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Climate change is the greatest existential threat to humanity. Throughout high school, I have connected myself to a massive global movement of youth fighting to change this. Over the past four years, I have dedicated my time to pursuing policy solutions to environmental issues and spearheading climate education initiatives in my local community, as well as at the national and global levels. Through these projects, I've engaged with other inspiring activists and learned the importance of collaboration and leadership - especially among young people whose futures are most impacted by global warming. When it came time for me to conduct my own research study in my senior year of high school, which I later submitted to Regeneron Science Talent Search, there was no question in my mind that I wanted to explore the social and political dimensions of climate change.

While my efforts to combat climate change were fulfilling, I often felt helpless as just one person in the face of a global emergency as massive as the climate crisis. As a high school student lobbying my local and state Democratic legislators on behalf of the environment, I was accustomed to hearing that certain necessary environmental legislation or projects simply couldn't be passed due to divided government and party polarization. I visited my county legislative building on numerous occasions, and the tension between the Republican and Democratic offices was always palpable. Not only were the offices of each party located on opposite sides of the building, Republican and Democratic legislators never even ate lunch together. Against the backdrop of today's political landscape, this division is nothing out of the ordinary. Civil discourse between Republicans and Democrats is sparse, especially as it concerns

highly politicized issues such as climate change. But something as simple as lunch time divided along partisan lines is representative of this greater divide in American politics that grows more and more prevalent each day.

Presently, American politicians are categorized by intense polarization and an absence of constructive discourse between members of opposing parties. To draw a few statistics from my paper, the percentage of Americans who identify with strong political views more than doubled in the span of twenty years (1994-2014), and 77% of Americans believe the country is more divided presently than it was in 2020. Largely contributing to this is the fact that expressions of public opinion on climate change occur disproportionately in polarized digital spaces plagued with echo chambers and misinformation (e.g., Twitter (X), Facebook, Reddit, Youtube, Instagram), in which information is often presented without valid scientific backing.

Witnessing political polarization affect the environmental projects I engaged in was frustrating, so I began my research in the field of environmental sociology my sophomore year of highschool with the intent of better understanding how we, as a society, can promote environmental awareness in a non-polarized manner. Before conducting my own research, I read and analyzed studies on various environmental issues, such as the relationship between redlining and environmental toxicology, clean energy, and international environmental politics. I also explored other areas of research I believed to be related to the multidimensional issue of climate change, such as sociology, communication studies, and international law.

My first full research study my junior year of high school focused on the intersection between cultural and racial identity and climate change messaging on social media. After completing this study, I began working on a second study which I eventually submitted to Regeneron Science Talent Search, titled “Inside the Echo Chamber: A Closer Look at Climate

Change Discourse on Twitter (X), and Political Correlates of Affective Polarization.” This study was inspired by my climate activism work and interest in American politics, as well as my previous study which also focused on social media.

I honed in on the specific research topic of climate misinformation and political polarization early in the summer of my junior year, and began looking for a mentor around this same time. The process of looking for a mentor was exhausting due to the fact that most college professors prefer to work with undergraduate students rather than high school students. I eventually turned to a family member for assistance with my project, a distant cousin named Daniel Greenwald, who studied astrophysics at Columbia University and the Max Planck Institute in Germany, and is now a professor of astrophysics at the Technical University in Munich. Although my mentor’s research was in an entirely different field than my own, he was able to help me by providing useful statistical models and helping me develop my research methodology. I also received informal guidance from my aunt, Parisa Muller, who studied social psychology at UC Berkeley and Harvard College, and is now a school psychologist at a middle school in Oakland, California. Though both of my mentors’ own research was unrelated to my project, it was actually extremely helpful to receive input on my project from a mathematical/scientific standpoint as well as a social and psychological perspective.

I met with my mentors periodically throughout the summer and early fall to discuss my research. This was not always easy, as one of my mentors lived in California with a three hour time difference, and my other mentor split his time between Germany and Japan, which at times meant a twelve hour time difference. I remember a few nights in September meeting with my mentor at 3:00-4:00 AM my time, which, as bad as it may seem, was actually a pretty cool

experience. I conducted my entire study remotely on my own computer, mostly at the Port Washington Public Library, Schreiber High School, and my own kitchen table.

I had to learn new statistical models for my research. I used data from publicly available, online datasets, which meant that I did not collect my own data. However, this meant that a major portion of my study involved sorting, analyzing, and interpreting data. The main dataset I used in my study was the Climate Change Twitter Dataset, the largest and most extensive public dataset of climate change-related tweets to data. This dataset contains a total of fifteen million de-identified tweets, so sorting through this dataset took learning the intricacies of platforms such as Gigasheet and , rstudio, and SPSS. Additionally, I also utilized two other datasets, the FiveThirtyEight Partisan Lean metric, and Boris Schor and Nolan McCarty's models of ideological polarization in state legislatures. One statistical concept that my mentor was able to familiarize me with was normalized residuals, and this was extremely useful when I got to the analysis portion of my study. I also had to familiarize myself with different data visualization techniques in excel in order to produce the charts and visuals included in my final paper.

I used the combined data from these three datasets to examine the online behavior of climate change deniers—people who deny the existence of human-induced climate change—and how it varies according to the political leanings of the populations and legislatures of different states. More broadly, I looked at the hostility with which climate change deniers tweeted in different regions of the country. I used the FiveThirtyEight Partisan Lean metric to measure the partisanship (left or right lean) of the electorate in each of the fifty states, and Boris Schor and Nolan McCarty's models to measure legislative polarization (division between Republican and Democratic state legislators) in each state as well. I analyzed over two million tweets originating in the United States leading up to the 2020 election, organizing according to latitude and

longitude coordinates specific to each state. I found that partisanship of state populations and polarization of state legislatures have a negligible effect on the online behavior of climate change deniers. Additionally, I found that climate change deniers from Republican and Democratic states tweet with uniform aggressive sentiment. The results of my study suggest that social media encourages interaction networks that transcend geographic boundaries, diminishing the importance of in-person interactions in shaping political discussions online. My research also provides the basis for recommendations around hate speech and misinformation policies on social media platforms as discourse around climate change shifts away from X (formerly Twitter) and toward emerging platforms.

The process of conducting my own research study from start to finish was extremely gratifying. I enjoyed using creative thinking and problem solving when I came across issues in my methodology, as well as to interpret my results (or sometimes lack of results). Every issue I encountered taught me something about how to think critically and be detail-oriented. It is also exciting to know that my research now contributes to a vast body of research in the field of environmental sociology, and that I am connected to so many other students, scholars, and scientists who are combating climate change through scientific research. My research offers insight into one very specific aspect of climate change, but there is much more research out there that clarifies, corroborates, or contradicts specific aspects of my own research, and I find that fascinating.

Of course, there are things I wish I had known before getting started on my project. The most important piece of advice I would give to students looking to conduct their own research is that they should not be afraid to ask for help. Not understanding statistics or certain terminology is completely okay, and is not indicative of their potential as a researcher. In fact, I would argue

that the best research involves familiarizing oneself with concepts, formulas, and technologies that may seem, at first, complicated or foreign. Being open to new experiences throughout the research process will ultimately open up new pathways and possibilities for your study that you may not have conceived at the start. A second piece of advice I have is to pick a topic that you are passionate about, but also one that has relevance to a major societal issue. Whether that be climate change, public health, technology, human rights, or any number of other topics, your research should aim to address an important issue in a way that has not been done before. My third and last piece of advice is not to be deterred if your results do not yield any statistical significance. In the case of my study, I did not know what to make of my lack of results and prematurely deemed a study a “failure.” It was only when I tried to understand why I found no statistical significance for certain hypotheses when my study truly started to take form. It turned out that my results, albeit not what I was expecting, suggested something that contradicted previous literature in a very intriguing way. As an undergraduate student at UC Berkeley, I can’t wait to continue to build on this research and discover what broader implications my findings may have.