion, where respondents were asked to cite possible motivations or contributors to their behavior, such as personal, health related, economic, or environmental. A more thorough analysis of these responses could have provided better insight for respondent's motivations. The last section of the survey also included a question asking where the respondent grew up, or if their hometown or state was different from their university location. Limited analysis of this showed that, while most respondents grew up in their university state, 30% of Alabama respondents were from other states, such as Ohio, Tennessee, Florida, Kentucky, and more. It is possible that these differences could have contributed to green behavior engagement or personal attitudes, leading to higher pro-environmental responses from Alabama.

Another notable limitation that often comes with self-reported data is survey bias. Specifically social desirability, because even mentioning the words “climate change” or “environment” may sway people in their responses. Also, it is important to note that some green behaviors may not be equally available to everyone. For example, maybe they do not have the means to cut out meat because they don’t buy their own groceries. Many Alabama respondents cited the need to drive because they live in a rural area.

Finally, I believe this study would be the most successful if areas outside of the United States were considered. The United States is not nearly as at risk to climate change impacts as other areas of the world, such as Asia, Africa, and many small islands. Due to limited time and money, only a few areas within the United States were analyzed. Findings may have been more efficient or significant if respondents could include those outside of the U.S.

6. Conclusion

If green behavior can serve as a tool to combat the climate crisis, it is imperative to have a better understanding of green behavior motivations. Although literature cites many factors, ranging from personal beliefs to demographics, it fails to consider how vulnerability or risk perceptions could impact a person’s willingness to engage in green behavior. Since many survey respondents were not accurate in assuming their vulnerability to climate change effects, this shows that people should be more educated on these issues, considering climate impacts have and will affect them. Public perceptions of risk can drive policy, so if people have a better understanding of their personal risks to climate change, maybe we can better address the climate crisis.

Clearly, education is needed not only on climate risks, but personal contributions to climate change and ways to minimize these impacts. Wynes and Nicholas (2017) find that

increasing green behavior engagement can aid us in solving the climate crisis. From this study, we can see that, regardless of location, political affiliation, or demographics, people are attempting to mitigate their personal impact on the planet through engaging in green behavior. When looking at the future of this study, conducting a similar one with more respondents and a more complete sample, maybe even including respondents outside of United States, would provide a better understanding of the relationship between green behavior and geographic location or vulnerability.

7. Bibliography

The American Public Health Organization. (APHA). 2019. A Declaration on Climate Change and Health. Climate Change is a Health Emergency. https://www.apha.org/-/media/files/pdf/topics/climate/190429_declaration_climate_health.ashx

Ballew, M., Marlon, J., Rosenthal, S., Gustafson, A., Kotcher, J., Maibach, E., & Leiserowitz, A. (2019, June 12). Do younger generations care more about global warming? Retrieved from https://climatecommunication.yale.edu/publications/do-younger-generations-care-more-about-global-warming/

Barr S, Gilg AW, Ford N. 2005. The household energy gap: examining the divide between habitual and purchase-related conservation behaviours. *Energy Policy* 33:1425–4

Brody, S. D., Zahran, S., Vedlitz, A., & Grover, H. (2008). Examining the Relationship Between Physical Vulnerability and Public Perceptions of Global Climate Change in the United States. *Environment and Behavior*, *40*(1), 72–95. https://doi.org/10.1177/0013916506298800

Butler C. D. (2018). Climate Change, Health and Existential Risks to Civilization: A Comprehensive Review (1989–2013). *International journal of environmental research and public health*, *15*(10), 2266. https://doi.org/10.3390/ijerph15102266

Center for Disease Control and Prevention. (CDC). 2021, March 02. Climate effects on health. Retrieved from https://www.cdc.gov/climateandhealth/effects/default.htm

Cho, J., & Lee, J. (2006). An integrated model of risk and risk-reducing strategies. *Journal of Business Research, 59*(1), 112-120. doi:10.1016/j.jbusres.2005.03.006

Dunlap, Riley. (1975). The Impact of Political Orientation On Environmental Attitudes and Actions. Environment and Behavior. 7. 428-454. 10.1177/001391657500700402.

Gabbatiss, J., & McSweeney, R. (2021, February 22). *Media reaction: Texas 'DEEP freeze', power blackouts and the role of global warming*. https://www.carbonbrief.org/media-reaction-texas-deep-freeze-power-blackouts-and-the-role-of-global-warming.

IPCC. (2012) Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (Eds.) Cambridge University Press. 582 pp.

Jackson, T. (2005). Motivating Sustainable Consumption: A review of evidence on consumer behavior and behavioural change. *Sustainable Development Research Network*.

Joseph, O. O. (2019). Pro-Environmental Consumer Behavior: A Critical Review of Literature. *International Journal of Business and Management, 15*(1), 1-15. doi:10.5539/ijbm.v15n1p1

McAlpine, S.A., Porter, J.R. Estimating Recent Local Impacts of Sea-Level Rise on Current Real-Estate Losses: A Housing Market Case Study in Miami-Dade, Florida. *Popul Res Policy Rev* 37, 871–895 (2018). https://doi.org/10.1007/s11113-018-9473-5

Murphy, T. P., & Hamline University. (2004, August). Minnesota Report Card of Environmental Literacy: A Survey of Adult Knowledge, Attitudes, and Behavior. Retrieved from https://www.pca.state.mn.us/sites/default/files/p-ee5-06.pdf

ND Global Adaptation Initiative. (2018). Climate Vulnerability of UAA Cities. Retrieved 2020, from https://gain-uaa.nd.edu/matrix/

Pagiaslis, A., & Krontalis, A. K. (2014). Green Consumption Behavior Antecedents: Environmental Concern, Knowledge, and Beliefs. *Psychology & Marketing, 31*(5), 335-348. doi:10.1002/mar.20698

Peattie, K. (2010). Green Consumption: Behavior and Norms. *Annual Review of Environment and Resources*, *35*(1), 195–228. https://doi.org/10.1146/annurev-environ-032609-094328

Rees W., & Wackernagel M. (1994). Ecological footprints and appropriated carrying capacity: measuring the natural capital requirements of the human economy. In *Investing in Natural Capital: The Ecological Economics Approach to Sustainability*, ed. AM Jannson, M Hammer, C Folke, R Costanza. Washington, DC: Island.

UN Environ. Program. (UNEP). 2001. Consumption Opportunities: Strategies for Change. Paris: UNEP.

Williams, A. P., Abatzoglou, J. T., Gershunov, A., Guzman-Morales, J., Bishop, D. A., Balch, J. K., & Lettenmaier, D. P. (2019). Observed impacts of anthropogenic climate change on wildfire in California. *Earth's Future,* 7, 892– 910. https://doi.org/10.1029/2019EF001210

Wong-Parodi, G. (2020). When climate change adaptation becomes a "looming threat" to society: Exploring views and responses to California wildfires and public safety power shutoffs. *Energy Research & Social Science*, *70*, 101757. https://doi.org/10.1016/j.erss.2020.101757

Wynes, S., & Nicholas, K. A. (2017, July 12). *The climate mitigation gap: education and government recommendations miss the most effective individual actions*. Environmental Research Letters. https://iopscience.iop.org/article/10.1088/1748-9326/aa7541

8. Appendices

Appendix A: Four square sample

Party Leaning→ Vulnerability↓	Conservative	Liberal
Low	University of Alabama Huntsville Huntsville, AL	Indiana University-Purdue University Indianapolis Indianapolis, IN
High	Lamar University Beaumont, TX	California State University Long Beach, CA

Appendix B: Vulnerability scores

City	Flood	Drought	Sea level rise	Heat	Cold
Huntsville, Alabama	30.2	28.5	0	22.9	22.2
Indianapolis, Indiana	25.3	42.6	0	38.7	34.0
Beaumont, Texas	62.5	41.6	69.6	32.8	32.1
Long Beach, California	31.3	75.4	32.3	78.8	74.3

Source: Notre Dame Global Adaptation Initiative (2018)

Appendix C: Explanatory variables

Variable	**Type**
Geographic location	Categorical
Behavior	Ordinal
Attitudes	Ordinal
Vulnerability	Continuous
Perception	Nominal
Race	Categorical
Age	Continuous
Gender	Categorical
Income	Categorical
Political party	Categorical

Appendix D: Survey questions

1. Please indicate the name of your university below.

Part 1: Attitudes

**Q1-Q6: Likert scale, 1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree*

1. Each action we take as humans affects the environment. (Attitude1)
2. Environmental issues have a direct effect on my everyday life. (Attitude2)
3. I am concerned about climate change. (Attitude3)
4. I consider myself an environmentalist. (Attitude4)
5. Climate change has and/or will affect me in my lifetime. (Attitude5)
6. I do what is right for the environment, even when it costs more money or takes more time. (Attitude6)
7. On a scale of 1-10, with 1 being not at all vulnerable and 10 being extremely vulnerable, please rate the vulnerability of your college town to the following climate change effects: flood, drought, sea level rise, heat, and cold. (perception)

Part 2: Behavior

***Q1-Q8, Likert scale, 1=never, 2=rarely, 3=sometimes, 4=often, 5=always*

How often do you…

1. Make an effort to clean and sort recyclables? (gbv1)
2. Conserve water by taking short showers, less than 5 minutes? (gbv2)
3. Attempt to keep the lights on during the day? (gbv3)
4. Unplug appliances when they are not in use? (gbv4)
5. Use other types of transportation, such as walking, biking, or riding the bus, instead of driving a car? (if this is not applicable to you/if you do not have a car, please indicate below) (gbv5)
6. Avoid purchasing products that might be harmful to the environment? (gbv6)
7. Exclude meat from your everyday meals? (gbv7)
8. Exclude other animal products, such as dairy, from your everyday meals? (gbv8)
9. Which of the following, if any, contributed to your answers above?
    a. Personal, environmental, economic, health, religious, or other

Part 3: Demographics

1. What gender, if any, do you identify with?
    a. Male
    b. Female
    c. Non-binary/third gender
    d. Prefer not to say
    e. Other
2. What is your current age?
3. How would you describe yourself?
    a. Native American or Alaskan Native
    b. Black or African American

    c. Hispanic or Latino
    d. Asian or Pacific Islander
    e. White
    f. Multiracial or Biracial
    g. Prefer not to answer
    h. Other
4. Where did you grow up?
5. What political leaning do you most identify with?
    a. Very conservative
    b. Conservative
    c. Moderate
    d. Liberal
    e. Very liberal
    f. Prefer not to answer
    g. Other
6. What is your family's annual income?
    a. Under $25,000
    b. $25,000-50,000
    c. $50,000-100,000
    d. $100,000-250,000
    e. $250,000-500,000
    f. $500,000-1,000,000
    g. Over $1 million
    h. Unsure
    i. Prefer not to answer