Climate Change Perceptions at University of Wisconsin-Madison

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Research Question: How do perceptions of climate change vary among students at the University of Wisconsin-Madison?

Abstract

This study seeks to explore perceptions of climate change of students at UW-Madison by gauging demographics, political leanings, media influence, and exposure to climate change education. UW-Madison students tend to believe that climate change will be felt on a more global scale, but in greater percentages than non-students which is supported by the literature, that writes that people tend to see climate change as a phenomena that is spatially distant. Political affiliation tended to have more of an impact on perceptions of white respondents, but did not seem to reflect non-white respondents. Overall, this study found that students at the University of Wisconsin–Madison have more critical and concerned perceptions of climate change that vary slightly.

1. Introduction

In the past decade, the concept of climate change has been widely debated, especially in the United States (Oreskes 2005, 1686). Today, however, climate change has been increasingly accepted by both the scientific and general communities (Doran 2000, 23). Nonetheless, perceptions as to the causes of climate change and the extent to which it will impact the Earth vary widely from the global scale to the local scale. Not only will the impacts vary, but people's beliefs have a huge influence on their perceptions of climate change (Stedman 2004, 1395). How

do perceptions of climate change vary among University of Wisconsin-Madison students? We seek to understand the factors that contribute to varying climate change perceptions by exploring demographics between both students and non-students. Perception of climate change can play a huge role in the way someone decides to treat the environment, making perception an issue of future sustainability and adaptation to the effects of climate change.

2. Site Setting and Background

The site setting of our proposed research question is predominantly here on the University of Wisconsin-Madison campus, specifically using the University of Wisconsin-Madison Class of 2017, 2018, 2019, and 2020 respective Facebook pages. We are also distributing our survey via status updates with links to our own personal Facebook pages, so a portion of our respondents may not even be affiliated with the University of Wisconsin system, and we have accounted for that in our survey by asking whether the respondent is a student at the University of Wisconsin-Madison. Since we are looking at climate change risk perceptions, we are not necessarily only concerned with the views of Madison citizens, but we are looking more generally at the United States of America with some science underpinning the North American climate system, as we understand it currently. Of course a majority of our respondent pool will likely come from students answering our survey, so the perceptions of climate change will predominantly be representative of the risk perceptions at University of Wisconsin-Madison students, specifically the undergraduate classes.

3. Key Words and Concepts

Climate change, risk perceptions, Madison, the carbon cycle, ecosystem engineering, general/regional climate models, NARCCAP, the United States, the Great Lakes region, uncertainty, media, politics, race, climate change trends, climate change solutions, environmental education.

3.1 Climate Change and the Carbon Cycle

Climate change is arguably the greatest problem facing humanity in the twenty-first century, but how do people know exactly how the climate is changing? Climate change can be defined as an alteration in regional weather patterns over a period of time. Climate change is sometimes referred to as global warming, though this term is misleading, as not all areas of the planet will necessarily warm. For this paper the term used will be climate change. In order to understand climate change, one has to understand where scientists get measurements to feed into their climate simulations. Most notable among the measurements of greenhouse gases is the carbon cycle.

According to analysis of ice cores taken from both Greenland and Antarctica, during glacial periods, global levels of carbon dioxide were around 200 parts per million (ppm) while during interglacial periods, these global levels went up to around 280 ppm (Sigman and Boyle 2000, 859). Looking through these ice core samples, as well as numerous other means of climate detection such as sea core samples and tree rings to discern climatic environments of the past, scientists have seen that the 280 ppm number was about where the world was just before the industrial revolution took off in England and the West. According to NOAA, the United States National Oceanic and Atmospheric Administration, current carbon dioxide levels are situated at around 400 ppm, way above the normal levels of an interglacial period (NOAA 2016). This

figure should be alarming, but it is not to say that the Earth is going in a runaway greenhouse direction like her sister planet, Venus. The Earth system has a way to counteract these rising levels based on the carbon cycle, which acts as a map for how carbon is distributed within the Earth system.

The carbon cycle illustrates how carbon moves around the planet Earth while also illustrating how carbon is stored within the Earth system. Overall, the system is a very balanced one with volcanoes releasing carbon from the earth's crust and mantle that is then taken up by the ocean and landmasses, including flora and fauna to form the carbon based world humanity has come to know and love (Sigman and Boyle 2000, 860). Where this system gets of kilter is in the carbon sink of fossil deposits that happen to be humanity's primary source of fuel on which the world of humans is run. By burning fossil fuels, humans release much more carbon dioxide into the atmosphere than nature normally does which means the oceans and landmasses have to uptake more and more carbon, roughly half of all production annually per year (Cox, et al. 2000, 184). This means half of all the carbon humans produce every year is sitting in the atmosphere slowly raising temperatures by trapping in solar radiation. The uptake by the oceans leads to acidification and by proxy species go extinct, while further human progress through industry and urban sprawl lead to further landmass decimation of natural habitats, like forests, which act as carbon sinks where carbon dioxide can be sequestered back into biomass. By altering the patterns within the carbon cycle, humans have demonstrated perhaps their most unique trait and that is the fact that they are "ecosystem engineers" (Marín-Spiotta 2015). No matter the problem, humans find a solution that can be adapted to meet their needs thus leading humanity into a false sense of security that they are in control of the Earth and can anticipate the changes to come since they faced all others head on.

3.2 Climate Change Simulations

Anticipation is the first step to climate change, but how exactly do we predict the way in which the climate will behave in the future, especially the near future of the twenty-first century. The way in which we predict future climate is through computer simulation programs such as EdGCM used by the University of Wisconsin-Madison Geography Department in order to educate people on how scientists illustrate the science of climate change. General climate models, or GCMs, look at the overall Earth system and attempt to incorporate as much information about differing systems and their interactions upon the Earth system. More often than not, these GCM simulations incorporate the oceanic system when attempting to predict future climate models and this is because of the intricate relationship between the ocean and the atmosphere where the ocean tends to decrease the degree of variation among climate models. This is due to the fact that the ocean acts as a mediating force on the atmosphere when looking at long-term, in this case 2041-2070 CE, changes in the Earth's climate (Mearns, et al. 2013, 966). It may seem obvious to include the ocean system when creating a GCM simulation of the Earth system, but it is worth noting that the ocean system as a whole is relatively unknown in comparison to the climate system. The atmospheric system recirculates itself much more quickly than the oceans where a cubic meter of water is estimated to take a thousand years to make one circulation through the ocean system (NOAA 2013). This is because the climate system can be experienced and measured at all levels with modern technological equipment, but the oceanic system is much more difficult to measure and anticipate. So when this forcing is added into GCMs it does have the mediating effect, but this same mediating forcing also creates an unknown set of sub-forcings and fluxes that scientists are still figuring out how to grapple with even today (Collins, et al. 2005, 2124). Of course, an accurate simulation of the climate system

should incorporate the ocean system because the Earth is around 70% water, most of which is ocean. Incorporating as much known data as possible is essential in reducing uncertainty of climate simulations in order to predict future changes to the Earth's climate.

In order to get more comprehensive simulations which will hopefully lead scientists to a better degree of accuracy in predicting future climate, scientists couple their general climate models with regional climate models, or RCMs, in order to get a more detailed sense of what is happening within the simulation. GCMs are better at looking at coarse detail, or macro-level predictions such as where monsoons will deposit their rainfall in the coming century. RCMs on the other hand are better at looking at more fine detail such as variations in rainfall throughout the Great Lakes Region of North America (Mearns, et al. 2013, 966). When coupled together over a particular area, RCMs and GCMs can "provide robust detail over a particular [area of interest]" that allows scientists to make their more accurate predictions for the future. One such climate simulation project, in fact the first comprehensive study for North America, is the North American Regional Climate Change Assessment Program. This program, created in 2006, aims to provide a lens that scientists and geographers can use to more accurately predict future climate changes and their associated forcings within North America on the macro and micro scales. This project uses predictions gleaned from the simulations to influence and teach the way that people perceive climate change (Mearns, et al. 2013, 967).

3.3 Climate Change in the United States and the Great Lakes Region

Focusing in on North America and using information provided by NARCCAP along with various other peer reviewed sources, a closer look at the United States and in particular the Great Lakes Region looks to see just how climate change may positively or negatively affect this area of the nation and continent. The combination of factors predicates and enhances the survey

analysis that aims to look at the views of people living in Madison, Wisconsin. According to NARCCAP simulations, the state of Wisconsin will experience a five percent average annual increase in rain as compared to historical and contemporary records as the century progresses, though this study specifically pinpoints the time frame as 2041-2070 (Mearns, et al. 2013, 971). On the surface, this may seem like a positive outcome of future climate changes in the Midwest with the amount of crops grown here, but unfortunately the models show a large portion of this precipitation will come not during the growing season, but during the winter months with the summer months appearing to see roughly zero to five percent less rain than the averages of today (Bukovsky 2012, 3989). This small example of one particular state of the United States shows just how misleading climate science can appear when people simply look at the surface of the data collected, when in actuality there is a double edged sword simply cuts one way and that path is to uncertainty.

Not only will precipitation in the Great Lakes Region be affected by future climate change, but so too will temperatures of the atmosphere, but perhaps more importantly, the temperature of the Great Lakes themselves. By 2090, Lake Erie is projected to be completely ice-free year-round meaning that the water temperatures of the lake will have increased far beyond those seen in contemporary times (Lofgren, et al. 2002, 544). Why does it matter if a lake is warmer? Certain species require a particular environment in which to consume and reproduce, the two primary and basic functions of any given species overall. Since a drastic change in environment is predicted to occur in the next eight decades with Lake Erie moving to ice-free conditions year-round, species will have to adapt or face extinction. An ice-free year-round lake will further increase boat traffic both recreational and commercial and the danger here is that with more commercial and recreational traffic there is more chances for humans to

introduce non-native invasive, species to already pressured habitats. Not only will non-native invasive species pose a threat to the native species, but also the changing lake temperatures will force some species to move beyond their regular distributions. This creates a scenario where invasive indigenous species push out other indigenous species within the lake, creating a cascade of shifts and possible extinctions to the biosphere of the Great Lakes, and in particular Lake Erie's ecosystem (Rahel and Olden 2008, 523).

These examples illustrate the dangers posed by climate change should the Earth system adhere to the simulations provided by NARCCAP and other peer reviewed sources, but the science of climate change prediction is inherently uncertain and variant in its possible avenues for prediction. This variation and uncertainty provide the sounding board upon which people's perceptions and opinions are based leading to the wide array of variant uncertainty seen perceptions of climate change risk in human populations. Depending on how the science is viewed, presented, and analyzed can have a huge impact in how people understand the risks of the climate change to come.

3.4 Climate Change Uncertainty

Climate change is an uncertain science, even though climatology is one of the hard sciences, and this overall uncertainty stems from two major uncertainty factors. The first factor being "the [trajectory] of future emissions of greenhouse gases," which we do not have any concrete data on because these emissions have not yet occurred within the Earth's climate system (Mearns, et al. 2009, 311). As the trajectory of future emissions contains a wide range of data points, a greater degree of uncertainty is propagated due to the necessity of a particular simulation program having to account for a wide range of possible scenarios that inevitably decrease the accuracy of the projected climate change results. The second factor influencing the

uncertainty of climate change is the many possible natural responses of the global climate system to any degree of added forcings, such as greenhouse gas emissions (Mearns, et al. 2009, 311).

The Earth system is an amalgamation of many complex systems including, the climate system which is intimately connected and influenced by the oceanic system, both of which are constantly exchanging material in ways that scientists do not have a full understanding of quite yet. Because of this systematic complexity and unknown interactions within and between systems, uncertainty is the major tenant behind future climate model predictions that in turn have a hand in influencing the general public's perceptions of climate change risk. What else influences risk perceptions related to climate? People tend to be bound by their every day interactions in regards to what they believe. For example if someone is suffering economically, they may react poorly to government regulation on what they can and cannot do in regards to the economy ecologically, thus possibly pigeonholing them into a certain way of life that further constrains their economic and social mobility (Stedman 2004, 1404). A similar situation may provoke the opposite reaction in someone who benefits from ecological regulation, such as a person wanting to utilize shade agriculture in coffee growing (Perfecto, et al. 1996, 598). The comparison shows how beliefs influence a great deal to how someone perceives risks to climate change, the number one factor being how is the individual is affected or unaffected by climate change and climate change policies.

This great amount of uncertainty leads many people, especially hegemonic Americans to believe that climate change risk is of only moderate concern, and will only be felt by "nonhuman nature" and in a temporally distant space (Leiserowitz 2005, 1437). That is to say not in the immediate future so not to be dealt with in the here and now, rather they should be dealt with then and there. What this means is that Americans tend to believe that climate change and the

associated risks are only a problem to be faced by future generations in some far off land, but is this really the case? Based on earlier discussion of how the world and specifically, North America through simulations like those used in NARCCAP, Americans overall seem to have a lack of knowledge as to perceived risks to both American and human society. Of course only future generations will understand with any degree of certainty whether climate change really does pose a risk to human society, but based on the science known today climate change is coming whether humans see it on the spectrum of risk (Leiserowitz 2005, 1441). With this knowledge in mind, how are perceptions of climate change, changing with the times here in Madison, Wisconsin and what is influencing these perceptions to risk?

3.5 Climate Change and Media

For most of the general public, exposure to and knowledge about climate change is understood and shaped through the media. US media coverage, in the past, focused more on the controversy of climate change, giving equal representation to arguments for and against the occurrence of climate change. This is misrepresentative of the issue as a majority of scientists have reached a consensus agreeing on climate change. As climate change has become more accepted within the general public, controversy in the media shifted to the cause of climate change; focusing on whether or not it's anthropogenic (Doran 2000, 23). While this is not the only argument concerning climate change, it is the most popular, especially in media.

Studies have shown that how media is presented has a profound impact as to how climate change is perceived (Boykoff Presentation of climate change differs around the world. Human causes have shifted to the primary focus of U.S. media coverage, as climate change is no longer controversial. This is in contrast to European media which focuses more on diplomatic and intergovernmental conflicts over climate change. The personification of climate change in U.S. is

thought to make the issue more relatable and thus resonates more strongly in those consuming the media (DiFrancesco and Young, 2011, 520-521).

Other studies found that climate change related imagery that made viewers feel as they could contribute to change is the most effective. The greatest impact was found with solar imagery which includes both personal and industrial uses of solar panels. Flood, march (protest), and smoke imagery all also produced significant response but to a lesser degree than solar (Hart and Feldman, 2016, 422). Solar power is a change that can be made on the individual scale. It is also more economically feasible to the masses than most other renewable energy sources. This accessibility is thus thought to led to greater amounts of change. [KR4]

Climate change media on campus directly relates to small individual changes that can be made. The most profound changes are seen from the WE CONSERVE initiative that started in 2006 by the Office of Sustainability at UW-Madison. As part of this initiative, a plethora of posters and other conservation inspired media were placed around residence halls, dining locations, lecture halls, and buses. Most of these posters and advertisements focus on sustainability, especially in regards to water and other food waste. The Office of Sustainability uses clear and concise media promoting recycling patterns in hopes of making behavioral change. Posters tend to be strategically placed around where the opportunity for change is present (UW–Madison Sustainability Initiative Task Force, 2010, 31-35). For example, posters promoting the use of reusable water bottles may be placed near vending machines and water bubblers in order to make students more conscious of their decisions. However, the full impact of these initiatives is not known, especially since WE CONSERVE was disbanded in late November of 2016.

Internet media also has had large impacts on climate change perceptions. Activist groups, like Greenpeace, used tools like YouTube to spread awareness and outage in response to sustainable production techniques. Many large companies and stores used this to their advantage. Without making any real changes to their production processes, companies increased sales by alluding to being "green" with the use of clever marketing and vague promises (Korosec, 2012). This "greenwashing" of products can significantly skew perceptions of climate change, as these products are sold in a wide array of markets. Dining halls with UW-Housing also promote their food as "green" through advertisement of local and fair-trade food (Omri, 2014). By making it seem as if change is being made even though no change is actually happening, expectations of how to tackle climate change and what is contributing to climate change can be severely altered.

3.6 Climate Change and Politics

Politics have a significant impact on climate change perceptions. In the United States, political leanings are a fairly good indicator of climate change beliefs, especially among Whites (Schuldt and Pearson, 2016, 3). This is largely due to the stark differences between those in power. While most scientists tend to come to similar conclusions, Republican and Democratic views on climate change are extremely polarized. Highly politicized issues like "global-warming" are often polarized because stances on large issues like this are often fundamental to the parties' core beliefs (Dunlap & McCright, 2010, 29-33). Perceptions on the cause of climate change effectively demonstrate how political influence is integral to climate change perceptions. 70% of democratic voters believe that causes of climate change are anthropogenic whereas only 27% of republicans believe this (ClearPath, 2016, 14).

Results at UW-Madison, and within the younger population in general, may differ from these current trends as climate change has become a more visible issue in recent years. An increasing number of policies and programs, like the President's Climate Change Plan have increasingly focused on what the current generation can do to prevent climate change, putting a majority of the burden on young graduates and students entering the workforce (Office of the Press Secretary, 2013). As climate change data becomes more accurate and daunting, there has been a call for immediate action and concern. This quote from President Obama demonstrates the shift to focusing on climate change as a current issue, "We are the first generation to feel the impact of climate change and the last generation that can do something about" (Obama, 2015).

The Wisconsin Initiative on Climate Change Impacts (WICCI) is a partnership between the Wisconsin Department of Natural Resources and UW-Madison's Nelson Institute for Environmental Studies (WICCI, 2009). Increased collaboration between the university and government organizations may aid in shifting perspectives of students by making political changes that are created by and suited more towards younger individuals.

3.7 Climate Change and Race

Race also plays a critical role in forming perceptions of climate change. Studies have shown that white views on climate change are more closely aligned with political orientation than minorities. The term environmentalist[KR6] is exclusively identified with by Whites. Non-Whites who have similar beliefs as those who label themselves environmentalists tend not to label themselves as the term is highly politically orientated (Schuldt and Pearson, 2016, 2).

Minorities tend to shape their beliefs in regards to culture, religion, and location. This contributes to non-White minorities having the greatest risk perception of climate change. White males, on the other hand, have the lowest risk perceptions in comparison to both females and

non-Whites. 30% of white males view climate change hazards at an extremely low risk, much higher than any other group (Finucane et al., 2000, 159). Location is a primary factor for many minorities, as environmental hazards are disproportionately found in low-income minority neighborhoods (Katz, 2012). These groups are more likely to feel to the impacts of climate change, and thus most minority groups tend to be in favor of stricter political policy at equal or greater levels than White groups (Pearson et al., 2016, 637).

3.8 Solutions to Climate Change by Altering Risk Perception

Environmental Education

Definition

Beginning with the National Environmental Education Act of 1990, written by the United States Environmental Protection Agency, the term "environmental education" was legally defined, although the term has been involved in academic discourse for decades before the EPA defined it for legal purposes. The US EPA writes that "Environmental education is a process that allows individuals to explore environmental issues, engage in problem solving, and take action to improve the environment. As a result, individuals develop a deeper understanding of environmental issues and have the skills to make informed and responsible decisions (US EPA, 1990). Within literature there are debates on what makes for the most effective form of environmental education. While some interpret environmental education to only be based on knowledge learned in the classroom, others argue that attitudes and perception should be included in order for students to develop sustainable habits that will help to mitigate and adapt to climate change in the future.

An example of this argument on the definition of environmental education would be the study performed by Pooley and O'Connor (2000) psychologists that highlight the involvement of affect while learning/teaching environmental education. Pooley and O'Connor (2000, 712) argue that there are issues with the current structure of environmental education. Pooley and O'Connor discuss that ideally, environmental education should introduce environmental issues to its audience, then present possible ways of mitigating and/or adapting to climate change while also improving the attitude of the audience toward the environment. As environmental psychologists, the authors believe that current environmental education puts too much emphasis on knowledge rather than affect- or the way the audience feels towards the environment (2000, 711-712). With the differences in educators' interpretations of environmental education, though, there are different results of effectiveness and studies providing insight on the most successful methods of educating students on the environment (Smith, 1997, 169).

Studies on effectiveness

Over decades, studies have been performed to investigate the effectiveness of environmental education programs in K-12 schools. Depending on the environmental education program, effectiveness is quite variable. Many of these studies, though, point to positive changes in the attitudes and knowledge of the environment among the students.

Smith (1997, 169) writes that the effectiveness of environmental education in schools in the United States is variable. While some schools excel at teaching students about climate change and sustainability, others do not. Many reasons for low effectiveness include poor funding for environmental education programs in schools, lack of training for teachers on the subjects to be taught, and the lack of standards and curricula across the nation for environmental education (Smith, 1997, 169). This relates to our research survey on the perceptions of students

at the University of Wisconsin-Madison as we ask a demographic question on where they are from. If we find there to be a high correlation between a certain region and responses that have great knowledge and perception of climate change risk, we could further investigate the funding and effectiveness of environmental education in certain regions of the country.

A study performed by Euler (1989), involved sixth graders from an urban area of New York, who were exposed to two different methods of environmental education, one method being more hands-on in a local park and another in a formal classroom setting. Based on a survey measuring knowledge and attitudes on the environment, both groups of students that were exposed to the environmental education program facilitated by Euler showed positive changes in their attitudes and knowledge of the environment. The results and discussion of the study show that students in the group who were taught environmental education in a classroom setting had more positive change in their environmental knowledge. These results also show that there is positive attitude change towards the environment among this group of students, but this change was not as strong as the environmental knowledge change. Moreover, the students exposed to environmental education in the local park setting, had more positive change in their attitudes towards the environment (Euler, 1989, 57-58). This is important to note as it may help educators and even environmental policymakers to decide on which form of environmental education curriculum to implement when looking to improve either knowledge on the environment, attitudes towards the environment, or both, among younger students.

Programs in Madison

The Sustainability Plan, published by the Sustainable Madison committee of the City of Madison in 2011, includes a list of goals for the improvement environmental education in schools, as a means to further the sustainability of Madison. The city's interpretation of

environmental education is similar to that of the United States Environmental Protection Agency and Pooley and O'Connor (2000). The city states that their vision for teaching environmental sustainability in K-12 schools is "An informed citizenry that is committed to the stewardship of resources, respect for place, and the health and well-being of the broader community, now and in the future," (Sustainable Madison, 2011, 55). While Sustainable Madison's idea of environmental education incorporates the knowledge of the environment and resources that the US EPA calls for, it also focuses on developing respect for the environment, which utilizes Pooley and O'Connor's (2000, 711-712) concept of incorporating affect and attitude in environmental education.

Sustainable Madison introduces five different goals, three relating to raising sustainability awareness among young people, one relating to promoting sustainable purchasing, and a final goal to increase accessibility healthy foods by growing food on the school grounds (Sustainable Madison, 2011, 56-60). The last goal listed is similar to the environmental education that Pooley and O'Connor (2000, 718-719) argue to be the most successful, as it would allow students to become involved and even connect with the environment in a new way. With this involvement in gardening and education on sustainability and climate change, an attitude or emotional association with the environment could be formed, which could potentially lead to students leading a more environmentally conscious lifestyle in the future.

In 2010, Madison Metropolitan Schools began arguing for an increased use of the Madison School Forest. This proposal to make better use of the Madison School Forest predates Sustainable Madison's goals on sustainability by one year, but is significant as it shows that many different actors have control over changing and influencing the public's perceptions of climate change risk. As firm believers in the need for student involvement directly with the

environment in order to achieve the most successful environmental education, they write of education goals that can be achieved in the Madison School Forest that correlate with state standards that need to be met by the schools, ways to develop the staff to best teach environmental education curricula, and the history and importance of the forest (Madison Metropolitan School District, 2010, 5-6). Since the university that we are studying is located in Madison, Wisconsin, this literature on environmental education in Madison is important to our research and may be reflected in our survey results as there may be a significant amount of students participating in our survey that have grown up in the Madison area and attended K-12 schools in the city.

Another environmental education program in Wisconsin is the Green & Healthy Schools, which offers training for teachers on different methods of instructing environmental courses and different ideas on how to initiate environmental education in schools. A booklet published by the program covers many different environmental issues and topics with information and then provides possible education opportunities that could be used in the classroom to effectively teach environmental education. Schools in the program can compete to be the most sustainable and knowledgeable school on the environment, and gain recognition for focusing on environmental education. In order to participate in the Green & Healthy Schools Wisconsin, a school must go through a process of applying to be a part of the program. The current goal of the program is to reach 3,000 K-12 schools (Wisconsin Environmental Education Foundation). This literature is valuable to our research since many schools in Wisconsin have the opportunity to participate in this program. This literature may be reflected in our survey findings, as many of the participants in the survey may have grown up in the state of Wisconsin, therefore possibly being exposed to

state-wide environmental education programs such as the Green & Healthy Schools Wisconsin Program.

Sustainability in Madison

Sustainability policies also can play a great role in improving the public's risk perception of climate change, as they draw attention to increasing the sustainability of human activities.

Sustainability goals

Besides goals towards improved environmental education in schools, Sustainable Madison lists other plans to mitigate and adapt to climate change. These include plans to reduce carbon emissions, increasing the affordability of living in greener housing, and encouraging businesses to be more environmentally friendly. Sustainable Madison writes that they strive to reduce the city of Madison's carbon emissions by 80 percent by the year 2050 (Sustainable Madison, 2011, 32). Both Madison Electric and Gas Company and the Madison metro system are currently making efforts to meet these goals.

Madison Gas and Electric Company

With its Energy 2030 plan, Madison Gas and Electric Company is striving for renewable energy to make up 25 percent of the energy used by its customers by 2025 and then 30 percent by 2030. Madison Gas and Electric also wants to reduce carbon dioxide emissions of 2005 by 40 percent by 2030 (Madison Gas and Electric Company, 2015, 2). Throughout their website, which customers visit to pay their bills (if they choose to do so on the internet), MGE writes in great detail on how important sustainability is to their company and how they plan to become more sustainable in the near future. This information is rather readily available to visitors of their website, giving Madison Gas and Electric the ability to teach about climate change and human

effects on the environment. Furthermore, MGE has the ability to influence perceptions of climate change risk by highlighting that a customer personally could help to mitigate climate change by purchasing from a gas and electric company that uses renewable and sustainable energy sources.

Madison Metro System

The Madison metro system currently has 19 hybrid buses, which accounts for ten percent of all of its buses. These hybrid buses are powered by the Allison electric drive system which emits up to 90 percent less carbon than normal bus systems. While this is directly a method to sustainability in the realm of decreasing carbon emissions and human-caused pollution into the atmosphere, it also targets the public's perceptions of the effects of humans on the environment. If a passenger of the bus knows nothing at all about climate change or carbon emissions, and sees that the bus they are boarding is "green" or "clean," these claims may lead the passenger to inquire the meaning, therefore possibly bettering knowledge and perception of climate change and the effects of human activity on the environment.

With the methods of sustainability made by Madison Gas and Electric and the Madison metro system, it would be rather difficult for a student at the University of Wisconsin-Madison to be unaware of climate change science and possibly the debate on whether climate change is caused by anthropogenic forces. Since the terms "sustainability" and "eco-friendly" are potentially used more in Madison, than other areas, this exposure to the ideas of combating climate change could likely have an effect on the results that we receive in our survey, since it will be administered to undergraduate students at the University of Wisconsin-Madison.

4. Methods

Existing scientific literature on climate change was used to create a survey using Qualtrics. Demographic and perceptual data was collected through the administration of the survey to the University of Wisconsin-Madison undergraduate class pages on Facebook. The survey was also distributed to other group pages on Facebook like the engineering group page as well as the personal pages of the authors in attempt to gain a larger and more diverse sample of respondents. Data was collected over the course of just under a month, at 26 days. This was done in order maximize our sample size.

The "class of" Facebook pages were used to achieve the most diverse sample size, as the pages are run by the university itself. These pages are private and an invitation is required to gain access to the page. Invitations are sent to anyone that has been accepted to the university. We figured that since most undergraduate students are members of these Facebook pages, this would be where the most diverse responses could be achieved.

Surveys were also distributed on the personal pages of the authors to increase the exposure of the survey to UW-Madison students, as well as distribute the survey to any non-students that were willing to participate in the survey. To avoid the non-student responses affecting our student data, a "yes" or "no" question was included towards the beginning of the survey, asking if the respondent was a current student at UW-Madison. This way, it was possible to compare the many climate change perceptions among UW-Madison students, as well as compare them to the perceptions of non-students.

4.1 Study Selection

Peer-reviewed literature and studies were gathered in regards to current climate change trends both nationally and locally. Studies focusing on climate change perceptions were also

analyzed to see which factors affect perceptions and the scale to which these perceptions exists. Electronic searches for literature consisted of two main databases: *Web of Science* and *Google Scholar.* Studies were filtered based on the criteria of being peer-reviewed and on quality of the information included. Data and techniques used in each study were compared to similar studies in order to see if proper techniques were used and if data gathered was reasonable. Studies were removed if there were no applicable connections or lessons that could be applied to UW-Madison.

4.2 Survey Creation

Survey questions were created based upon results of analyzed literature and previous studies of climate change perceptions. Media, race, politics, and environmental education were prevalent factors of climate change perceptions in previous studies and may play a big role in the risk perceptions of undergraduate students at the University of Wisconsin-Madison. A total of 12 questions were asked in our survey. This was done to minimize the time commitment required by those participating and to ensure that participants completed our survey.

Similar to surveys found in analyzed literature we asked a few demographic questions to understand if factors such as race, gender, political orientation, and location had any effect on climate change perceptions. We then explored overall feelings of climate change, as well as the perceived extent to which politics, media, and environmental education have affected perceptions. Questions were answered using either a ranking system or Likert scale based responses. Respondents were also asked if they are currently a student at the University of Wisconsin-Madison in order to clearly distinguish between students and non-students.

5. Case Studies

A 2014 study from Yale that contains national, state, and county level data on climate change perceptions will be used as an example of how to create a survey on climate change perceptions. These comparisons will allow us to see how perceptions on campus vary from and affect surrounding areas. Dane county tends to have higher levels of risk perception and beliefs than any of the surrounding counties (Yale, 2014). Similar studies conducted at other campuses around the country, such as the one done at Tulane, can provide insight into how campus perceptions affect the surrounding areas. Data from other selected studies will also be used in order to understand the extent to which factors like race, politics, media, and environmental education shape climate change perceptions.

6. Prevailing Explanations

Although it has been confirmed among scientists that climate change is occurring, the perceptions of how much of a risk climate change carries is variable among the general public. Different factors play a role in the perception of risk and ideas on how climate change will affect an individual and their hometown in a personal manner. With the understanding of these perceptions of climate change risk, solutions to climate change can be made so that the general public is more willing to participate in actions that mitigate and adapt to global climate change.

7. Results

220 people responded to our survey. 131 of these were students and 89 were non-students. The majority of respondents identified as female at 71%. Democrats made up 63% of respondents, republicans accounted for 17%, and about 20% specified other or preferred not

answer. A large majority of our respondents were white, making up 84.5%. 85% of respondents were also from the midwest.

7.1 Media

Participants were asked to rank media sources in order of how they have affected their understanding of climate change. An ANOVA was run comparing the means of media sources between students and non-students were run (Table 1). We found no statistically significant differences. Both students and non-students ranked online news sites the most effective source, followed by television and newspapers. Students found other print media to have a slightly greater impact than radio/podcasts. In contrast, non-students found radio/podcasts to have a greater impact. However, the differences between these means are subtle, and both are relatively close to each other.

7.2 Politics

Using a chi-square test we found statistically significant differences (p-value < 0.001) between democrats and republicans in both concern over and cause of climate change (Tables 2 and 3). Those who chose not to answer or chose a third party were excluded from this test, in order to better compare our data to previous literature. While the majority of republicans agreed that they were concerned about climate change, the extent to which they agreed varied from democrats. 100% of democrats agreed that they were concerned about climate change; 80% of them strongly agreeing. In contrast, only 64% of republicans agreed that they were concerned with climate change; with only 22% strongly agreeing. Very similar trends were seen in the extent to which respondents agreed that humans were causing climate change. Close to 100% of democrats agreed, with only 1 respondent disagreeing. 92% of democrats strongly agreed that

humans were causing climate change. On the other hand, only 70% of republicans agreed with this; with 30% of them strongly agreeing.

A chi-square was also run using only data from UW-Madison students (Tables 4 and 5). Results between republicans were also found to be significantly different. Suggesting that political orientation has a similar effect on both students and non-students. This is particularly interesting as it differs from responses to the statement, "Politics have influenced my understanding of climate change." Responses to this question varied more than any other question (Figure 1). Responses show that political orientation does have an impact on climate change perceptions, although responses varied on whether respondents felt that politics influenced their opinions.

7.3 Race

Variance between racial groups were also explored using a chi-square. Due to the small sample size, minority groups were combined and then compared to white respondents. This aligns with previous studies, like a 2016 study by Pearson, which compared whites to non-whites. A chi-square was run comparing the level of concern of climate change between whites and non-whites. We found no significant differences between the groups, and calculated a p-value of 0.35 (Table 6). We also explored differences between the groups in regards to whether the respondents felt that humans are causing climate change. There were no significant differences between whites and non-whites with a p-value of 0.20 (Table 7).

7.4 Environmental Education

We found that students have generally received more environmental education than non-students. Using a chi-square test we compared how levels of environmental education translated

to concern over climate change. This test yielded a p-value of less than 0.001, suggesting that environmental education and concern about climate change are related (Table 8). We also compared environmental education to causes of climate change. This resulted in a p-value of 0.03, which is still significant, but to a lesser degree than to that of concern over climate change (Table 9). Overall, environmental education does seem to have an impact on climate change perceptions.

7.5 Climate Change Ranges

In question 6 of the survey, respondents are asked to rank to what extent climate change will be felt at three different geographic level: locally, regionally, and globally. Each level could be ranked out of 100%, so a respondent did not necessarily have to choose a level that would be most affected and could have chosen to rank all levels the same, such as 100% of all three levels would be affected the most by climate change. However, overall student respondents wrote that climate change would be most impactful globally, with the region being less impacted and the local level being the least impacted by climate change. This pattern is also found in responses of non-students (Figure 2).

8. Discussion

Climate change perceptions do vary among students at the University of Wisconsin-Madison, but not to a great extent. Most student respondents reported being concerned about climate change and agreed that humans are causing climate change. Students tended to have greater risk perceptions of climate change than non-students. It is difficult to determine, though, exactly what factors among students determine perception. There were little to no differences between students and non-students in regards to media, political orientation, and race.

Environmental education appears to have the most profound effect on climate change perceptions between students and non-students.

8.1 Limitations

Limitations of this study were primarily due to the distribution of the survey. Administration over Facebook could potentially have skewed our results. Those who are more interested in climate change may have chosen to take our survey in the first place. Using a more ambiguous title in our Facebook post would have potentially pulled in a wider sample group. Where we chose to post the survey could have also impacted the results of our survey tremendously. While the class pages on Facebook tend to include a majority of students in each undergraduate class, by choosing to only focus on these pages and a few other select pages, we could be over representing a particular population at UW-Madison. Results may have also been skewed through friends and family who chose to take the survey out of personal obligations.

We also found that we were limited through survey size. The questions that we chose to include in the survey may have not been the most representative of actual climate change perceptions. For example, while media sources were perceived as similar between students and non-students the specific types of media could potentially come from different sources with varying biases.

8.2 Future Research

With appropriate time and funding, a stratified sample of UW-Madison students can be achieved, therefore improving evidence to support the claim that UW-Madison students are more critical of climate change than non-students. Although the sample that our survey was distributed to was decent in size, it was not diverse by the means of demographics. For the demographics of

the survey responses to be more diverse, this survey must be distributed to more male identifying students, more non-white students, as well as more respondents that do not identify with the democratic political party.

Another option for future research on climate change perceptions would be to survey students from other universities and compare these results to the UW-Madison student results. Universities from different regions of the United States could be surveyed to measure how geographic location may play a role in climate change perception. Similarly, different universities throughout Wisconsin could be measured and compared, which could provide a more politically diverse sample as well as possibly provide information on climate change perceptions across rural and urban landscapes.

To attempt to research exactly what factor influences climate change perceptions, different groups of people could be surveyed, and then results could be compared. As an example, differently aged groups of people could be surveyed, such as high school students and senior citizens. This could help to determine if age plays a role in how someone perceives climate change and its risks. It could be difficult, though, to select groups of people that completely differ from one another. Therefore with the example provided, even though people may be differently aged, older respondents may have similar environmental education backgrounds to younger respondents. Much work would be required to use a survey to determine precisely which factors influence climate change perceptions and to what extent they have influence.

As discussed in the literature review, solutions to climate change may also influence climate change perceptions. Questions could be included in this survey, or used to create a different survey, that ask a respondent about their knowledge of current climate change

solutions. A respondent could be asked a “yes” or “no” question on whether they are familiar with the climate change solution, and then followed up with questions on how they perceive these solutions to have an impact on their life and idea of climate change. This information could be used to determine ways to better the education on solutions to climate change, as well as incorporate into public education ways that individuals can make a difference in the environment.

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Appendices

A. Survey:

Perception of Climate Change Risk in Madison

1. What gender do you identify as?

   -Male

   -Female

   -Other (please specify): _____

   -Prefer not to answer

2. Which political party do you tend to identify with?

   -Democrat

   -Republican

   -Other (please specify): _____

   -Prefer not to answer

3. What race do you identify yourself as?

   -White

   -Black or African American

   -American Indian and Alaska Native

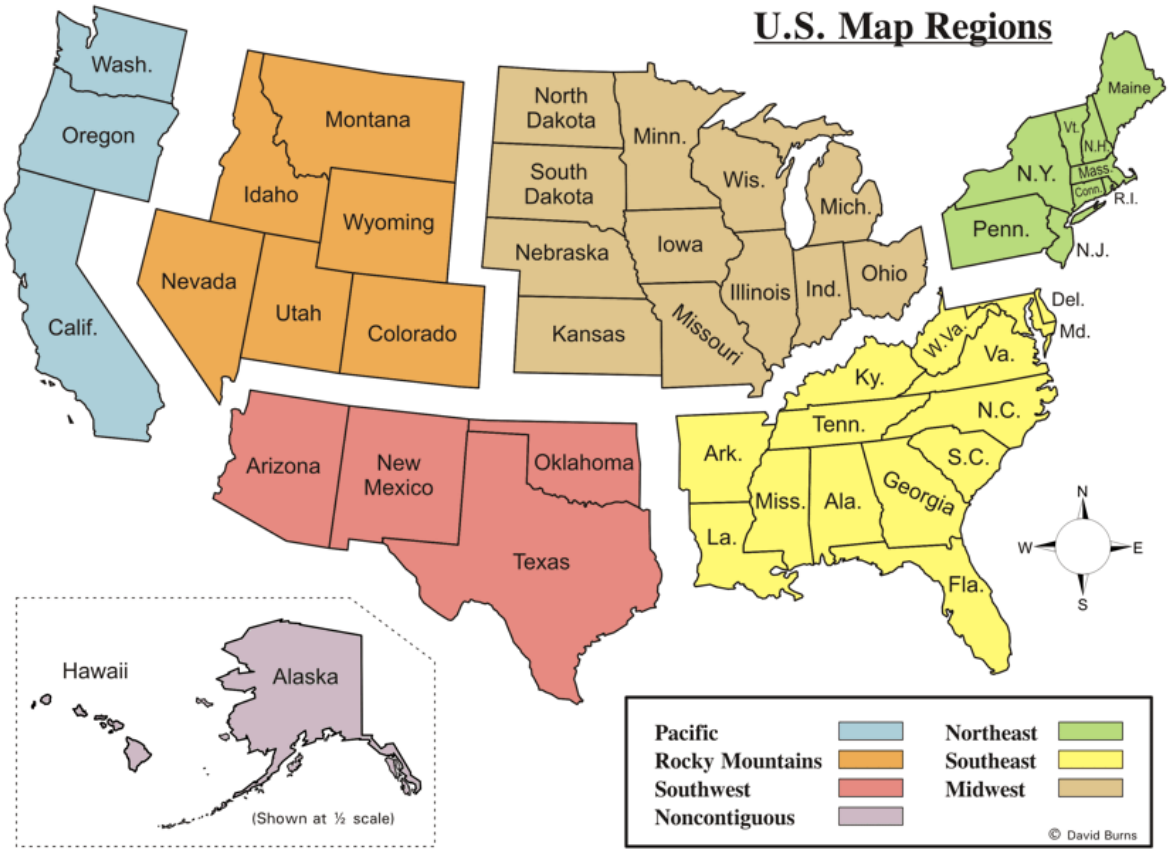
   -Native Hawaiian and Other Pacific Islander

   -Asian

   -Latino/a

   -Two or more races

4. What region of the United States are you from?



-Southwest

-Northeast

-Southeast

-Midwest

-Noncontiguous

-I am not from the United States (please specify): _____

5. Are you currently a student at UW-Madison?

-Yes

-No

6. Where do you believe the impacts of climate change will most likely be felt by human society?

(Respondent can give terms “locally”, “regionally”, and “globally” different percentages all out of 100)

7. The media has influenced my understanding of climate change

(Respondent can rate “television”, “newspaper”, “online news sites”, “other print media [posters, billboards, advertisements]”, “radio/podcasts” based on a scale from 1-5, 1 being most influential, 5 being least influential to respondent’s understanding of climate change)

To what extent do you agree with the following statements:

8. I am concerned about global climate change.

-Strongly agree

-Agree

-Neither agree nor disagree

-Disagree

-Strongly disagree

9. Human activity is playing a role in global climate change.

-Strongly agree

-Agree

-Neither agree nor disagree

-Disagree

-Strongly disagree

10. Politics have influenced my understanding of climate change.

-Strongly agree

-Agree

-Neither agree nor disagree

-Disagree

-Strongly disagree

B. Privacy Statement

We are a research group for the Colloquium of Undergraduate Majors in Geography at the University of Wisconsin - Madison. Our focus is on perceptions of climate change risk from people at UW and around the nation. We intend to use the data collected by this survey to analyze how people are interpreting perceived risk to climate change. You will remain anonymous and your answers will not be shared individually with anyone outside of the research team, but instead will be compiled with everyone else's responses so that the researchers can say things like: 55% of respondents are female. This study will be presented at the Undergraduate Symposium on Thursday, December 15, 2016 at 4:00 PM in L196 Education. You are welcome to attend, and we appreciate your participation. Thank you.

Tables and Figures

Source	SS	df	MS	F	P
Treatment (between groups)		1	0	0	1.000
Error	0.0746	4	0.0187		
Ss/BI	7.4129	4			
Total	7.4875	9			

Table 1. Summary of ANOVA for means of media sources with correlated samples, k=5

		Do you identify as a democrat or a republican?
I am concerned about global climate change	Chi Square	69.0269
	Degrees of Freedom	16
	p-value	0.00001

Table 2. Chi-square table comparing democrats and republicans to the extent to which they agree with the statement, "I am concerned about global climate change."

		Do you identify as a democrat or a republican?
Human activity is playing a role in global climate change	Chi Square	75.6609
	Degrees of Freedom	4
	p-value	0.00001

Table 3. Chi-square table comparing democrats and republicans to the extent to which they agree with the statement, "Human activity is playing a role in global climate change."

		Do you identify as a democrat or a republican?
I am concerned about global climate change	Chi Square	31.77
	Degrees of Freedom	4
	p-value	0.0001

Table 4. Chi-square table comparing student data only of democrats and republicans to the extent to which they agree with the statement, "I am concerned about global climate change."

		Do you identify as a democrat or a republican?
Human activity is playing a role in global climate change	Chi Square	51.57
	Degrees of Freedom	4
	p-value	0.0001

Table 5. Chi-square table comparing student data only of democrats and republicans to the extent to which they agree with the statement, "Human activity is playing a role in global climate change."

		White or non-white
I am concerned about global climate change	Chi Square	5.8885
	Degrees of Freedom	4
	p-value	0.20763

Table 6. Chi-square table comparing responses of whites and non-whites to the extent to which they agree with the statement, "I am concerned about global climate change."

		Do you identify as a democrat or a republican?
I am concerned about global climate change	Chi Square	4.46
	Degrees of Freedom	4
	p-value	0.3473

Table 7. Chi-square table comparing responses of whites and non-whites to the extent to which they agree with the statement, "I am concerned about global climate change."

		White or non-white
Human activity is playing a role in global climate change	Chi Square	5.8885
	Degrees of Freedom	4
	p-value	0.20763

Table 7. Chi-square table comparing responses of whites and non-whites to the extent to which they agree with the statement, "Human activity is playing a role in global climate change."

		To what extent do you agree with the following statement: During my years of schooling, I have learned about climate change and how human activity affects the environment
To what extent do you agree with the following statement: I am concerned about global climate change	Chi Square	41.70
	Degrees of Freedom	16
	p-value	0.00

Table 8. Chi-square table of data from all respondents comparing their responses of two "to what extent do you agree with the following statement" questions: "I am concerned about global climate change," and "During my years of schooling, I have learned about climate change and how human activity affects the environment."

		During my years of schooling, I have learned about climate change and how human activity affects the environment
Human activity is playing a role in global climate change	Chi Square	27.71
	Degrees of Freedom	16
	p-value	0.03

Table 9. Chi-square table of data from all respondents comparing their responses of two "to what extent do you agree with the following statement" questions: "During my years of schooling, I have learned about climate change and how human activity affects the environment," and "Human activity is playing a role in global climate change."

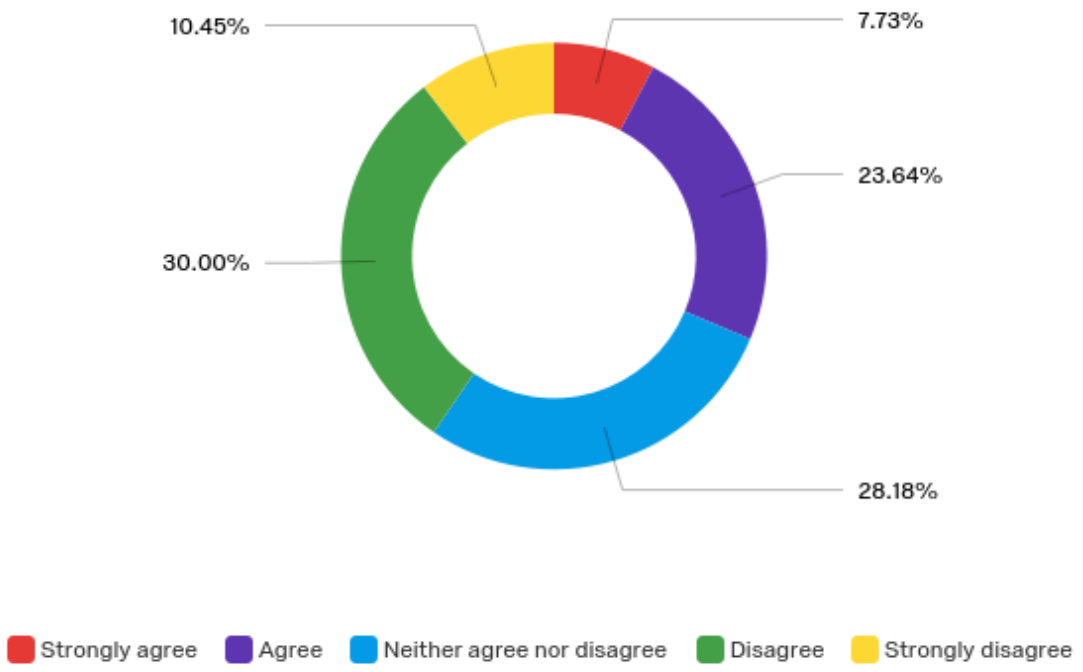


Figure 1. Breakdown of responses to the question, "To what extent do you agree with this statement: Politics have influenced my understanding of climate change"

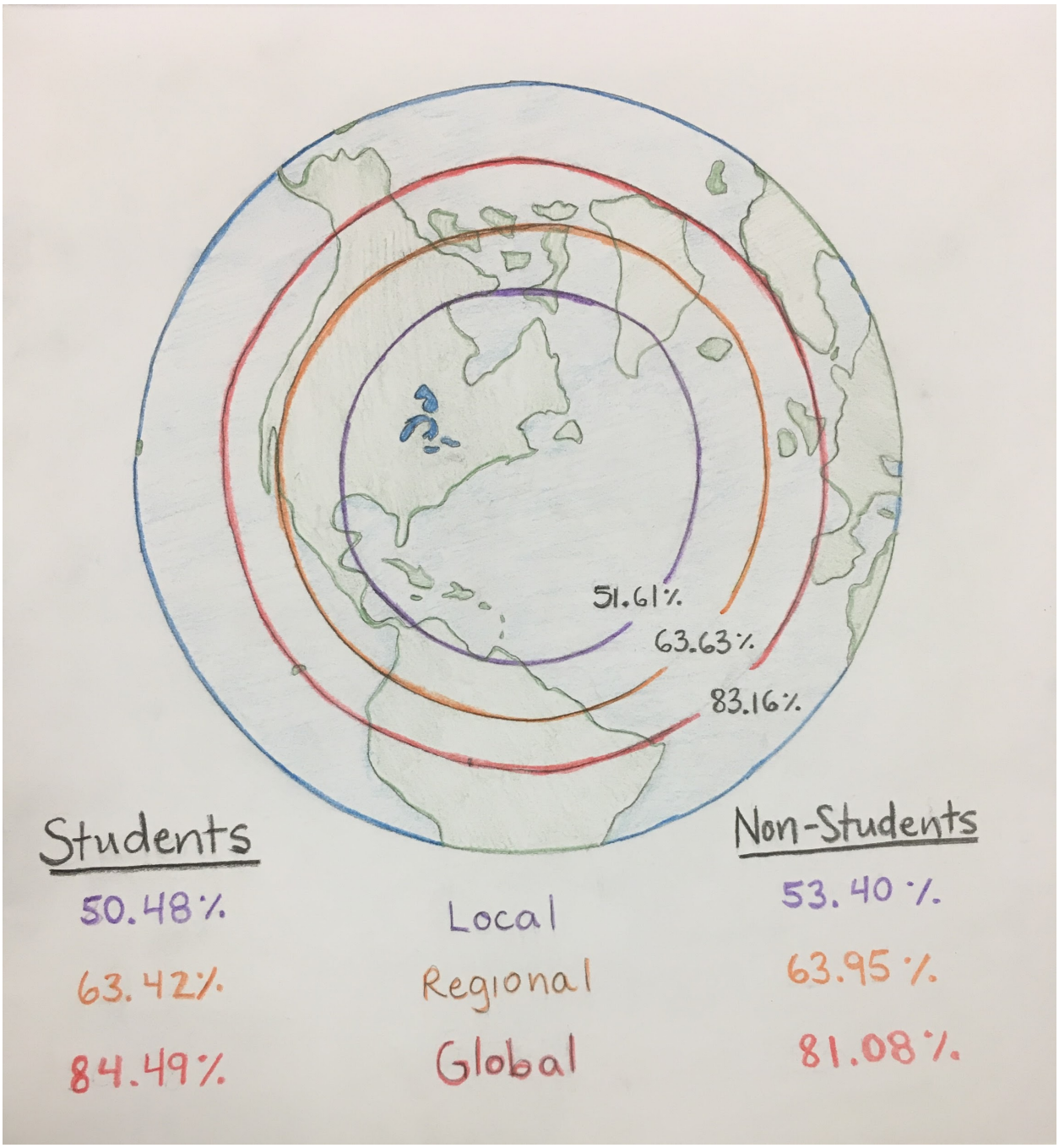


Figure 2. Original graphic showing spatial perceptions of climate change.