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Fundamental Human Factors of the Climate Crisis

A dissertation submitted in partial satisfaction of the requirements for the degree of

Doctor of Philosophy

In

Cognitive and Information Sciences

by

Brandon Batzloff

Dissertation Committee Members:

Professor Michael Spivey

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University of California, Merced
2022

This work is dedicated to my sister Lisa who
always encouraged me to follow my dreams.
I hope Lisa is living her dreams.

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Abstract

Relative Ideology Spacing and the Climate Crisis from the Perspective of Marginalized Students

A dissertation submitted in partial satisfaction of the requirements for the degree of
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In
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by
Brandon Batzloff
Dissertation Advisor: Professor Michael Spivey

Chapter 1: An overview of the human dimension of the climate crisis that details the urgency of developing adaptation solutions that benefit communities already being impacted.

Chapter 2: Marginalized UCM students from the San Joaquin Valley were paired and asked to discuss multiple climate change related prompts. Recordings of the discussion were analyzed. Findings reinforced knowledge that students learn climate science information better when it is presented in a culturally salient manner. Expertise in addressing the effects of the climate crisis was found among farmworkers. Findings suggest areas of cross-cultural communication research that should be expanded on to improve an understanding of the climate crisis on diverse populations.

Chapter 3: Recognizing that climate science is presented to the public as a political issue, a study was designed regarding ideological messaging. Research on ideology typically scores individuals on inventories that place the individual on static scales and assigns the individual to ideological groupings. The approach in this study was to use mouse tracking to create an implicit measure of the decision making involved when participants define ideologies according to a set of ideological traits. The result was a mutated Left-Right scale that represented the ideological landscape as viewed by a population.

Chapter 4: The effects of the climate crisis are inevitable. This chapter explored three areas of applied, community engaged research developed in conjunction with other lines of research over the last several years. Research education programs are used to improve the success of marginalized students, increasing the presence of marginalized people in academia. Mediating organizations are a method of balancing the power of academic institutions when negotiating research agreements with community organizations. Data archives controlled by indigenous communities are proposed as a method of preserving scientific data, financing the futures of the communities, and as a long-term process of transferring ownership of data to indigenous communities.

Chapter 1

The Human Dimension of the Climate Crisis

The impacts of the climate crisis have had devastating effects across the globe, yet efforts to confront the crisis and develop strategies for reducing emissions have made little progress. A disconnect between policy makers and the people whose lives they impact has been depressingly obvious. Such human action and inaction is encompassed in the area known as the human dimensions of climate change. The research contained in this dissertation was conducted as subsets of basic questions. What do people with no scientific background understand about climate change? How does policy messaging impact ideological identity? How can adaptation strategies be applied to marginalized communities? What was learned was an important foundation for a lengthy course of research. This dissertation is only the foundation for future research

The Climate Crisis

In 2018, The Intergovernmental Panel on Climate Change (IPCC) released their Fifth Assessment Report on the impacts of climate change. Traditionally, the IPCC has been extremely conservative in projecting the speed of global warming and in the severity of impacts of climate change. The Fifth Assessment Report signaled a departure from this approach with a warning that the Earth would cross the threshold of 1.5° C warming since the preindustrial era as early as 2032 (IPCC, 2018). Further, the report contained detailed descriptions of the disastrous consequences of a 1.5° C temperature increase. Four years later, the IPCC issued the Sixth Assessment Report (2022) warning the situation had become even more dire. Agreements made between governments were not enough to keep heating below 1.5° C. Less than a year remained to reduce emissions enough that the target would be met. There was no evidence this would happen. In fact, the 2021 United Nations Climate Change Conference (COP26) was considered a failure with existing agreements becoming more diluted (Masood & Tollefson, 2021). The goal has shifted to keeping warming under 2° C, but even that seems ambitious given that at the current rate, the temperature increase will be at least 2.4° C (Masood & Tollefson, 2021).

It has become increasingly clear to both experts and the public that climate disruption is a grave threat to human civilization. We are at a point in history where crafting a response to the crisis is imperative, yet an adequate response from both public and private sectors does not exist. An urgency to find a solution to what is an existential crisis is overwhelmed by the short-term economic interests of a relatively small number of individuals and corporations. In July of 2022, UN Secretary General, António Guterres issued a video statement to the Petersberg Dialogue on climate change in which he stated:

“We need a concrete global response that addresses the needs of the world’s most vulnerable people, communities and nations. The first step is to create a space within the multilateral climate process to address this issue – including on finance for loss and damage....This has to be

the decade of decisive climate action. That means trust, multilateralism and collaboration. We have a choice. Collective action or collective suicide.”

Secretary General Guterres was referring to the fact that the 2010 pledge made at COP16 by developed countries to provide \$100 billion in assistance per year between 2020 and 2025. This funding was to be delivered to developing countries with the goal of financing climate adaptation projects (fig 1.1). To date, only a small amount of funding has been provided and that has mostly been in the form of global finance investments for which a return is expected by the investor. Secretary General Guterres made the point that developed countries should be providing financial assistance without an expected return because developing countries are most afflicted by climate disasters resulting from the behaviors of developed countries. One of the reasons that COP26 was considered a failure was because corporate interests were strongly opposed to the idea of reparations (Masood & Tollefson, 2021), or compensating developing countries for past damages. Failure to pay reparations is a form of wealth extraction. The cost of fossil fuel production and use is displaced onto external economies to increase profitability of fossil fuels. Rather than compensate developing countries for climate change induced damages, loan offers are made to nations when there is low risk of default.

1.1

Adaptation in Developing Countries

What is Needed

Aid to develop infrastructure.

Compensation for damages caused by wealthy countries.

Social strategies to live with effects.

What is Offered

Investment in Global Finance.

Loan offers when risk is low.

Promotion of incremental changes for public in developed countries.

On the left are the financing needs of developing countries. On the right is what has been provided instead. Instead of offering financial aid, developed countries have created investment schemes that profit off the damages to developing nations created by the behaviors of developed nations.

While large scale changes in social life are required in both developed and developing countries, only incremental changes are offered that have little impact on emissions by developed countries. Charging customers for bags or banning plastic straws

are examples of incremental changes of this type. Refraining from purchasing certain items makes a consumer feel good. They do not have to do much to help with the crisis, when in fact these measures have little to no impact. What is needed instead is a more radical reshaping of social life and social practices (Monbiot, 2022).

The history of climate science has been one of continuously updated projections. There is a tendency to be conservative with predictions, however, the worst-case scenario in modeling has often come to be reality. Where scientists in the 1980s were ridiculed for claiming that the Earth was warming (McKibben, 1989; Kerr 1989), it is now the case that the most conservative interpretations of data suggest that warming is accelerating so rapidly that it will seriously disrupt human activity across the board (IPCC, 2022; Hoegh-Guldberg et al, 2018; Roy et al, 2018; Gowda, Steiner, Olson, Boggess, Farrigan, and Grusak, 2018; Maxwell, Julius, Grambsch, Kosmal, Larson, and Sonti, 2018).

In 1988, James Hansen was the first scientist to state definitively that the Earth was warming because of human activity (McKibben, 1989). He made this statement while testifying before Congress (Shabecoff, 1988) about his research concerning warming over different periods (Hansen and Lebedeff, 1987). The research showed that warming between 1965 and 1980 was statistically different than warming periods earlier in the century. Hansen was later asked to testify in Congress about whether the draught of 1988 was an effect of warming (McKibben, 1989). He stated that he believed warming would lead to many types of weather effects. Later, Hansen would go on to counter a popular assumption that warming would expand desertification but would make other regions lush with vegetation (Hansen et al, 1991). His research showed that rather than new temperate bands, weather patterns would become unstable, having generally negative effects globally.

It was still believed that the serious effects of climate disruption were centuries in the future or that they could be easily managed. It quickly became clear that what was expected to occur in a century or more would become the stuff of daily headlines less than 30 years later.

The climate crisis became a contentious issue due to political messaging and corporate propaganda (Supran & Oreskes, 2021). Fossil fuel extraction companies first denied there was an issue, then denied they had knowledge of the issue, then claimed the problem was easily solvable. The fact that fossil fuel companies have long been aware of the threats of climate change are well documented. Exxon commissioned research in the 1970s that showed a doubling of CO₂ emissions would result in a mean global temperature increase of between 2° C and 3° C (Banerjee, Song, and Hasemyer, 2015). The same modeling showed an increase of as much as 9° C at the poles. These projections were later used to propose new Exxon research regarding the melting of polar ice. It was believed the positive feedback loops that would result in increased melting of Arctic ice would open territory for oil drilling in the Arctic (Jerving, Jennings, Hirsch, and Rust, 2015). The view of fossil fuel executives was that global warming was profitable and would open new opportunities. Former Exxon CEO Rex Tillerson (2012) expressed this viewpoint when he declared, “So we will adapt to this. Changes to weather patterns that move crop production areas around — we’ll adapt to that. It’s an engineering problem, and it has engineering solutions.” Tillerson could not have been more wrong. The climate is an aspect of multiple dynamical processes of the earth. Study

of a single effect requires examination of thousands to millions of variables. The outcomes are not as simple as farming zones simply moving northward.

Yet, the view that engineering will save us became ingrained in the public and represents only one aspect of the debate between advocates of science and propaganda. Understanding the development of this divide has been one of the great puzzles of the human dimension of the climate crisis for many years. research in the following chapters was conducted to explore such puzzles.

The Human Dimension

While there have been many calls over the years to focus on the human dimension of the climate crisis, research on the human dimension has not received nearly as much funding as other areas of research (Flores-Landeros, Pells, Campos-Martinez, Fernandez-Bou, Ortiz-Partida, & Medellín-Azuara, 2021; Hochachka, 2020, 2022). Research included in this dissertation was conceived as an exploration of the human dimension of the climate crisis. Chapter 2 included a study in which the lived experiences of a population experiencing the crisis was used to ascertain knowledge of the climate crisis in the population that impacts intercultural communication. In chapter 3 focus shifted to the impact political messaging had on how ideological spaces were conceptualized using implicit measurements. Finally, in chapter 4 the foundations of applied research that improves the resilience of marginalized communities during the climate crisis were examined.

Chapter 2 focused on the experiences of marginalized people in California's San Joaquin Valley (SJV). As with other marginalized populations, marginalized groups in the SJV have been the most impacted by the climate crisis and other crises, such as the COVID pandemic. Data was collected in the form of recorded dyadic conversations. Qualitative data was an important resource for this study, as it allowed a direct examination not only of the knowledge and experience of marginalized people, but of the way knowledge was communicated within communities. Conversations began with a request to define climate change and then evolved with the inclusion of other topics that allowed participants to jointly define climate change through their lived experiences and the experiences of their families.

A main finding of this study was that even though laborers, such as farmworkers, might not have had a scientific understanding of climate change, they did understand the practical impacts of climate change on their lives and applied this understanding to their areas of expertise. Research on the experiences of marginalized workers in the SJV is mostly limited to public health research on air and water quality. The study in chapter 2 joins this larger body of research in showing that more research into cultural understanding and cultural communication of marginalized laborers, such as agricultural workers and livestock workers, is necessary. As is described in chapter 4, research on the human dimension of the climate crisis requires active partnerships between academics, scientists, and marginalized communities. Without a deeper understanding of the accrued cultural knowledge of the climate crisis, it is not possible for academics to communicate with marginalized communities in a meaningful or productive manner.

The study in chapter 3 was designed as a method for researching a more fundamental aspect of communicating climate science information effectively. Because the influence of fossil fuel extraction interests has caused climate policy debates to become so polarized, it is important to communicate climate science as a political form of information. When communicating complex policy issues to the public, political elites simplify such messages using ideological signaling: “social welfare is bad because it is socialism.” Ideology is largely conceived by the public as a single dimensional Left-Right scale. The true dimensions of ideological spaces are multidimensional, but messaging by elites serves the purpose of collapsing the multidimensional space into a single dimensional space for public understanding. A voter hearing that social welfare is socialism might use this single dimension to determine, “socialism is on the Left and the Left is bad, I am on the Right so I am opposed to socialism and social welfare.” Obviously, nobody uses such simplistic language, but simplistic language encapsulates the logic of political arguments well.

Research of ideology scales have historically been used to place individuals on a scale based on static characteristics, such as the degree of authoritarianism an individual is comfortable with. Because political messaging is used to collapse multidimensional spaces to single dimensions, and because individuals use ideological identity as an identity signaling mechanism (Smaldino, 2019), it was assumed that ideological identity spaces are dynamic spaces. The Left-Right scale was used as a familiar model on which to display how ideologies are aligned relative to the ideological identity of the participant. Relative Spacing (RS) scales were developed in which the order of ideologies is changed based on the identities of populations of participants. Doing so allowed for the creation of a scale that shows how ideological alignment is perceived by a population, rather than how individuals in a population might be ideologically aligned. Understanding the public view of how ideologies relate to each other is critical in predicting the impacts of political messaging and policy decisions. RS scales can be a fundamental tool that points to the best climate science communication methods.

Establishing RS scales requires the collection of implicit data. Computer mouse tracking was used to generate implicit data. Participants were tasked with determining which ideology of a pair of ideologies was most associated with an ideological trait. The curvature of trajectories resulting from movement of the mouse were used as a metric that was associated with the cognitive process of deciding which ideology was associated with the trait (Spivey, Grosjean, Knoblich, 2005). Use of mouse tracking as an experimental paradigm has grown rapidly over the past several years demonstrating it to be an accurate indirect measure of cognitive processes. The results of the study in chapter 3 provide evidence that mouse tracking can also be used to ascertain group identity traits.

The case is made in chapter 4 that applied, community engaged research is required as a tool to compensate marginalized communities for the wealth extracted from those communities, and as a process for building resilience in marginalized communities so they can better weather the effects of the climate crisis. Earlier in the present chapter, the effects of the climate crisis were described as taking place now and that governmental negotiations have done little to slow global warming. The effects of the crisis are not only affecting developing countries but are negatively impacting marginalized communities in the United States, as is described in chapter 2. Developed countries extract wealth from

developing countries by refusing to compensate developing countries for climate crisis induced losses. Similarly, academic institutions, extract future wealth, in the form of offset climate crisis effects, from marginalized communities by not compensating marginalized communities for past injustices that resulted in wealth extraction.

Wealthier communities have the resources to represent themselves on policy issues and are better able to plan adaptation strategies. To improve the resilience of marginalized communities, it is necessary to improve the wealth of these communities and the access they have to public institutions. Many academic institutions have used community engaged research practices to share data ownership with marginalized communities. Combined with practices that ensure the success of marginalized students and researchers, ownership of data by marginalized communities results in increased wealth and community resilience.

Three approaches for community engagement in applied research were shared in chapter 4. The first was a research education approach in which research programs were used as outreach to marginalized communities. In addition to increasing knowledge of scientific practice, such programs create a familiarity in the community for the academic institution. The institution becomes a part of the community. Training of students in outreach programs creates social skill sets necessary for success in the academic environment. Familiarity and potential for academic success generate pipelines through universities for marginalized students.

A mediating organization was proposed based on restorative justice practices. The mediating organization acts as a neutral party to negotiate community-based research agreements between the academic institution and community organizations. My experience in developing such an organization was used as a guideline.

The final approach was a proposal for a future project in which archives of scientific data are created by indigenous communities using external funding. If the climate crisis is as destructive in the coming decades as it might be, the failure of large-scale systems will result in the loss of large quantities of data. The construction of the archives provides physical resources for indigenous communities. In the event of data loss, the communities will also be left with ownership of the data. This would give indigenous communities an advantage in a future era of recovery.

The future might seem dark with climate disasters lurking around every corner. As Bill McKibben said, it is people, not governments, who are doing the hard work of building adaptation strategies and planning for a better future (2021). Research on the human dimension of the climate crisis is important because it helps *people* survive. It is important for academic institutions to lead the way in developing adaptation strategies for marginalized communities. Doing so addresses historical injustices committed by academic institutions and increases the chances of the survival of both marginalized communities, academic institutions, and research data. This dissertation was written as a starting point for developing cross cultural communication strategies that eventually provide access for the more ambitious projects proposed.

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Chapter 2

Experiencing the Climate Crisis: The Perspective of Marginalized Communities in the San Joaquin Valley

When the 2018 Intergovernmental Panel on Climate Change (IPCC) report was published, it included multiple calls for a greater focus on research regarding the human dimensions of the climate crisis. The term “human dimensions” encompasses multiple areas of research at multiple scales. The 1990’s slogan “think globally, act locally” is used to frame research reported in this chapter. I propose that a scientific understanding of the climate crisis is the global perspective, and the lived experience of non-scientists is considered local action. In this view a connection can be developed between the two levels. Specifically, this chapter focuses on the experience of marginalized populations in the San Joaquin Valley (SJV) of California through the perspective of university students from the area. Is it important to focus on whether people living in the San Joaquin Valley think globally by accepting climate change as real? Does this assessment change if the climate crisis has forced these people to alter their lives? Rather than focusing on what people should believe, this chapter explores how lower socio-economic status communities in the San Joaquin Valley understand and adapt to the reality of the climate crisis in daily life.

The area referred to as the San Joaquin Valley incorporates the San Joaquin Basin and the Tulare Basin, which are a part of the larger Central Valley of California. The Central Valley comprises 1% of farmland in the US and supplies 40% of the fruits and nuts, as well as 10% of other food products, consumed in the US (US Geological Survey). Agriculture is an important economic foundation of the region and is the main source of employment for marginalized people in the region’s cities. College students whose families work in agriculture usually have some experience with field work or associated jobs, such as packaging fruit. English is often the second language of farmworkers in the SJV. Farmworkers tend to be immigrants or children of immigrants from multiple countries, including Latin American countries like Mexico, El Salvador, Honduras, and Guatemala, and South Asian countries like India, Sri Lanka, and Bangladesh. There is also a large Hmong population in the area, as well as a sizeable Black or African American population.

People of color account for 60-74% of the population of SJV counties (US Census Bureau, 2022). Included research was conducted at the University of California Merced (UCM) where students of color comprise 90% of the student population (University of California Merced, 2022). A living salary in the SJV is \$70,000 per year and the range of median income in SJV counties is \$52,534 per year to \$68,628 per year (US Census Bureau, 2022). The combination of low-income levels and larger communities of color results in large marginalized communities.

Air quality in the San Joaquin Valley is extremely poor. Three SJV metropolitan areas appear at the top of the American Lung Association’s worst air quality report for 2018-2020, Bakersfield, Fresno-Madera-Hanford, and Visalia (2022). Stockton-Modesto-Merced has appeared at the top of previous three-year reports. Research has shown that varying levels of particulate pollution present in the SJV cause residents to alter their behaviors (Veloz, Gonzalez, Brown, Gharibi, & Cisneros, 2020; Cisneros, et al, 2017). It

should be expected, then, that air pollution will contribute to the perceptions marginalized people in the SJV have of climate change.

Water shortages should also contribute to perceptions of climate change. California and the Western United States are in the midst of a megadrought, or a drought lasting more than two decades, that has been attributed largely, but not entirely, to climate change (Williams, Cook, & Smerdon, 2022). The impacts of the drought on the SJV have been extreme and has led to the depletion of aquifers, further limiting water availability (Jeanne, Farr, Rutqvist, & Vasco, 2019; Ojha, Werth, & Shirzaei, 2019). Some SJV marginalized communities have not only lost access to safe water sources, but all water sources (London, et al., 2021).

Marginalized communities in the San Joaquin Valley are particularly susceptible to the effects of the climate crisis due to a long history of unjust treatment (Fernandez-Bou, et al., 2021). While the IPCC issued a call in 2018 for further research into the human dimensions of the climate crisis, there has been a failure among researchers and policy makers to consider research on human dimensions as seriously as research on physical, biological and chemical climate sciences (Flores-Landeros, Pells, Campos-Martinez, Fernandez-Bou, Ortiz-Partida, & Medellín-Azuara, 2021 ;Hochachka, 2020, 2022), as well as a failure to consider local and indigenous knowledge of the climate crisis and environmental history (London, Karner, Sze, Rowan, Gambirazzio, & Niemeier, 2013; Mignolo, 2011, Kovach, 2009). These failures of human omission have exacerbated the environmental justice crisis for marginalized communities. Adaptation to climate change has been commodified as a private good rather than a public interest (Khan & Munira, 2021), which has resulted in a focus on global financial development instead of improvement of local community resilience (Iskander & Lowe, 2020; Bridge, Bulkeley, Langley, & van Veelen, 2019; Scoville-Simonds, Jamali, & Hufty, 2020; Martineau, & Lafontaine, 2019; Davis, 2019).

An important distinction is the difference between farmworkers, who are mostly marginalized people, and farm owners, who are mostly wealthy individuals and corporations. Farmworkers do not have the decision-making power that farm owners have. For example, one of the reasons for poor air quality in the SJV is the use of fertilizers on crops. The fertilization of crops results in Nitrogen Oxide emissions from soil, which create smog and contribute to the greenhouse effect (Guo, et al., 2020). Because it is not the decision of the farmworkers to use nitrogen-based fertilizers, the agricultural output of greenhouse gases can not be attributed to their labor. In fact, the use of nitrogen-based fertilizers has displaced more sustainable indigenous farming practices used by marginalized groups (Berkes, 2017). Attitude changes that would reduce Nitrogen Oxide emissions from agricultural production must take place among farm owners.

Among American farm owners, the acceptance that climate change is real varies by region and differs from the larger population. In 2012, it was found that 66% of farmers in Midwestern states accepted climate change as a real phenomenon (Arbuckle, et al., 2013), while 54% accepted climate change as real in the Central Valley (Haden, et al., 2012). Midwestern farmers were more likely to accept climate change was occurring than the general public and farmers in the Central Valley were less likely to accept climate change was occurring than the general public.

In recent years, the portion of the population of the United States who accept climate change as fact has increased dramatically. According to the Yale Program on Climate Change Communication, in 2010, 61% of Americans accepted global warming was occurring and 50% accepted warming was caused by human activity. By 2017, 72% of Americans accepted global warming was occurring and 54% accepted warming was caused by human activity, while 18% were alarmed by climate change. Finally, in 2021, 76% of Americans accepted global warming was occurring and 60% accepted warming was caused by human activity, while 33% were alarmed by climate change.

People who do not have a scientific understanding of the climate crisis typically distance themselves from the cause of the crisis, while identifying local effects of the crisis as being of more immediate concern (Wilbeck, 2014; Whitmarsh, 2009) based on local values and priorities (Wolf, Alice, & Bell, 2013). The research reported in this chapter was intended as an exploration of the perceptions of marginalized students and their families in the San Joaquin Valley. It was expected that students would have a greater scientific understanding of the climate crisis after university education, which would have replaced a definition based on the effects of climate change as created by the experiences of their families.

While marginalized communities of the San Joaquin valley may have common traits with other marginalized communities, such as increased exposure to the negative effects of climate change, the specific details about how SJV communities understand and interact with the climate crisis are likely related to the differences that exist in their lived experiences. Marginalized students from the San Joaquin Valley are often immigrants or the children of immigrants who are introduced at an early age to agricultural labor. They live most of their lives in poor environmental conditions, such as poor air quality and sometimes with restricted access to safe water supplies. The purpose of the research in this chapter is to begin to understand how these factors have shaped the understanding of the climate crisis for these students and their communities.

Climate Crisis Perception Survey

A survey was designed as an exploration of trends in opinion among university students. Opinions of interest in the survey were the degree to which participants did or did not view climate change as a crisis, the degree to which participants believe they have agency in addressing climate change issue, and the degree to which participants aligned with different political ideologies.

The participants of this study were university students. Because younger people are usually more concerned about the climate crisis (Poortinga, Whitmarsh, Steg, Böhm, & Fisher, 2019), it was expected that concern about the seriousness of the climate crisis would be greater than the average for Americans overall. It was expected that if differences in opinion existed, they would be between socio-economic status (SES) groups.

Determining the degree to which participants believe they can have an impact on the climate crisis was intended as a measure of whether individuals believe the effects of climate change can be mitigated. If individuals do not believe they or their communities are responsible for the global effects of climate change (Wilbeck, 2014; Whitmarsh,

2009), it seems likely they would not believe they themselves could have an impact on the crisis, which would result in negative responses. Positive responses would indicate an idealistic hope for the future. Such idealism was not expected.

Most climate perception studies in the US use political party affiliation or liberal/conservative ideology choices as a categorical variable. Doing so assumes that ideological alignment lies on a single axis of left/liberal to right/conservative alignment. Being neutral on such an axis indicates partisan independence or political unaffiliation, however, such neutrality is not clearly defined and can serve many different purposes for the individual choosing to be neutral (Rempala & Okdie, 2022). Further, a large neutral population or a neutral population that displays dynamics changes in nature and size is evidence that a single dimension should not be used to evaluate ideological alignment (Iversen & Goplerud, 2018). To compare scaled responses, six political ideologies were selected for participants to indicate alignment with.

The results of the survey were intended to provide information on perceptions that exist to direct future research. Of particular interest was a comparison of views of people from the San Joaquin Valley (SJV) and people from outside the San Joaquin Valley.

Methods

Population

The survey was conducted among undergraduate students at the University of California Merced (UCM) in the Fall of 2017. Participants received course credit. There were 591 participants. Ages of participants were 18-25 with three non-traditional students aged 30-35. Participants represented a range of class backgrounds. Participants whose family income was less than \$70,000 per year were categorized as lower SES, as a \$70,000 per year income is less than a living wage in the San Joaquin Valley and most of California. Participants whose family income was greater than \$70,000 were categorized as higher SES.

In this study we were most interested in the responses of participants who lived in the San Joaquin Valley for at least five years before attending UCM. This includes the counties of San Joaquin, Stanislaus, Merced, Madera, Fresno, Kings, Tulare, and Kern. Participants from these counties were categorized as being from the San Joaquin Valley. Other participants were categorized as being from elsewhere or “other”.

Participants were asked to provide their race as an open response. After determining there were no significant differences in responses across subcategories within a racial category, races and ethnicities were categorized as follows:

- 33 participants identified as Black or African American, including 3 participants who self-identified as mixed race, African American or Black and White.
- 88 participants identified as Asian (East and Southeast Asia), including 9 participants who self-identified as Hmong, and 4 participants identifying with ethnic groups in the Middle East.
- 41 participants who identified as ethnicities coming from South Asia, including Indian, Punjabi, Telegu, Pakistani, Bengali and Sikh self-identified participants.

- 365 participants identified as Latinx, including Latino/a, Hispanic, Mexican, Salvadoran, and South American, and 6 mixed race, Indigenous (American Indian) and Latino/a self-identified participants.
- 64 participants identified as White.

Procedures

Construction of the survey took place in the online platform, Qualtrics. The structure of the survey was a series of statements for which participants were to respond with a degree of agreement or disagreement on an 11-point Likert scale. 0 was labeled “strongly disagree”, 3 was labeled “disagree”, 5 was labeled “neutral”, 7 was labeled “agree”, and 10 was labeled “strongly agree”. Statement blocks included two distractor blocks about the importance of different types of education and about the quality of life in Merced. Three relevant blocks were structured as follows:

Personal Views

- S1. I see climate change as a serious problem which demands immediate attention.
- S2. I see climate change as a serious problem, but there are more pressing problems.
- S3. I see climate change as a problem, but not a very serious problem.
- S4. I do not see climate change as a problem.

Personal Action

- S1. I can do something to make a large difference on the negative effects of climate change.
- S2. I can do something to make a small difference on the negative effects of climate change.
- S3. I can do something, but it will not make much difference on the negative effects of climate change.
- S4. I can do something, but it will not make any difference on the negative effects of climate change.

Ideological Placement

- S1. I consider myself to have liberal ideals.
- S2. I consider myself to have conservative ideals.
- S3. I consider myself to have leftist ideals.
- S4. I consider myself to have socialist ideals.
- S5. I consider myself to have alt-right ideals.
- S6. I consider myself to have fascist ideals.

Blocks of statements were randomized for each participant. Ideological alignment statements were presented randomly within the ideological placement block, while statements from other blocks were presented sequentially.

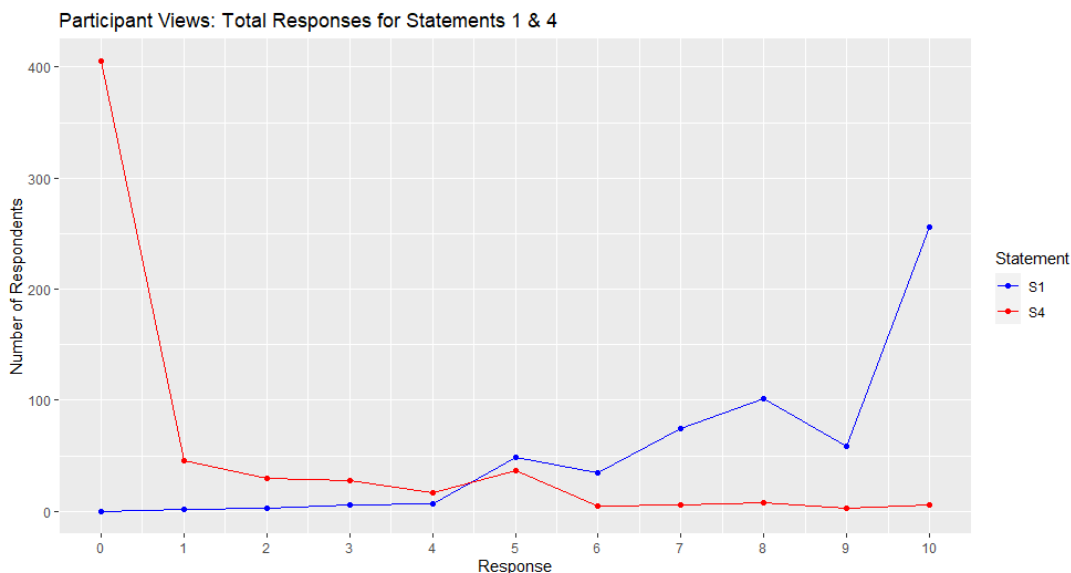
Results

Participant Views

Participants overwhelmingly agreed with statement 1 (fig 2.1), “I see climate change as a serious problem which demands immediate attention.” The statement was rated 7-10 by 82.74% (489/591) of participants. Similarly, statement 4, “I do not see climate change as a problem,” was rated 0-3 by 86.13% (509/591) of participants with 68.5% (405/591) of respondents rating the statement as “0.” Statements 1 and 4 were moderately inversely correlated, $r(589) = -0.50, p < .001$.

When comparing responses according to location SES, there was no significant difference between the ratings of groups. As expected, the mean response to statements for all location/SES groups declines from statement to statement as the seriousness of climate change is reduced in each statement (fig. 2.2). All groups tend to rate statement 1 as “agree” to “strongly agree” (fig. 2.3). The group “location other and high SES” had the highest mean rating for statement 1 (7.93, SD = 2.16), followed closely by “location valley and high SES” with mean rating (7.90, SD = 2.02), “location other and low SES” with mean rating (8.57, SD = 1.74), and “location valley and low SES” with mean (8.28, SD 1.91). All groups rate statement 2 as “neutral” and statement 3 as “disagree.” All groups tend to rate statement 4 as “strongly disagree.” The group “location other and high SES” had the highest mean rating for statement 2 (1.49, SD = 2.47), followed by “location valley and low SES” with mean rating (1.11, SD = 2.02), which was followed

2.1

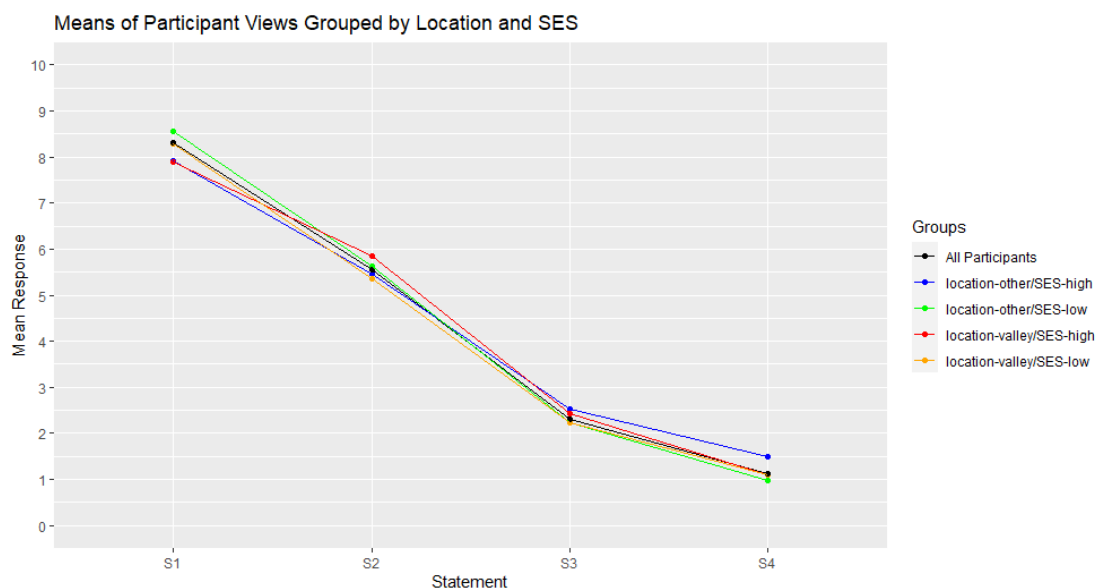


S1: I see climate change as a serious problem which demands immediate attention.

S4: I do not see climate change as a problem.

Participants agreed with statement 1 to varying levels and most participants strongly disagreed with statement 4. This indicates that participants are concerned about climate change and that very few participants are dismissive of the climate crisis.

2.2



A comparison of responses for personal views statements 1-4 was generated. Participants were grouped by whether they were from the San Joaquin Valley or another area, and whether they were from high or low socioeconomic status background. The means of participant responses for each group showed there was very little difference in opinion based on these factors.

closely by “location valley and high SES” with mean rating (1.10, SD = 2.06), and “location other and low SES” with mean (0.99, SD 2.04).

Means of responses for race groups followed the same pattern of decrease across statements as was seen with location and SES (fig. 2.5). The Latinx group had the highest mean for statement 1 and the lowest mean for statement 4 (fig 2.4). The Latinx group (365/591) was much larger than the other race groups. For this reason, other race groups were combined for comparison. No significant difference was found.

Personal Action

For both the location and SES groupings and the race groupings, responses trended toward “neutral.” For Statements 1 and 3, the greatest number of responses were for “neutral ratings.” Responses to statement 2 for both location/SES and race, the mean (7) response of all groups was “agree.” Responses to statement 4 were focused on neutral with a skew toward disagree ratings.

Ideological Placement

Participants tended to agree more with the Liberal (S1) and Leftist (S3) statements and to strongly disagree with the Alt Right (S5) and Fascist (S6) statements (fig. 2.6). To measure alignment with political ideology, responses rated 7-10, were grouped as “agree.” Responses rated 0-3 were grouped as disagree.

Comparison of ideological alignment groups for personal views and personal action resulted in a similar pattern as the race groupings. The number of “agree”

2.3

Descriptive Statistics for Personal Views Grouped by Location & SES			
Groups	n	Mean	SD
S1			
location-other/SES-high	122	7.930	2.16
location-valley/SES-high	50	7.900	2.02
location-other/SES-low	291	8.570	1.74
location-valley/SES-low	128	8.280	1.90
All Participants	591	8.320	1.91
S2			
location-other/SES-high	122	5.450	2.59
location-valley/SES-high	50	5.860	2.65
location-other/SES-low	291	5.620	2.50
location-valley/SES-low	128	5.370	2.71
All Participants	591	5.550	2.58
S3			
location-other/SES-high	122	2.520	2.36
location-valley/SES-high	50	2.440	1.98
location-other/SES-low	291	2.230	2.35
location-valley/SES-low	128	2.240	2.08
All Participants	591	2.310	2.27
S4			
location-other/SES-high	122	1.490	2.47
location-valley/SES-high	50	1.100	2.06
location-other/SES-low	291	0.986	2.04
location-valley/SES-low	128	1.110	2.02
All Participants	591	1.130	2.14

A full list of descriptive statistics for personal views statements using groupings of participants based on location and socio-economic status.

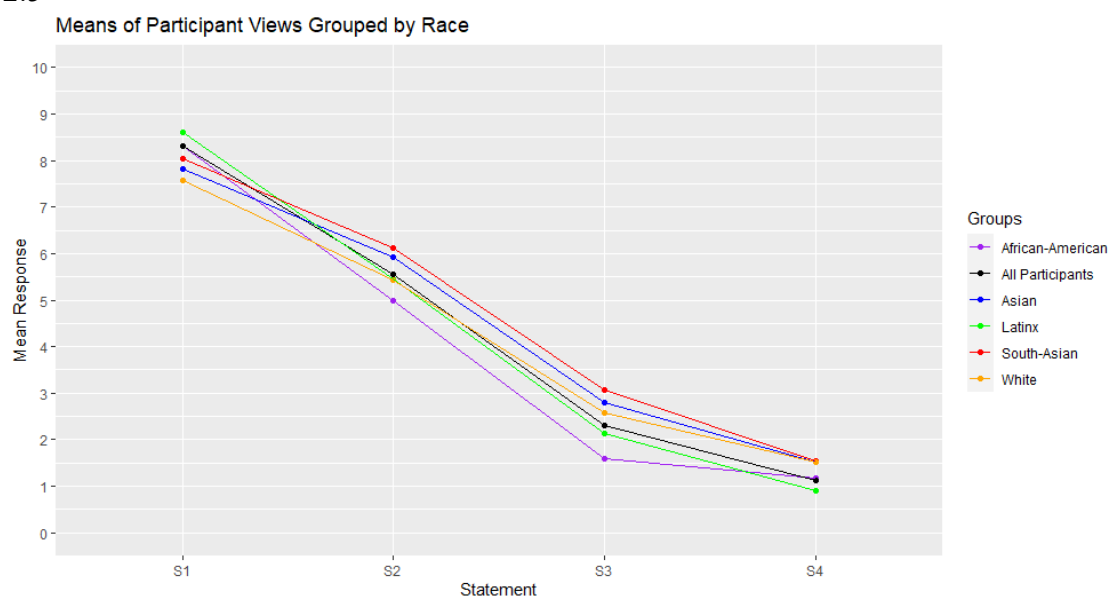
2.4

Descriptive Statistics for Personal Views Grouped by Race			
Groups	n	Mean	SD
S1			
African-American	33	8.30	2.01
Asian	88	7.83	2.07
Latinx	365	8.60	1.70
South-Asian	41	8.05	1.80
White	64	7.58	2.41
All Participants	591	8.32	1.91
S2			
African-American	33	5.00	2.72
Asian	88	5.93	2.31
Latinx	365	5.46	2.66
South-Asian	41	6.12	2.28
White	64	5.44	2.47
All Participants	591	5.55	2.58
S3			
African-American	33	1.58	2.21
Asian	88	2.80	2.20
Latinx	365	2.13	2.20
South-Asian	41	3.07	2.24
White	64	2.58	2.56
All Participants	591	2.31	2.27
S4			
African-American	33	1.18	2.65
Asian	88	1.52	2.10
Latinx	365	0.91	1.91
South-Asian	41	1.54	2.66
White	64	1.53	2.62
All Participants	591	1.13	2.14

A full list of descriptive statistics for personal views statements where participants are grouped by race.

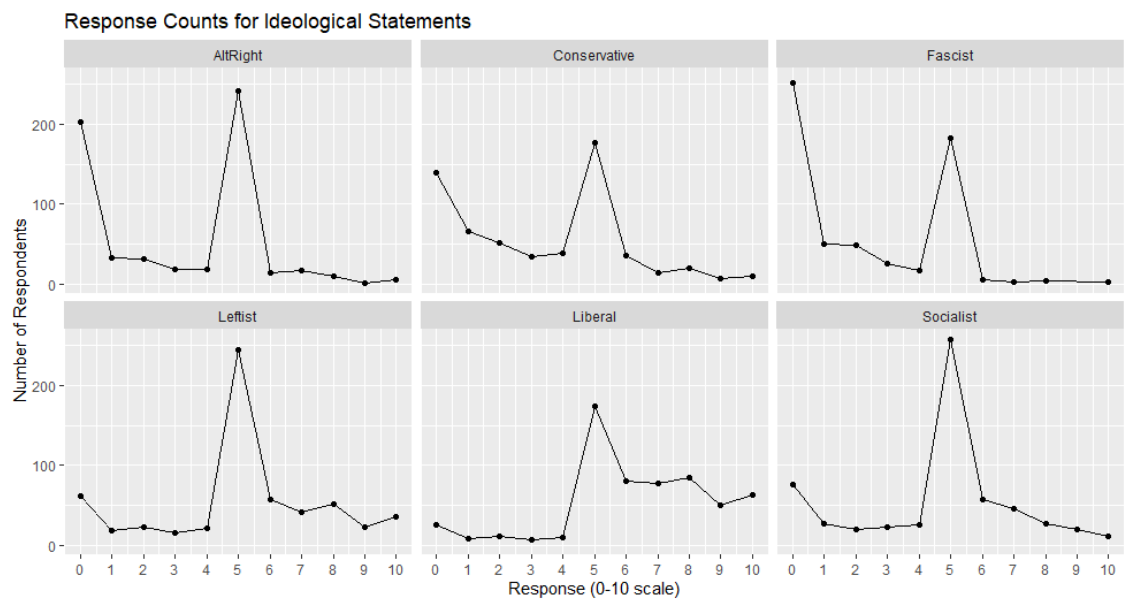
responses for (S6) Fascism (10), (S5) Alt-Right (33), and (S2) Conservative (49) were very small and did not differ from the response patterns of other groups. There was a degree of ambiguity in responses with many neutral responses for each statement. 19.46% (115/591) participants rated all ideological placement statements as neutral but responded in ways to other statement blocks (including distractor blocks) that did not appear to be the responses of an uncooperative respondent. For example, responses to statements within a block did not contradict each other. Most participants who rated an ideological placement statement tended to agree or disagree with others.

2.5



Comparison of responses to participant views statements by race grouping showed little difference of opinion.

2.6



Participants were asked how much they identified with each of six ideologies on a scale of 0-10, 0 being strongly disagree and 10 being strongly agree. Response counts are graphed to show comparative responses. There were far more Liberal, Leftist, and Socialist identified participants. Similarly there was a great deal of disagreement with Alt-Right, Conservative, and Fascist ideologies.

Discussion

In general, participants across all demographic groups and all political alignment groups believed that climate change is a serious problem. The bias toward the most urgent statement, “I see climate change as a serious problem which demands immediate attention,” created a ceiling effect that made it difficult to assess interactions with other variables. While it was expected that university-age students would display a greater level of concern about climate change than other age groups, it was still surprising that 82.24% of participants believed climate change to be an extremely urgent problem and that 86.13% believed climate change to be at least somewhat urgent.

The ideological alignments displayed were not surprising. For example, the strong negative responses to the “Alt-Right” and “Fascist” ideologies in a university population that is 90% students of color is to be expected.

Personal action statement 2, “I can do something to make a small difference on the negative effects of climate change,” was the only personal action statement to receive more agree responses than neutral responses. The low rate of disagree responses across personal action statements indicated that there is a feeling that some level of effect can be made on climate change through personal action, as was confirmed in the agree responses to statement 2. What do the large numbers of neutral responses indicate? To explore these levels of ambiguity, and to retrieve more detailed information about the experience of marginalized people in the San Joaquin Valley, it was decided the survey should be followed by a qualitative study.

Conversations About the Climate Crisis

The experience of marginalized students in the San Joaquin Valley (SJV) was required to gain an understanding of how students and their families incorporated the effects of climate change into their lives. Qualitative data highlights experience, knowledge, and interactions that are not considered in top-down study designs, designs where researchers determine potential responses and frame perceptions in a preconceived fashion (Fernandez-Bou, et al., 2021; Wilbeck, 2014; Whitmarsh, 2009; Wolf, Alice, & Bell, 2013; Flores-Landeros, Pells, Campos-Martinez, Fernandez-Bou, Ortiz-Partida, & Medellín-Azuara, 2021 ; Hochachka, 2022). As a qualitative study, the results of the study were not intended to be generalized to larger population, however, some cautious generalization about the experiences of students and farmworkers in the region were made

A scientific understanding of climate change is relevant to how global issues interact with local issues. Prior research has shown the global scale to be considered distant and unassociated from local concerns (Wilbeck, 2014; Whitmarsh, 2009). We hypothesized that marginalized students would display an intersection of views between local and global concerns based on the combination of their education and family experience. It was expected this intersection would involve environmental justice, but it was unknown whether there would be a tension between environmental justice and a scientific understanding of the climate crisis.

Methods

Population

During Spring 2018, participants were recruited from the student population of the University of California Merced (UCM). Ages of the 48 participants was 18-24. A prescreening process was used to filter participants with two criteria:

1. SES: All participants were members of families with an income less than \$70,000 per year, the living wage for the San Joaquin Valley.
2. Location: All participants lived in SJV Counties for at least five years before attending UCM. This includes the counties of San Joaquin, Stanislaus, Merced, Madera, Fresno, Kings, Tulare, and Kern.

Students were asked to identify their race as a standardized response. Racial breakdown was as follows:

- Asian: 9
- Black or African American: 5
- Hispanic or Latino: 33
- Native Hawaiian or Pacific Islander: 1

Procedures

Data was collected in the form of recorded conversations between pairs of participants. Participants were scheduled for conversations a minimum of one week after completing the filtering survey. Participants received course credit for participating in both the filtering survey and the conversation.

The study took place in a lab space with a casual layout that included a sofa, chairs, and a table. The purpose of the layout was to help participants feel at ease. Participants were provided with a list of discussion topics:

1. Discuss your ages, year in school, your major, and why you chose UCM and your major.
2. Where are your parents from? Why did they come to the San Joaquin Valley? What kind of work do they do?
3. What is the best way to define climate change? What are the effects of climate change? Be as detailed as possible.
4. Have you or has anyone you know been affected by climate change? In what ways?
5. In the immediate future (meaning the next year or so), how important is climate change compared to other issues for the Central Valley? How do these issues compare on a global scale? Next, talk about these same questions in the long term (in the coming decades).

6. Were your views regarding climate change different before you entered college? How have they changed or remained the same?
7. Have your parents' views regarding climate change changed since you entered school? How have they changed or remained the same?
8. How are your parents' views of climate change related to your own?
9. Discuss classes that have affected your view of climate change.
10. Discuss anything else that has affected your views of climate change.

Discussion topics were intended to encourage a broader conversation about the knowledge participants have of the climate crisis and effects of the climate crisis. The first topic about climate change asked participants to define climate change. The intent of starting the conversation with a difficult question was to learn what definitions, if any, each participant had before being given the opportunity to develop definitions through conversation.

Analysis

Transcriptions of each conversation were divided into segments. Each segment was defined as being a discrete discussion within the conversation. Segments were not restricted to responses to specific discussion topics, but frequently incorporated more than one discussion topic. For example, topics 7 and 8 were frequently discussed in one segment because both topics asked about the parents of participants which resulted in conversation continuing from one topic to the next.

Frequency counts (fig. 2.7) of references to relevant subjects were gathered. A list of subjects was created based on what participants discussed. An occurrence of a subject was counted only once per segment. If participants mentioned the word drought five times in one segment, the subject drought was counted once. The exceptions to one count per segment were the subjects "family discusses" and "labor," which were counted once per participant. Excerpts of each mentioned subject were grouped to provide a qualitative exploration of discussion topics and subjects.

Results and Discussion

Definition of climate change.

Participants were often hesitant to define climate change. Many participants would preface their definition by stating they were not that well educated about climate change. However, definitions given were usually accurate, even if they were not scientific definitions. Shifting weather patterns were given as a definition by 14 participants. Participant 15 stated, "I would define climate change as a change in the weather that's drastic compared to prior years." Other expressions of shifting weather patterns were not as concise as this definition.

Of the remaining 34 participants, there was an even split between definitions that presented climate change as a distant crisis and those who defined climate change through local impacts. Distant effects, such as ice caps melting, flooding on other

2.7

Frequency Count of Subjects Discussed	
Subject	Frequency
air pollution	22
asthma/allergies	6
climate migration	7
carbon cycle	4
crops destroyed	21
drought	28
environmental justice	14
family discusses, no	34
family discusses, yes	11
Food shortages	13
increased cold	10
increased heat	32
increased rain/flooding	12
knowledge, science courses	12
knowledge, humanities courses	14
labor, agriculture	18
labor, other	3
labor, professional	1
melting ice caps/glaciers	14
shifting weather patterns	23
soil subsidence	4
undocumented immigrants/DACA	3
volatile weather patterns	11
water quality	4
water shortage outside agriculture	9

A list of topics was generated based on conversations between participants. Discussions were broken into segments. If a topic appeared in a conversation segment, one occurrence was added to the tally for that topic.

continents, and global warming were described by 15 participants. Local effects like the impact of the drought on the San Joaquin Valley were described by 16 participants. Three (3) participants did not provide a definition.

A scientific definition of climate change would have included a description of the carbon cycle. Only one participant referenced a portion of the carbon cycle in their definition, “There are many greenhouse gasses that are causing the atmosphere to overheat” (participant 31). Across all discussion topics, references to the carbon cycle were made only three other times. There were 22 instances of discussion of air pollution across conversations, but such mentions were about the direct impacts of air pollution on the human body, such as increased asthma and allergies among people in the San Joaquin Valley, rather than a connection to the carbon cycle. Air pollution is of local concern for participants in the study but was not described as a more serious concern or even a different concern from climate change. Participants tended to use the terms for air pollution and climate change interchangeably.

Overall, definitions of climate change proposed by students followed the patterns observed in lay populations (Wilbeck, 2014; Whitmarsh, 2009; Hochachka, 2022; Wolf, Alice, & Bell, 2013) rather than those of scientifically educated students.

Education regarding climate change.

Nearly every participant (41/48) discussed “CORE,” a required general education course at UC Merced as being a major influence on their awareness of climate change. The “CORE” course was designed to give students an overview of subjects studied across disciplines at the university with a particular focus on California. Whenever the course was mentioned, students described an assignment in which they were required to calculate how long California’s current water reserves would last. The answer was usually around two years. The inclusion of the water sustainability exercises in the “CORE” course has been effective at helping students understand water sustainability during a megadrought, as well as helping students remain conscious of climate change as a serious issue.

With the environmental science portions of the “CORE” course having such a large impact, it seemed reasonable to expect that science courses overall would also have had a large impact on understanding the climate crisis. This was not the case. There were 12 mentions of science courses instilling an understanding of climate change in participants. Some mentions included more than one course. Some courses mentioned (course titles not precise) were “Environmental Systems Science” (participant 2), “Chemistry” (participant 14), “Earth Science” (participant 15), “Environmental Engineering Crisis” (participant 25), “Biodiversity” (participant 28), and “Environmental Crisis” (participant 44). Not all participants mentioned the names of courses.

Descriptions of how science courses assisted in participants’ understanding of the climate crisis could be divided into two categories. An understanding of climate change effects on specific systems learned in science courses was reported by 4 participants. The remaining 8 participants did not report any specific understanding, but rather that they learned “climate change is real” (participant 15).

Among the 14 mentions of climate crisis education in humanities courses, only three specific courses were mentioned, “Critical Ethnic Studies” (participant 2), “Chicano Studies” (participant 6), One participant mentioned a history course, and the remaining 11 participants referenced the field of Ethnic Studies. Participants who reported an increased understanding of climate change in humanities courses were more specific about what they learned. Examples included, “how minorities were placed in very polluted industrial neighborhoods and areas where climate catastrophes happen” (participant 2). There were four participants who made similar statements. One of these participants referenced a connection to CO₂ emissions and one discussed the construction of neighborhoods for marginalized people on flood plains. Other forms of environmental justice were discussed in an additional seven instances with more focus on critique of policy.

Participant 8 stated that, “It [climate change] feels more real because professors are talking about it.” This suggests exposure increased interest in and concern about the climate crisis. Similar statements were made about education in 16 other instances. An interesting anecdote was shared by participant 9 about a professor in a science course asking students to raise their hands if they believed climate change was real or not real. After doing so, the professor stated, “‘For the people who don’t believe in it or can’t even see it just walking outside,’ he’s like, ‘those are ignorant people.’ and that’s what he told us on the first day of school.” Participant 9 reported this event caused her to consider climate change more seriously, but this was likely because she had raised her hand in agreement. For students who might have disagreed, the opposing opinion might have resulted because the exchange would have affirmed preconceived biases (Stanovich, West, & Toplak, 2013).

The above story highlights a danger in higher education. When faculty stray from the role of mediating an understanding of critical interpretation of scientific findings while teaching science, the result is teaching students what evidence should be accepted as fact, rather than teaching students how to challenge evidence in the process of proposing refined plausible hypotheses. Ethnic Studies courses train students to think critically. In Ethnic studies courses there is the added benefit that education about scientific topics, like climate change, naturally intersect with the experiences of students taking the course, which creates a deeper understanding for students. Teaching about the connections to local communities when teaching climate sciences would likely improve students’ understanding of climate science.

The purpose of this discussion is not to state that humanities courses are better prepared to teach scientific material to students, but rather that when teaching about the mechanics of the climate crisis, it is important to maintain a connection to the human dimension of the climate crisis. Students in higher education represent a sizable portion of the human dimension through their engagement in a scientific understanding of the climate crisis and through their lived experiences. It would be beneficial to approach them not only as students of the research being discussed, but as participants in the unsanctioned global experiment we refer to as the climate crisis.

Climate change awareness among, and effects on, workers without an expertise in science.

Of the 48 participants involved in the study, 11 reported discussing climate change with their families, 34 reported they do not discuss climate change with their families, and 3 did not respond to the prompt. Of the 34 participants whose families do not discuss climate change, only one participant reported their parents did not believe climate change was real. Of the 11 participants that reported conversations about climate change, only participant 6 discussed a detailed conversation about climate change. The participant's grandfather taught him about the carbon cycle and the impact of climate change on farming, the grandfather's profession. Incidentally, this was the only instance in which the full carbon cycle was mentioned by a participant.

The other 10 participants who reported discussing climate change with their families tended to talk about a sense of hopelessness. Statements like, "they [parents] see how it [climate change] affects everyone around us, but they don't know what they can do about it" (participant 29), and "My mom is scared and says we might have to move where the [climate] changes aren't so bad" (participant 11) were common not only from participants whose families talk about climate change, but also from participants who reported no conversations about climate change with families, but whose parents are concerned about changing weather patterns. A growing uncertainty based on negative experiences in students' personal lives might explain the largely ambiguous responses to the personal action statements reported in the climate crisis perception survey.

The concern about relocating because of the effects of climate change expressed by participant 11 was shared by families of another 6 participants. All seven participants who reported concerns about relocation had parents who work in agriculture. Concerns about relocating because of the effects of climate change among 14.8% of participants raises the concern that potential internal displacement of farm workers in the San Joaquin Valley should be examined more closely at both local and regional levels. Potential internal displacement of farmworkers is evidence of economic displacement caused by the climate crisis. In 2020, the US saw the greatest increase of internally displaced persons in the Americas due to disaster. The US experienced a total of 1.7 million internal displacements due to disaster that year. Approximately one million of these displacements were due to fire, which accounted for 83% of internal displacement due to fire globally (Internal Displacement Monitoring Centre, 2021).

Even when families did not explicitly discuss climate change, participants either speculated about the knowledge their parents have of the climate crisis or stated their parents were concerned about the effects of climate change, even if parents were not aware their concerns were related to climate change. "They're [parents] not that educated, but they always complain about the weather changing. For all I know, they might know a lot of this information based on climate change and effects" (participant 31). Reports of parents' responses to changes in weather patterns or of the effects of the drought were usually matter of fact statements about how to deal with hardships in life. As an example, participant 32 reported that when taking too long a shower, their parents would say, "In Mexico we had to shower with buckets." In response, participant 31 exclaimed, "mine say that too." Statements about hardship or difficulty are indicators that many, if not most

of the participants, came from families that do not have the ability to participate in the culture of convenience that most Californians participate in. Facing shortages of resources like water are an expectation of life and not viewed as a loss of entitlement.

Hardship among participants and their families was often expressed in terms of ability to earn income. There were 21 instances of discussion of crops being destroyed or not growing. In 16 of these instances, the loss of income to farmworkers was listed as a major concern when crops are lost. In 13 instances food shortages were a concern, although food shortages were usually expressed as the loss of food production in the San Joaquin Valley impacting the rest of the United States. All 18 discussions about family working in agriculture included references to loss of work because of the drought, changes in employment, or concern about future well-being. Failures in agriculture impact other forms of labor as well. Participant 40's father is a construction foreman who often has complaints like, "Well we can't finish the job because the ground is really dry," or "The crops didn't go up so we can't build." Participant 40 continued, "So sometimes he's very upset. And sometimes he's upset when he has to let people go."

Part of the reason it is important to conduct qualitative research on specific populations is to use the experience of participants to help us understand the characteristics of the knowledge base of a laborer with an expertise outside scientific research. A frequent discussion topic in this study was not simply that seasons are shifting, but that planting, growing, ripening, and harvesting periods are also changing. "So say like, strawberries. They're super ripe and good during April. So, they're seeing that the dates they've been ripe in the past are shifting in the calendar," (participant 47). Four participants, including participant 11 from the beginning of this section, described their parents and grandparents discussing changes to food production over the past decades. Another 8 participants described similar concerns of their parents over the past several years. There were 14 descriptions of changes to farming practices due to water shortages, 13 descriptions of changes to farming practices due to knowledge of seasonal shift, 7 descriptions of changes to farming practice due to weather events like flooding, hail, and high winds. In the descriptions of changes to farming practices, there were 4 examples of prior knowledge, or the events of a previous growing season, being used to plan for a future growing season.

Even though farmworkers are disconnected from the science of the climate crisis, they have developed knowledge of the effects of climate change because they deal with those effects every day. The knowledge gathered by farmworkers and other laborers regarding the climate crisis should be regarded by scientists as a form of expertise.

Conclusion

The San Joaquin Valley (SJV) is a unique region of the United States. As an agricultural hub for the country, the effects of the climate crisis on the SJV are relevant from economic and food production perspectives. There is an unusual concentration of marginalized communities in the SJV that span multiple cultural backgrounds, such as Indigenous, multi-national Latinx, Sikh, and Hmong communities. The studies included in this chapter did not examine interactions between these communities. Findings included a strong concern about the climate crisis among all demographic groups that

was derived both from educational experiences and the lived experiences of participants. The labor of marginalized populations, particularly of farmworkers, was found to be impacted by the effects of the climate crisis. While there was a focus on qualitative research in this chapter, data collected opens avenues for quantitative research.

The climate crisis is progressing rapidly with far-reaching effects. While it was found that the effects of climate change were impacting marginalized communities in the SJV in 2017-18, it is likely that as the crisis persists, impacts are being felt among higher SES groups. Evidence of this is the internal displacement of 1.7 million people in the US due to disaster in 2020 (Internal Displacement Monitoring Centre, 2021). It is quite likely that the situation for marginalized communities in the SJV has become more critical. More intensive field research among impacted communities across cultural and ethnic groups is needed.

As the effects of the climate crisis impact larger numbers of people, it will be important to adjust education strategies to match the impact on communities. Science education tends to focus on the physical aspects of the climate crisis. Adjusting lessons and curricula to incorporate the experiences of students will help students connect global and local causes and effects.

The labor of marginalized populations has been impacted by the effects of the climate crisis and laborers, particularly farmworkers, recognize the effects and are able to connect them to global effects, such as seasonal shift. It does not seem there is a need for farmworkers and other laborers to understand or accept the scientific description of the climate crisis. What is important is for scientists and academics to recognize the expertise in adapting to the effects of climate change that is emerging amongst marginalized laborers.

A next step in exploring the experiences and views of laborers would be to examine if marginalized laborers are involved in or disassociated from political debates on the climate crisis. It is plausible given present results that marginalized laborers exist outside the debate in the same way they deal with the climate crisis outside scientific interpretations. Understanding political engagement would help with cross-cultural communication efforts.

The qualitative nature of this study has provided the groundwork for mixed methods research. Computer mouse tracking paradigms, discussed in more detail in chapter 3, create the opportunity for both quantitative and qualitative analysis. Future research in the San Joaquin Valley will utilize mouse tracking for studies directly involving laborers. The resulting data will be compared to data collected in Midwestern states to develop an understanding of similarities and differences in how the climate crisis is approached in two of the most important agricultural regions of the United States.

The studies included in this chapter scratch the surface of a large data pool that should be explored in greater depth. Researching the experiences and developed expertise of marginalized communities in the San Joaquin Valley regarding the climate crisis is a local action that is relevant to global issues, such as food security, adaptation, and education.

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Chapter 3

Relative Spacing of Ideologies on the Left-Right Scale

The previous chapter included in exploration of the experiences and views marginalized populations of the San Joaquin Valley (SJV) have of the climate crisis. Political orientation had little effect on the urgency with which these populations viewed the climate crisis. An interest for future research was to ascertain the political engagement of laborers from marginalized communities in the SJV. To begin exploring the political views and political engagement of this population, it was first necessary to understand how future participants might identify themselves ideologically. The survey questions regarding ideology in Chapter 2 revealed a stronger tendency toward agreement with Liberalism than other ideologies. There was also very small number of participants who indicated agreement with the Fascist ideology, although disagreement with Fascism was strong. A question arose as to whether including a discrete selection of an ideology that a participant identifies with would increase alignment with left-leaning ideologies and decrease alignment with right-leaning ideologies. This question evolved into a larger study examining how marginalized students in the SJV self-identify with ideologies, as well as how this population understands ideologies to be related to each other as defined by the assignment of ideological traits to ideologies. Research in the current chapter was an attempt to understand ideological relationships among marginalized students that would help frame future research.

A unidimensional Left-Right scale of political ideology is often used to describe the partisan divide that exists in climate change debate. However, the composition of specific ideologies is more complex than a unidimensional scale allows for. Political elites simplify complex scales of interaction through messaging to the public. Scientific measures of ideology are composed using a combination of scaled social and economic views. Rather than using social inventories, it is possible to ask experimental participants to define ideologies through the assignment of ideological traits using a forced choice mouse tracking task. The resulting selection curves describe the degree to which each ideology is associated with an ideological trait and allows for the construction of a relative ideological space that can be used to describe ideological interactions with political positions, such as support for policies to slow climate change.

Conservative or Right-Wing alignment and gender are strong predictors of denial of climate change (Tranter & Booth, 2015). It has been found that Conservative white men are much more likely to deny the threat of climate change than other adults (McCright & Dunlap, 2011) and that increased education and income further polarize the views of Conservative white men (Ballew, et al., 2020). Left-identified Americans who are concerned about the threat of climate change tend to have strong beliefs about the science that are difficult to counter, while Conservative or Right-identified Americans have more unstable opinions about climate science (Jenkins-Smith, et al., 2020). The difference in stability of opinion between the Left and Right in this study might be because people who accept the science of climate change view the issue as non-political and accept the consensus of scientific experts, while those who deny climate change view the issue as political and rely on ideological signaling from political elites and partisan information sources that are trusted because they defer to Conservative elites (Tesler,

2018). To understand the effects of ideology on opinions and beliefs regarding climate change, it is necessary to first examine how political elites signal ideological alignment to the public.

The explicit use of a Left-Right separation of ideologies is typically dated to the French Revolution of 1789-1799 (Laponce, 1981). The French Revolution began with the failure of the French Estates General in 1789. At this assembly, the clergy were seated at the right hand of the king and the nobility at the left hand of the king. According to Laponce, the subsequent rupture lent this arrangement a greater political significance. Laponce posited that binary left and right ideals were a metaphorical representation of left- and right- handedness. The right was more strongly represented as more people were right-handed. The ideological right was associated with moral virtue while the left was associated with moral weakness. In the French Language the right hand was associated with strength and legitimacy while the left was associated with inadequacy and embarrassment. These associations crossed language barriers. After all, the French word for *left*, “gauche,” has even come to mean “unsophisticated and graceless in English. Further, in Christianity and Judaism there are references to saints and prophets sitting at the right hand of God; “But he, being full of the Holy Ghost, looked up stedfastly into heaven, and saw the glory of God, and Jesus standing on the right hand of God” (Acts 7:55, King James Version).

Caution is necessary when generalizing research on ideology and ideological scales from specific times and places to larger frameworks. The work of Laponce was an exploration of the origin and evolution of the Left-Right scale in French politics but might not explain circumstances in other periods or states. For example, Laponce wrote about the Right trying to preserve ethnic minorities by maintaining regional languages within the borders of France. As a colonial state that occupied the lands of previously existing nations, ethnic minorities of the United States differ from the majority because they are not members of the conquering or occupying ethnic class. The meaning of “ethnic minority” in 18th century France and the 19th century United States are quite different. In the 20th century, efforts to protect ethnic minorities transitioned from being a characteristic of the Right to a characteristic of the Left in both North America and Europe.

The unidimensional Left-Right scale has proven advantageous for Political Scientists due to its simplicity, yet it has also been controversial. The Left-Right scale holds significance in evaluations of political history, but the use of the scale in research has been debated (Duckitt & Bizumic, 2013; Freire, 2015; Jost, Federico, & Napier, 2009). Yet, the scale is considered robust (Fuchs & Klingemann, 1990; Carney, et al, 2008), especially regarding how the right and left are characterized cross culturally. Some traits associated with the right include nationalism, militarism, corporatism, individualism, and authoritarianism, while some traits associated with the left include egalitarianism, civil rights, Marxism, environmental protection, and democracy (Klingemann, et al., 2006; Fuchs & Klingemann, 1990). Additionally, individual ideologies are themselves considered “messy” and difficult to map through reductive means (Charney, 2008; Hibbing, Smith, & Alford, 2014)

Methods for evaluating ideological placement of individuals usually involves asking participants to place themselves on a Left-Right Likert scale, as well as

administering assessments to determine placement on other scales, such as the Right-Wing Authoritarianism Scale (RWA) (Altemeyer, 1981; 1996) and Social Dominance Orientation Scale (SDO) (Sidanius & Pratto, 2001). In recent years, criticisms of RWA and SDO being unidimensional resulted in mutations to RWA, such as expanding the model from one to three dimensions: Authoritarianism, Conservatism, and Traditionalism (ACT) (Duckitt, et al., 2010; Dunwood & Funke, 2016; Duckitt & Bizumic, 2013), adding a Left-Wing Authoritarianism Scale (Altemeyer, 1996, Costello et al., 2022) or Authoritarian Symmetry (Conway, et al., 2018). These multi-dimensional ideological modeling methods often project the higher dimensional ideological space onto lower dimensional spaces, including the Left-Right scale. Plotting individual scores for various assessments creates clusters that can be labeled with ideologies like Liberal and Conservative.

Part of the reason that self-placement of a participant on a Left-Right scale is robust is that Left-Right identification has many robust is well correlated with behavioral traits (Hibbing, et al., 2014). Threatening stimuli were found to be more distracting for Conservatives than for Liberals (Carraro, Castelli, & Machiella, 2011). Conservatives were found to spend more time viewing negative images than Liberals (Dodd, et al., 2012). It was also found that people identifying as Left or Right are better able to recognize different emotions (Vigil, 2010). It is important to point out that psychological differences between adherents of one ideology or another is not an indication that one ideology is superior to another. If popular media reported that ideology and behavior research suggested conflict is the result of psychological irregularities associated with an ideology, then such reporting would be a misrepresentation of the research.

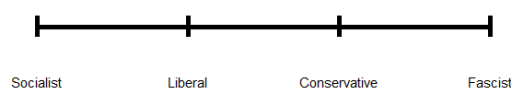
The understanding of Left-Right ideological placement is different for political elites than it is for the public. Elites project Left-Right placement as a way of signaling to an electorate that their social, economic, and religious inclinations are like those of voters (Fuchs & Klingemann, 1990; Jost, Federico, & Napier, 2009; Freire, 2015). In the public, there are varying degrees of understanding regarding ideology and the Left-Right scale. At one end of the spectrum are people engaged with the political or electoral environment. Engaged members of the public are familiar with political figures and can identify their ideological placement (Jennings, 1992) and tend to identify more with Left-Right divisions than less engaged people (Abramowitz & Saunders, 2008). Wealthy white men discussed earlier fall into this category. For less engaged members of the public, ideological alignment tends to be based more on party alignment as determined by cultural factors (Tausanovitch & Warshaw, 2018; Meyer & Wagner, 2020).

In the United States, elite messaging within a two-party system resulted in closer alignment between ideological position and partisan position in the form of extreme polarization in both the political elite and the public (Groenendyk, Sances, & Zhirkov, 2020; Barber & Pope, 2019). This polarization is a possible reason that opinions in the public hold a policy position that does not match the ideological position of the opinion. For example, 84% of Americans who identify as Republican are opposed to Socialism (Hartig, 2019), but 68% of Republicans oppose reducing funding of Social Security (Parke, Morin, & Menasce Horowitz, 2019), which is a Socialist program.

In a polarized political system represented by a Left-Right scale, the most ideal positions are those closest to one's own position. Left to Right, ideological positions

would be ordered as Socialist, Liberal, Conservative and Fascist (fig. 3.1). The furthest position from the Conservative position would be Socialist. According to a Left-Right scale, a Conservative would be opposed to Socialism as the previous example suggests. But what would account for Conservative support for a Socialist program like Social Security?

3.1 Traditional Left-Right Scale



The Left-Right ideology scale is typically displayed with Liberal and Conservative ideologies being at the center while Socialist and Fascist ideologies are at the edges.

In the US, cultural alignment is determined by economic class and race, which strongly overlap due to wealth inequality. Research shows that white Americans tend to support economic programs, regardless of the ideological nature of the program, that are perceived as most benefiting white Americans. Clawson and Jett (2019) conducted a study of media representations of Social Security recipients. 86% of pictured recipients were white. Wetts and Willer (2018) showed that portrayal of racial minorities benefiting from social welfare programs increased opposition to programs by white participants. Conservative support for Social Security stands in contrast to the notorious case of welfare programs that were defunded in 1996 due to the racist myth of Black or African American women as “welfare queens” (Gilman, 2013).

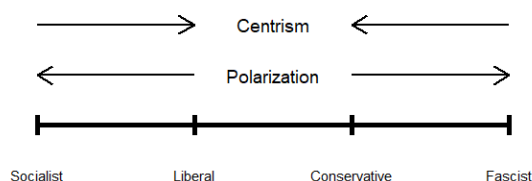
Except for wealthy white Americans (Weeden & Kurzban, 2016), the public does not necessarily support policy based on ideological identification, but rather supports policy based on cultural alignment (Tausanovitch & Warshaw, 2018; Connors, 2020). As of 2019, 81% of Republican and 59% of Democratic voters were white (Pew, 2020). Support for Social Security among American Conservatives while opposing other social welfare programs is an example of how a cultural trait like whiteness can attenuate the rejection or acceptance of Socialist ideological policy positions. Political elites like Ronald Reagan (Gilman, 2013) created an ideological parameter for Conservative values identified within the Republican Party. The established parameters are the values a Republican voter should hold. The resulting values can be ideologically neutral for

accepted values, such as support for Social Security, while at the same time ideologically active, such as opposing other social welfare programs as a form of Socialism.

Parameterization of party values that define ideological functions is the way political elites (Freire, 2015) functioning in a higher dimensional policy space (Bonica, 2018) signal positions to the public. Elites collapse the higher dimensional space into a lower dimensional space (Bonica, 2018) that is more relatable to the public and is easily recognizable on the Left-Right scale (Freire, 2015; Hare, Highton, & Jones, 2021). In this way, American political elites define ideology and use such definitions to their advantage.

The movement of Ideological traits on the Left-Right scale between the 18th and 20th centuries suggests that scaling of ideological traits, if not ideologies themselves, might be the result of a dynamic system of categorization (Kallens, Dale, & Smaldino, 2018). In this framing, the higher dimensional ideological positions projected onto a Left-Right scale through messaging by elites would be described as ideological group traits determined in a top-down fashion by the interaction of political elites (Smaldino, 2014; Federico, & Napier, 2009; Freire, 2015; Tesler, 2018). These group traits interact with bottom-up social and cultural identification traits of the public that begin with the individual (Tausanovitch & Warshaw, 2018; Meyer & Wagner, 2020; Tranter & Booth, 2015). If the Left-Right scale is a projection of a higher dimensional space, then changes to that space would result in mutability in the Left-Right scale. The example of Social Security being considered a conservative policy position, while other social welfare programs are considered Socialist policy positions, is emblematic of such mutability.

3.2 Polarization & Centrism



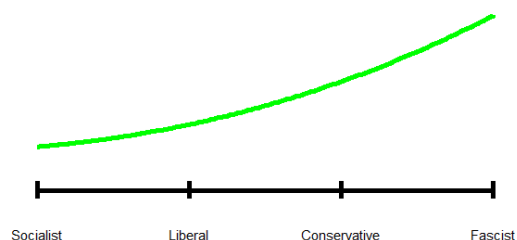
Centrism is usually described as moving toward the center of the Left-Right scale. The view of an ideological center is often used to frame policy that combines the interests of conservative Democrats and moderate Republicans. Polarization is viewed as the movement of interest of Liberals and Conservatives away from each other. For example, conservative Democrats crafting policy that is in the interest of more left-leaning members of the Democratic Party is considered polarizing because it is a movement away from Republicans.

If polarization is movement in ideological alignment of elites and the public to the outer edges of the Left-Right scale, then Centrism is a move toward the middle of the scale (fig. 3.2). Evidence for polarization exists in the failure of Centrist parties in Europe during the rise of populism (Zur, 2021) and the reluctance of County-level Party leaders to support Centrist candidates in the United States (Broockman, et al., 2021). While Democratic Party leaders are less likely to support Centrist candidates, Republican Party leaders are much more likely not to support Centrist candidates and are much more likely to support extremist candidates (Broockman, et al., 2021), which fuels both elite and public polarization (Freire, 2015). An effort by elites at the national level of the Democratic Party to frame a Centrist Party position for the public can be seen as an effort to offset polarization at the local level. If the way the public identifies ideologies and ideological traits on the Left-Right scale is changing due to the increase in polarization of political elites, the resulting differences would impact the success or failure of policy decisions. A political elite signaling Centrist policy decisions would be making unpopular choices if what the public categorizes as a Centrist position has changed.

Pair-Wise Comparisons of Ideologies Associated with Ideological Traits

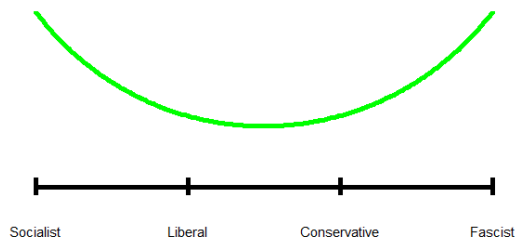
The Left-Right scale is continuous. The degree to which a trait is associated with an ideology will decrease or increase when moving left or right. When applying the Right-Wing Authoritarianism scale (RWA) to the Left-Right scale, the level of Authoritarianism will increase as ideology moves rightward (fig. 3.3). If RWA and Left-Wing Authoritarianism (LWA) are combined, the result is a curve in which the level of Authoritarianism increases the further an ideology moves from the center (fig. 3.4). It is also possible to have a curve that increases as an ideology approaches the center (fig. 3.5). A centrist might describe an ideology as being more democratic the closer to the center of the scale it lies. Returning to the example Republicans and social welfare

3.3 Right-Wing Authoritarianism on the Left-Right Scale



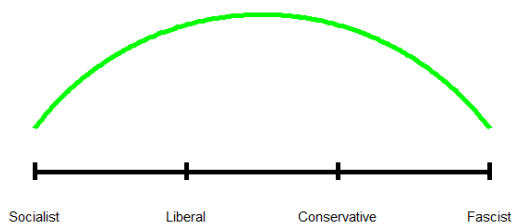
The green line represents the scores of the Right-Wing Authoritarianism scale. The further right an ideology is, the higher the individual scores and the greater the likelihood that Authoritarianism is a trait of the ideology.

3.4 Right- and Left-Wing Authoritarianism



When Right- and Left-Wing Authoritarianism scores are both used, the tendency for authoritarianism increases as an ideology moves further from the center of the Left-Right scale.

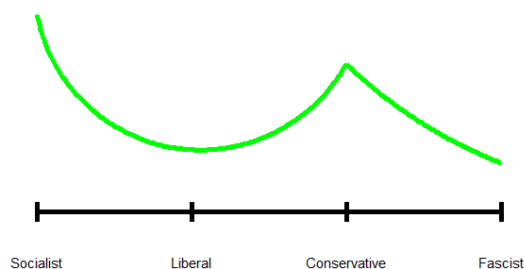
3.5 Democratic



For a Centrist, representation the ideology trait “Democratic” would increase the closer an ideology is to the center of the Left-Right scale and decrease the further from the center the ideology is.

programs, we can use support for social welfare programs as an ideological trait. Moving left on the scale would create an increase of support for social welfare programs. for the sake of argument, we will assume low support for social welfare programs among Liberals. In this scenario, because Republicans support some social welfare programs and not others, support for social welfare programs declines moving rightward from Socialist and then peaks at Conservative before declining again toward Fascist (fig. 3.6). This indicates the placement of the Conservative ideology is incorrect. Conservative should be to the left of Liberal to smooth the curve.

3.6 Violation of Continuity



The Left-Right scale is a continuous scale. For this reason, the identification of an ideology trait with an ideology must increase or decrease in a continuous manner, as was the case for figures 3.3, 3.4, and 3.6. Evidence of discontinuity for the association of ideology traits with ideologies indicates that the ideologies are not in the correct order.

As has been discussed, individuals in the public understand that their personal alignment with ideological traits creates a similarity to, or difference from, other individuals, particularly elites. It should be possible to define ideologies through the understanding individuals have of how ideological traits and ideologies are associated, or how elite messaging has reshaped the scale for the public. A forced choice task between pairs of ideologies in which participants must assign a trait to one ideology or another creates the possibility to compare the ordering of ideologies and how distant they are from each other. Computer mouse tracking is a paradigm well suited for such a study.

In traditional computer mouse tracking studies, participants choose between two options in the upper corners of the screen based on a stimulus or prompt. Cognitive competition between the two choices results in longer and more eccentric curves while direct movements signify less competition (Spivey, Grosjean, & Knoblich, 2005). The connection between cognitive processes and motor action are well established in many areas (Spivey, 2008, 2020; Koop & Johnson, 2013), such as language (Spivey, et al., 2005; Spevack, Falandays, Batzloff, & Spivey, 2018), interpersonal communication (Shockley, Baker, Richardson, & Fowler, 2007; Paxton & Dale, 2013; Falandays, Batzloff, Spevack, & Spivey 2020), social categorization (Stoller & Freeman, 2017) and more.

A concern about research involving personality and preferences that might not be perceived as socially acceptable is the tendency of participants to falsify responses. A concern might be that showing sympathy for Fascism would skew response data. In a mouse tracking study, attempts to falsify a response results in movement toward the truthful response followed by a sharp change in trajectory to the selected false response (Tabatabaeian, Dale, & Duran, 2015). Even though a dishonest answer is selected, the

eccentricity of the trajectory signifies a level of competition that allows classes of such trajectories to stand out.

In the present study, participants were asked to decide which of two ideologies an ideological trait was best associated with. Movement along a straight line indicated that the trait and selected ideology were more closely associated than the trait was associated with the opposing ideology. Stronger and more complex curves indicated that there was competition between the two ideologies. To determine how ideologies are distributed on a unidimensional Left-Right scale, all that was required was the pairwise comparison of ideologies selected by participants to be associated with an ideological trait. The greater the difference in trajectories toward the selected ideology, the greater the relative spacing between the ideologies on a unidimensional scale. The term relative spacing is used in this study to describe the order of ideologies on a scale, as well as the approximate distance between each. This study was intended to display the utility of such relative spacing.

Relative spacing of ideologies was intended as a method of learning how the public conceptualizes ideological space. The assumption was that establishing relative spacing of ideologies could be used as a process by researchers to gauge the impact of political elites defining higher dimensional policy spaces on the structure of single dimensional identity spaces of the public. To be clear, this study is not an attempt to develop a new ideology scale. The intent is to determine the mapping of the Left-Right scale as it is understood by the participating population. Hypotheses about the structure of relative spacing of ideology were made based on trends observed in political ideology. Hypotheses are as follows:

Primary hypothesis: The order of ideologies along a particular dimension of trait does not necessarily follow the order as generally understood on the Left-Right scale:
Socialist ↔ Liberal ↔ Conservative ↔ Fascist.

Hypothesis 2: Conservative and Fascist ideologies are closer to each other for all ideological traits. This closeness is suggested by the rightward shift of the Republican Party (Skocpol & Hertel-Fernandez, 2016; Saeki, 2019; Espinoza, 2021).

Hypothesis 3: Liberal and Socialist ideologies will be closer to each other for all traits. Even though partisan pressure results in the Democratic Party favoring Conservative economic policy (Polacko, 2022), the tendency to favor inclusive social policies has resulted in perceptions of the Democratic Party being further to the Left, particularly after Democrats rebounded from a Rightward shift created by pressure from the populist tea party movement (Ragusa & Gaspar, 2016). These perceptions are then projected by elites in both parties which should result in the closeness of Liberal and Socialist ideologies.

Methods

Participants

The study was conducted at the University of California Merced (UCM). Participants were students of UCM and received course credit for participation. There were 179 participants. Ages of participants ranged from 18-25 with one participant aged 31.

Caution Regarding Generalization of Study

This study was intended as a proof of concept using a small number of factors drawn from a much more complex social system. Prior research has shown that race and income impact ideological views (McCright & Dunlap, 2011; Weeden & Kurzban, 2016; Tausanovitch & Warshaw, 2018; Wetts & Willer, 2018; Clawson & Jett, 2019; Ballew, et al., 2020; Connors, 2020). 90% of UCM students are students of color (University of California Merced, 2022). Similarly, 88% of participants were students of color. Due to the skew in racial demographics of the target population, results of this study should not be generalized to the United States as a whole or even to all of California. The results of the study best represent public mapping of ideological scales among younger people of color in California.

Materials

The study was conducted in closed testing rooms using large format monitors. Oversize mouse pads were used to allow participants to make larger movements with their hands using a mouse with reduced gain.

The experiment was built using the Python based platform OpenSesame (Mathôt, Schreij, & Theeuwes, 2012). Analysis of data was conducted using the mousetrap (Wulff, Kieslich, Henninger, Haslbeck, Schulte-Mecklenbeck, 2021) package in R.

Study Design

Ideological Terms Used

The terms for ideologies used are Socialist, Liberal, Conservative, and Fascist. Of the four, there is often a perception that fascism is ill defined. Because of this perception it is necessary to justify the inclusion of Fascism as an ideology. The perception that fascism does not have a definitive definition is an effect of political elites after World War II borrowing tenets of political Fascism, while distancing themselves from the ideology of Fascism. Fascism rose in Europe as a response to Socialism and was considered completely opposed to democratic principles and process (Mussolini, 1933) in the form of a corporatist government structured similarly to a business with various levels of management. Fascism began as a merger between socialist and anarcho-syndicalist movements in Italy. The Fascist parties of both Italy and Germany were portrayed by

party leaders as socialist parties to garner public support but by that point were based on a fully formed Fascist ideology that stood in opposition to Socialist movements (Paxton, 2007). This was why the full name of the Nazi Party was the National Socialist Party. The term “totalitarian” arose during this period to indicate that all aspects of life in a state would be incorporated into the corporate structure of the state (Arendt, 1973). In practice, totalitarianism functioned as the privatization of all public goods by corporate entities below the corporatist state (Paxton, 2007). While the use of the term fascism or fascist might be controversial in modern politics, many components of fascism as a political ideology have in fact gained prominence in recent years.

The three ideological traits selected for the present study are Authoritarian, Democratic, and Civil Rights. Definitions of ideological traits are taken from the New Oxford American Dictionary (2005):

Authoritarian – Favoring or enforcing strict obedience to authority, especially that of the government, at the expense of personal freedom. Greater association with the Authoritarian trait indicates stronger placement on the Right.

Civil Rights – The rights of citizens to political and social freedom and equality. Greater association with the Civil Rights trait indicates stronger placement on the Left.

Democratic – A system of government by the whole population or all the eligible members of a state, typically through elected representatives. Greater association with the Democratic trait indicates stronger placement on the Left.

Experiment Structure

The experiment was divided into two sections. Part one was used to determine ideological self-placement of participants. Part two was used to determine relative spacing of ideologies. Both used the mouse tracking paradigm.

In part one, participants were given a prompt in the form of a noun or adjective and asked to indicate whether they agreed or disagreed that the noun described them. Each trial of the experiment ended with participants using a mouse to click a button to continue to the next trial. The button was located at the center of the bottom of the screen. Requiring participants to click this button resulted in the mouse cursor being at the center of the bottom of the screen at the start of the next trial. When a trial started, participants were instructed to move the cursor upward. After crossing a horizontal threshold (dynamic start position) at the bottom of the screen, the prompt would appear under the mouse cursor. The target terms “agree” and “disagree” were positioned in opposing top corners of the screen. The agree and disagree targets were randomly placed in the left or right corners for each trial. When a participant moved the cursor over one of the targets, the trial ended.

Each prompt was associated with only one trial for each participant. Prompts included 34 distractors. Examples of distractors were parent, farmer, nervous, and shy. Words selected as distractors were chosen because they were unambiguous and would

result in little cognitive competition for the participant. The purpose of including distractors was to ensure the response to targets were as honest as possible. Prompts included four target terms that were used to determine agreement or disagreement with an ideology. The four target terms were Conservative, Fascist, Liberal, and Socialist. Each target term was associated with one trial for each participant.

A training session took place before the start of part one. The purpose of this training session was to train participants how to interact with the mouse tracking exercise.

Part two of the experiment involved the same functional structure as part one, with a prompt at the bottom of the screen and targets in the upper corners. The prompt for part two was one of four ideological traits: Authoritarian, Civil Rights, or Democratic. At the start of part two and then second time, halfway through the trials, a training session took place. During this session, the prompt at the bottom of the screen was the definition of an ideological trait. The participants were required to match the definition with the correct trait at the top of the screen. Trials in the training session were reiterated until the correct trait was selected.

The two targets in the upper corners were ideologies. There were again four options: Conservative, Fascist, Liberal, and Socialist. Each target ideology was paired with every other such that each participant was required to select between every combination of two target ideologies for each ideological trait. For example, the target pairs for the Authoritarian trait prompt were Conservative-Fascist, Conservative-Liberal, Conservative-Socialist, Fascist-Liberal, Fascist-Socialist, and Liberal-Socialist. The corner that each ideology appeared in was randomized. The presentation of trait and target combinations was also randomized so that every participant was presented with the ideological trait and target pairing combinations in a different order. Participants were asked to select which target ideology was best associated with the trait prompt during each trial.

Distributed throughout both parts of the experiment were trials intended to test whether participants were focusing on the required mouse tracking tasks. Each of these test trials included a prompt for a simple math problem with potential answers as targets. An example might be a prompt of “ $1+1=$ ” with the option of selecting the targets “2” or “532.” There were a total of ten test trials in part two of the experiment. If a participant answered incorrectly for two or more test questions, the data they produced was rejected.

Analytical Method

Comparison of trajectories resulting from decisions made by participants was evaluated based on curvature, complexity, and curve type. The variables used for measurement were the following:

1. Maximum absolute deviation (MAD) is a measurement of the point at which a given trajectory is furthest from the ideal trajectory (McKinstry, Dale, & Spivey, 2008). The ideal trajectory is the straight line that connects the starting position of the mouse with the end position of the mouse (where the mouse cursor crosses a target). MAD can be considered a measure of attraction toward the oppositional

ideology.

2. Average deviation (AD) is the mean of each point of a time normalized trajectory from the ideal trajectory (Koop & Johnson, 2013). A time normalized trajectory is a trajectory broken into 101 time slices (Spivey, et al., 2005). AD is like the area under the curve (AUC) measurement, which is determined by the area under the arc created by the given trajectory over the ideal trajectory (Spivey, et al., 2005). It was expected that because part two of the experiment involved a more complex cognitive process than the identification task of Spivey et al. (2005), the decision process for competitive ideologies would be more elongated resulting in more complex (looped) trajectories. AD was selected as a variable instead of AUC because AD is more accurate in representing complex trajectories than AUC is.
3. Maximum Deviation above the ideal trajectory (MD) is like MAD except it only measures the maximum deviation toward the oppositional ideology.
4. X-flips are the reversal in direction of movement on the x-axis. The number of x-flips are counted as a measure of complexity. X-flips are considered a level of stability in selection (Koop & Johnson, 2013). The more x-flips there are the less stability there is in the movement toward an ideology, meaning the movement might reverse.
5. X-reversals take place when movement crosses the vertical axis at the center of the screen. The number of reversals is a measure of complexity. X-reversals indicate change in selection (Koop & Johnson, 2013), meaning a participant has reversed directions and is moving toward an opposing ideology. Greater complexity in both x-flips and x-reversals indicates greater competition between ideologies.
6. Chi-Square difference between curvature types (X2) is a measurement of difference between curvature types. The mousetrap package for R includes a process for clustering trajectories into five prototypes (Wulff, et al., 2021) that range from straight to curved to sharply curved (cm1) to two more levels of increasing complexity of curvature (cm2 and cm3). A chi-square measurement of the number of curve types in each category gives the difference between curve types.

Except for the chi-square measure of curvature types, all variables were compared using t-tests. Prior to conducting t-tests, data was aggregated per participant and condition.

For all *selected* ideologies, the trajectories of each selected ideology were compared to every other selected ideology regardless of what the opposition (unselected) ideology was. Chi-Square difference in curve type was considered the primary variable of interest because all other variables would contribute to the significance of difference in curve type. When examining residuals, it was assumed that differences in the CM3 and

possibly CM2 categories would likely be due to a small number of trajectories in the category. If all difference in a comparison of selected trajectories was due to difference between the number of trajectories in CM3, with no other significant variables to support the result, then the significance of the chi-square result in curve types might be dismissed.

Other significant variables were used to support results for chi-square test of curve type difference. If no curve type difference existed for a comparison, significant results among other variables could be considered. AD was not considered without other curvature variables being significant, and complexity variables were only considered on their own if significance was $p < .01$ or greater. The strength of differences in comparisons was used to establish relative distance. Means and standard deviation scores were used to establish direction.

Heat maps of trajectories for each comparison were created (fig. 3.11). The first ideology in a comparison was colored yellow and the second was colored red. For example, the Liberal-Socialist comparison included a heat map with concentrations of yellow Liberal trajectories and red Socialist trajectories. Heat maps were used as visual referential support for difference between distributions of trajectories for each ideology. More direct trajectories would appear as brighter coloring on the left of the heat map. Trajectories angled toward the opposing ideology appeared as brighter coloring on the right and top of the heat map. Sometimes small spots of a color will appear on a heat map amid the opposing color. These areas are where the concentration of trajectories for the less represented color are greater than the more prominent color. If there is an equivalent concentration of trajectories in an area, the coloring of both decreases toward black.

After the placement of ideologies was determined, a graph of the new relative spacing scale (RS) was created. The total number of trajectories for a selected ideology was used to establish a curve for each trait that demonstrated the scale did not violate the continuity requirement.

Results

Rejected Data

The data of 8 participants was removed from the data for failing the attentiveness test or because data was incomplete. This left 171 participants.

Across both parts of the experiment, 173 trials, or 4.8% of trials, were deleted. Trials were deleted for anomalies, such as clearly moving the mouse off the mousepad, lifting the mouse from one position to another, moving the mouse in circles or back and forth multiple times (as might occur during mind wandering), etc.

Self-Identification of Ideology

Trajectories resulting from participants identifying or not identifying with an ideology resulted in little competition. Because participants were able to identify with more than one ideology, compound ideologies were formed. The number of participants identified with each compound ideology can be seen in in figure 3.7. More participants identified

3.7

Ideological Identity of Participants	
Ideology	Count
Conservative	17
Fascist	0
Liberal	48
Socialist	8
Conservative Liberal	14
Conservative Socialist	9
Liberal Socialist	44
Conservative Liberal Socialist	11
None	20

Each participant was able to select more than one ideology that they identify with. This resulted in the compound ideologies listed.

as Liberal (48) than any other ideology. No participants identified with Fascism.

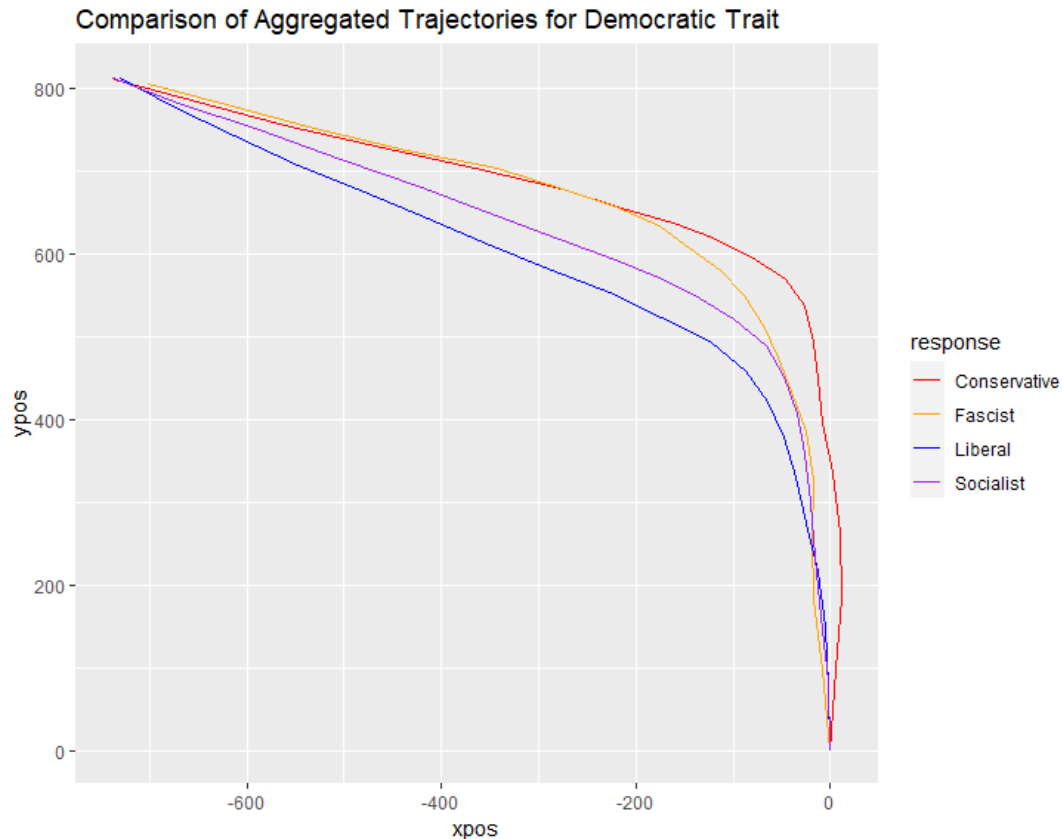
It was expected that in part two of the experiment, participants would assign ideological traits to ideologies differently depending on their own ideological identification. Interestingly, there was no evidence for this even when ideological identification was reduced to a Conservative-Liberal comparison by eliminating the Socialist vector. It was not possible to test party affiliation because there were only a handful of participants who identified their party affiliation as Republican. A Conservative participant was just as likely to identify the Democratic ideological trait as a characteristic of the Liberal ideology as Liberal participants were.

Relative Spacing of Ideologies

Ideological Trait: Democratic

The comparison of aggregated trajectories shows that the Liberal Ideology was likely the most associated with the Democratic trait compared to other ideologies (fig. 3.8). The greatest significant difference in curve type, $X^2(4, N = 624) = 23.48, p < .001$ occurred in the comparison between Conservative and Liberal ideologies. An examination of the residuals (fig. 3.10.C) revealed that the Liberal selected trajectories had more straight trajectories than Conservative selected trajectories, as well as fewer trajectories with exaggerated or sharp curves to the opposing option. The heat map of trajectories (fig. 3.11.3B) showed a clear separation between observed trajectories for Liberal and Conservative ideologies. For this particular plot, the red-colored Liberal

3.8



selected trajectories dominated the left side of the heat map, while the yellow-colored Conservative selected trajectories were more prominent on the upper right. Further, all other variables were also highly significant at $p < .001$ (fig. 3.9.A, 3.9.B). The Conservative-Liberal difference was used as an anchor point in step 1 (fig. 3.12) of the RS scale creation for the Democratic trait.

For step 2, the Fascist-Liberal comparison was used. The difference in curve types was $X^2(4, N = 494) = 14.88, p < .01$. The largest difference in residuals (fig. 3.10.C) was in CM3 and the number of trajectories of that type were too few to produce a reliable result. However, a t-test of the Maximum Deviation above (MD) the ideal trajectory supports the conclusion that there was a significant difference, $t(69.77) = 3.022, p < .01$ between Fascist selected ($M = 469.63, SD = 354.88$) and Liberal selected ($M = 321.34, SD = 198.46$) trajectories. MAD was similarly different, $t(71.09) = 2.91, p < .01$, between Fascist selected ($M = 450.44, SD = 378.53$) and Liberal selected ($M = 297.34, SD = 222.02$) trajectories. There was a slightly significant difference in complexity measured by x-reversals, $t(69.89) = 2.4, p = .0189$, between Fascist selected ($M = 1.4, SD = 1.2$) and Liberal selected ($M = 1, SD = 0.68$) trajectories. AD was barely significant (fig. 3.9.A, 3.9.B) and was considered negligible for evaluation of RS placement. The

3.9.A

Results of T-Tests and Chi-Square For All Comparisons

	Curvature									Complexity						Curve Type		
	MAD-df	MAD-t	MAD-p	AD-df	AD-t	AD-p	MD-df	MD-t	MD-p	xflips-df	xflips-t	xflips-p	xreversals-df	xreversals-t	xreversals-p	X2-df	X2-X2	X2-p
Authoritarian																		
Conservative-Fascist	309.69	-0.63835	0.5237	310.55	-1.12	0.2636	311.86	-0.20201	0.84	311.29	0.60565	0.5452	311.42	-1.091	0.309	4	9.9214	0.04177*
Conservative-Liberal	105.6	-2.2483	0.02633*	101	-1.8713	0.0642	100.39	-2.185	0.03121*	110.06	-0.37307	0.7098	111.87	-2.3103	0.0227*	4	12.006	0.01731*
Conservative-Socialist	268.98	-1.9412	0.05328	264.59	-1.9759	0.04921*	263.71	-2.0398	0.04237*	265.81	-1.821	0.07099	244.82	-3.1525	0.001821**	4	8.7846	0.06671
Fascist-Liberal	97.639	-1.8788	0.06325	95.03	-1.1973	0.2342	97.481	-2.0747	0.04065*	112.49	-0.80006	0.4254	113.93	-1.5634	0.1207	4	9.5227	0.04928*
Fascist-Socialist	250.95	-1.4666	0.1437	249.24	-1.0904	0.2766	255.47	-1.8983	0.05879	267.4	-2.3159	0.02132*	247.05	-2.324	0.02094*	4	7.4137	0.1156
Liberal-Socialist	129.2	0.69015	0.4913	125.79	0.35083	0.7263	125.49	0.60165	0.5485	138.12	-1.0264	0.3065	158.63	-0.48417	0.6289	4	1.4113	0.8422
Civil Rights																		
Conservative-Fascist	66.029	0.58732	0.559	63.893	0.71378	0.478	63.089	0.87146	0.3868	75.42	1.7792	0.07924	64.772	1.9617	0.0547	4	1.7071	0.7894
Conservative-Liberal	253.11	3.9409	0.0001051***	266.31	2.3895	0.01757*	252.53	4.1942	0.0000379***	218.02	3.9722	0.0000968***	234.34	5.1739	0.0000005***	4	26.333	0.0000271***
Conservative-Socialist	287.88	1.36	0.1748	301.52	0.17	0.8633	289.64	1.59	0.1123	289.61	1.58	0.1153	262.52	2.98	0.003158**	4	6.56	0.1613
Fascist-Liberal	53.2	1.71	0.09302	54.07	0.64	0.5261	51.77	1.4274	0.1595	51.77	0.635	0.5284	50.363	0.827	0.4123	4	5.887	0.2078
Fascist-Socialist	59.9	0.2456	0.8068	64.17	-0.606	0.547	58.172	0.056	0.8076	67.75	-0.712	0.4787	53.92	-0.316	0.7531	4	1.644	0.8008
Liberal-Socialist	316.02	-2.7013	0.00728**	307.05	-2.1918	0.02915*	313.75	-2.6653	0.00809**	279.4	-2.3493	0.0195*	322.07	-2.4967	0.01303*	4	8.1467	0.08635
Democratic																		
Conservative-Fascist	105.51	0.558	0.5783	102.26	0.736	0.4637	107.78	0.48338	0.6298	145.8	2.1823	0.03069*	109.56	0.6708	0.5037	4	1.0689	0.8992
Conservative-Liberal	206.42	5.1487	0.0000006***	230.66	4.2032	0.0000376***	197.31	5.13	0.0000007***	217.06	4.786	0.0000124***	195.68	4.484	0.0000031***	4	23.484	0.0001014***
Conservative-Socialist	265.52	2.62	0.009312**	251.33	2.741	0.00657**	255.2	2.401	0.01705*	284.16	1.1793	0.2393	268.21	1.9908	0.04752*	4	4.851	0.303
Fascist-Liberal	71.086	2.9113	0.00484**	75.352	2.0572	0.04313*	69.772	3.0223	0.00356**	90.516	1.8217	0.0718	69.888	2.4029	0.01893*	4	14.876	0.004965**
Fascist-Socialist	87.842	1.3146	0.1921	80.885	1.1168	0.2674	85.349	1.2405	0.2182	137.13	-1.1659	0.2457	91.84	0.79023	0.4314	4	2.0323	0.7298
Liberal-Socialist	292.01	-2.6256	0.009105**	325.5	-1.6598	0.09791	-3.0751	290.88	0.002304**	282.2	-3.6709	0.000289***	275.09	-2.5945	0.009981**	4	12.271	0.01545*

*p < .05
**p < .01
***p < .001

3.9.B

Means of Selected Trajectories for Each Variable Used in t-tests

	Curvature						Complexity			
	MAD-M	MAD-SD	AD-M	AD-SD	MD-M	MD-SD	xflips-M	xflips-SD	xreversals-M	xreversals-SD
Authoritarian										
Conservative	314.7	309.37	142.74	138.63	348.09	268.56	2.22	1.48	0.87	0.72
Fascist	335.7	272.96	159.38	124.58	392	252.95	2.12	1.5	0.95	1.5
Liberal	429.55	364.33	187.6	173.22	450.25	338.4	2.31	1.66	1.13	0.79
Socialist	391.8	367.67	178.56	169.69	420	330.66	2.57	1.8	1.19	0.99
Civil Rights										
Conservative	454.49	351.09	184.33	145.33	479.54	321.7	2.86	2.1	1.48	1.05
Fascist	416.41	377.63	164.48	163.45	425.12	363.36	2.25	1.9	1.09	1.93
Liberal	311.81	265.3	147.52	119.04	340.57	242.23	2.06	1.27	0.94	1.27
Socialist	400.92	333.05	181.32	159.6	421.72	309.51	2.49	2.02	1.15	0.84
Democratic										
Conservative	483.33	366.48	205.75	150.15	495.55	351.81	2.06	1.27	0.94	0.71
Fascist	450.44	378.53	187.5	160.71	469.63	354.88	2.55	1.53	1.4	1.2
Liberal	297.34	222.02	140.87	107.12	321.34	198.46	2.14	1.36	1	0.68
Socialist	377.23	323.57	161.7	121.4	405.38	291.24	2.86	2.11	1.26	1.09

In 3.9.A, T-test results are grouped by trait and listed by comparison of selected ideologies. For each variable under curvature and complexity, results are listed as degrees of freedom (df), t-value (t), and p-value, (p). For curve type, results are listed as df, Chi-square value (X2), and p. 3.9.B is a list of all Means and standard Deviations grouped by trait and listed by comparison of selected ideologies.

3.10 Chi-Square Residuals

(A) Chi-Square Data for Authoritarian Trait

	straight	curved	cm1	cm2	cm3
Conservative vs Fascist frequencies ¹					
Conservative	116	110	21	27	15
ratio	40.14%	38.06%	7.27%	9.34%	5.19%
Fascist	135	133	39	36	5
ratio	38.79%	38.22%	11.21%	10.34%	1.44%
Conservative vs Fascist residuals ¹					
Conservative	0.2	-0.02	-1.19	-0.3	1.97
Fascist	-0.18	0.02	1.09	0.27	-1.79
Conservative vs Liberal frequencies ²					
Conservative	116	110	21	27	15
ratio	40.14%	38.06%	7.27%	9.34%	5.19%
Liberal	31	33	17	14	4
ratio	31.31%	33.33%	17.17%	14.14%	4.04%
Conservative vs Liberal residuals ²					
Conservative	0.64	0.34	-1.44	-0.64	0.23
Liberal	-1.1	-0.58	2.46	1.09	-0.39
Fascist vs Liberal frequencies ³					
Fascist	133	135	41	36	3
ratio	38.22%	38.79%	11.78%	10.34%	0.86%
Liberal	31	33	17	14	4
ratio	31.31%	33.33%	17.17%	14.14%	4.04%
Fascist vs Liberal residuals ³					
Fascist	0.47	0.37	-0.73	-0.35	-1.05
Liberal	-0.88	-0.69	1.36	0.65	1.97

¹ X²(4, N = 637) = 9.92, p = .04177
² X²(4, N = 388) = 12.01, p = .01731
³ X²(4, N = 447) = 9.52, p = .04928

(B) Chi-Square Data for Civil Rights Trait

	straight	curved	cm1	cm2	cm3
Conservative vs Liberal frequencies ¹					
Conservative	66	65	35	21	20
ratio	31.88%	31.4%	16.91%	10.14%	9.66%
Liberal	168	159	39	37	10
ratio	40.68%	38.5%	9.44%	8.96%	2.42%
Conservative vs Liberal residuals ¹					
Conservative	-1.37	-1.31	2.07	0.37	3.16
Liberal	0.97	0.8	-1.47	-0.26	-2.23
Liberal vs Socialist frequencies ²					
Liberal	168	159	39	37	10
ratio	40.68%	38.5%	9.44%	8.96%	2.42%
Socialist	112	105	44	32	14
ratio	36.48%	34.2%	14.33%	10.42%	4.56%
Liberal vs Socialist residuals ²					
Liberal	0.58	0.61	-1.25	-0.41	-1.02
Socialist	-0.68	-0.71	1.45	0.48	1.18

¹ X²(4, N = 620) = 26.33, p < .001
² X²(4, N = 720) = 8.15, p = .08635

Chi Square tests were conducted in two-way comparison of each selected ideology with every other ideology for each ideology trait.

(C) Chi-Square Data for Democratic Trait

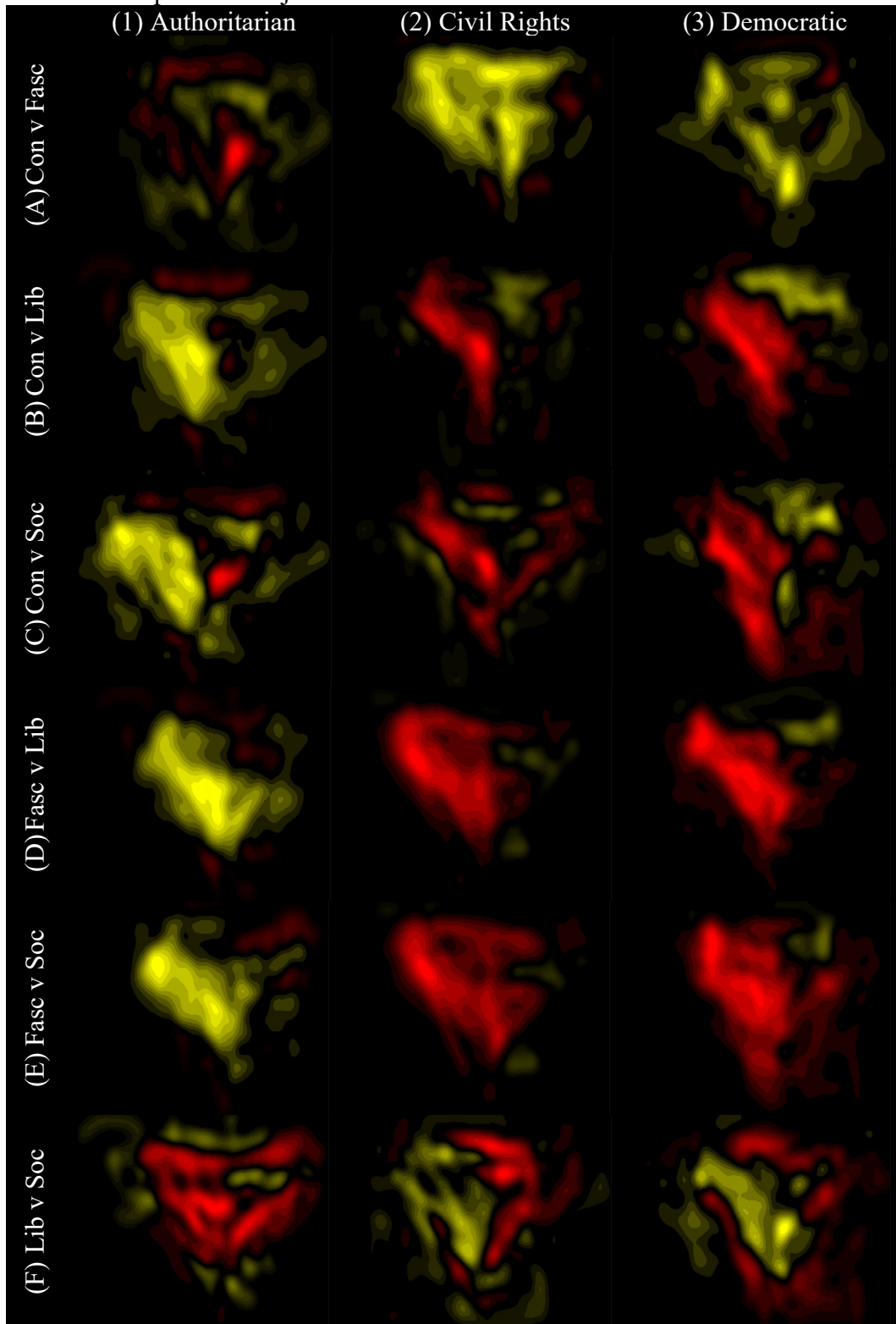
	straight	curved	cm1	cm2	cm3
Conservative vs Liberal frequencies ¹					
Conservative	62	70	31	25	16
ratio	30.39%	34.31%	15.2%	12.25%	7.84%
Liberal	172	164	46	30	8
ratio	40.95%	39.05%	10.95%	7.14%	1.9%
Conservative vs Liberal residuals ¹					
Conservative	-1.62	-0.78	1.16	1.66	2.91
Liberal	1.32	0.54	-0.81	-1.15	-2.03
Fascist vs Liberal frequencies ²					
Fascist	26	23	10	8	7
ratio	35.14%	31.08%	13.51%	10.81%	9.46%
Liberal	172	164	46	30	8
ratio	40.95%	39.05%	10.95%	7.14%	1.9%
Fascist vs Liberal residuals ²					
Fascist	-0.67	-0.95	0.56	0.97	3.17
Liberal	0.28	0.40	-0.23	-0.41	-1.33
Liberal vs Socialist frequencies ³					
Liberal	172	164	46	30	8
ratio	40.95%	39.05%	10.95%	7.14%	1.9%
Socialist	109	113	41	23	20
ratio	35.62%	36.93%	13.4%	7.52%	6.54%
Liberal vs Socialist residuals ³					
Liberal	-74.00	0.30	-0.61	-0.12	-2.04
Socialist	-0.87	-0.35	0.72	0.14	2.34

¹ X²(4, N = 624) = 23.48, p < .001
² X²(4, N = 494) = 14.88, p < .01
³ X²(4, N = 726) = 12.27, p = .01545

difference between Fascist selected and Liberal selected trajectories was not as significant as the difference between Conservative selected and Liberal selected trajectories. Additionally, the means of all significant variables (fig. 3.9.B) for Conservative selected trajectories were higher than the means for Fascist selected trajectories. This assessment resulted in placement of the Fascist ideology between Liberal and Conservative.

Step 3 required an examination of the Liberal-Socialist comparison. The difference in curve types, X²(4, N = 726) = 12.27, p = .0155, was slightly significant with the largest difference found in CM3 (fig. 3.10.C), although the heat map (fig. 3.11.3.F) does show greater dispersal for Socialist selected trajectories. Difference in CM3 was likely due to significant differences in complexity. There were significantly fewer x-reversals, t(275.09) = -2.6, p < .01, for Liberal selected trajectories (M = 1, SD = 0.68) than for Socialist selected trajectories (M = 1.26, SD = 1.09). There were also significantly fewer x-flips, t(282.2) = -3.67, p < .001, for Liberal selected trajectories (M = 2.14, SD = 1.36) than for Socialist selected trajectories (M = 2.86, SD = 2.11). Liberal selected trajectories (M = 321.34, SD = 198.46) had less curvature than Socialist selected trajectories (M = 405.38, SD = 291.24) as was shown in both MD, t(290.88) = -3.08, p < .01, and MAD, t(292.01) = -2.63, p < .01 (Liberal: M = 297.34, SD = 222.02; Socialist:

3.11 Heat Map of All Trajectories



The first ideology in a comparison is colored yellow and the second ideology is colored red. For more information on the creation of heatmaps, please see the appendix.

3.12

Ideological Trait Response Counts					
Trait / Response	Opposition				Total
	Conservative	Fascist	Liberal	Socialist	
Authoritarian					
Conservative		63	128	98	289
Fascist	95		127	126	348
Liberal	55	0		44	99
Socialist	52	33	116		201
Civil Rights					
Conservative		131	29	47	207
Fascist	30		14	10	54
Liberal	135	152		126	413
Socialist	118	149	40		307
Democratic					
Conservative		122	29	53	204
Fascist	42		15	18	75
Liberal	140	150		130	420
Socialist	116	153	37		306

Participants were asked to select which of two ideologies best represented each ideological trait. *Response* refers to the ideology participants selected. *Opposition* refers to the ideology not selected. For example, when asked to choose whether the Authoritarian trait was best associated with Conservative or Liberal ideologies, 128 participants selected Conservative and 57 participants selected Liberal.

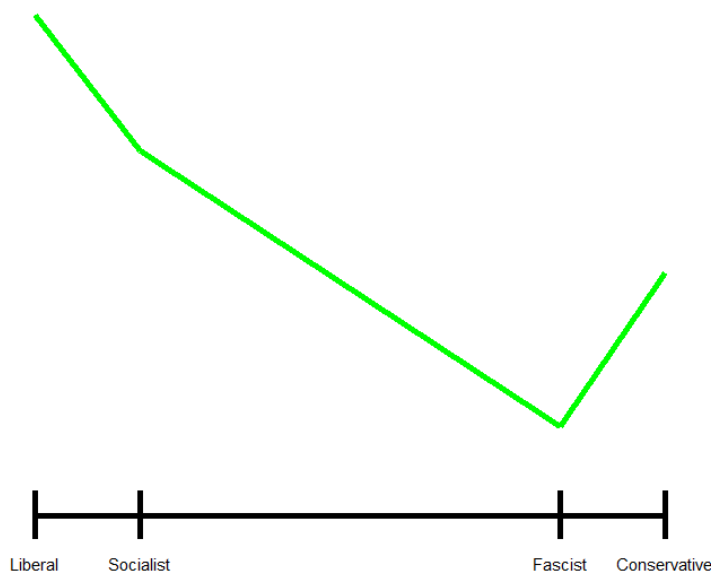
$M = 377.23$, $SD = 323.57$). The lesser degree of significance in difference between curve types of liberal selected trajectories and Socialist selected trajectories, and the lesser means in variables for Socialist selected trajectories compared to Fascist selected trajectories suggests that the RS placement of the Liberal ideology was between the Liberal and Fascist ideologies. The results of the comparison between Conservative and Socialist selected trajectories resulted in differences in MD, $t(255.2) = 2.4$, $p = .0171$ (Conservative: $M = 495.55$, $SD = 351.81$; Socialist: $M = 405.38$, $SD = 291.24$), MAD, $t(265.52) = 2.62$, $p < .01$ (Conservative: $M = 483.33$, $SD = 366.48$; Socialist: $M = 377.23$, $SD = 323.57$), and AD, $t(251.33) = 2.74$, $p < .01$ (Conservative: $M = 205.75$, $Sd = 150.15$; Socialist: $M = 161.7$, $SD = 121.4$), which resulted in placement of the Socialist ideology closer to the Liberal ideology.

Comparisons of means of significant variables also pushed the Fascist ideology closer to the Conservative ideology. The total number of associations between ideologies

and the Democratic trait as determined by number of trajectories divided by ten (fig. 3.12) was added as the green line to display the continuity curve (fig. 3.13).

3.13

Relative Spacing of Ideologies for Democratic Trait



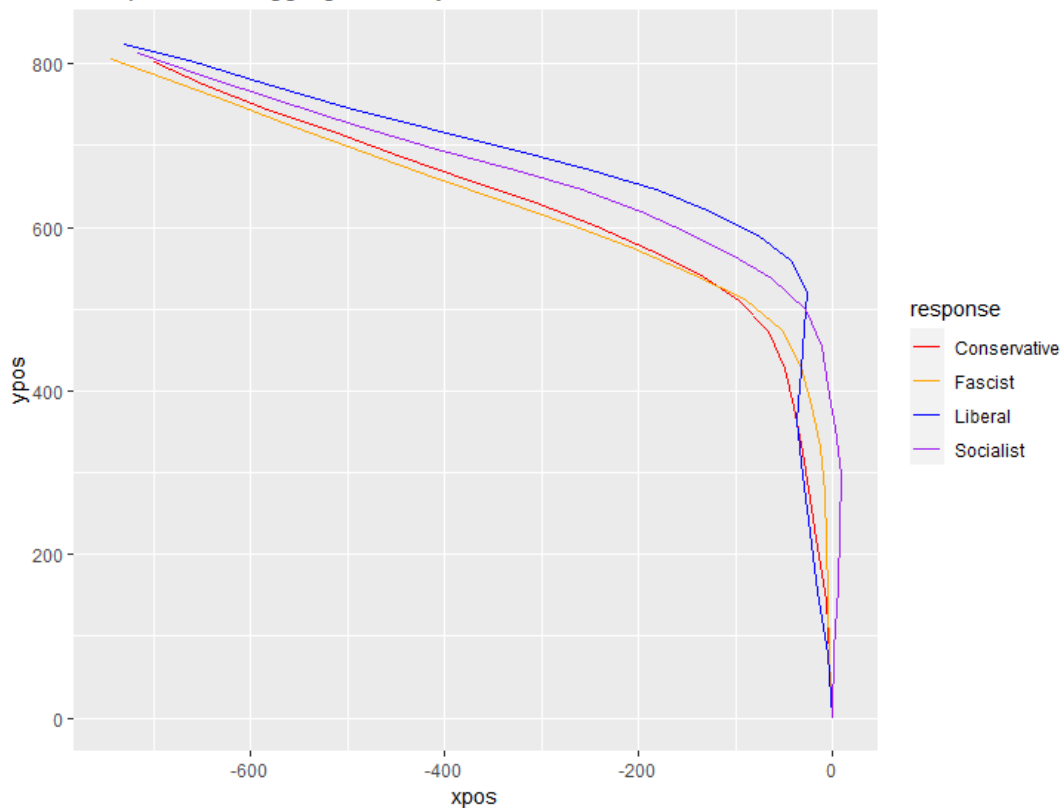
A comparison of t-test results for measurements of curve types, curvature, and complexity resulted in this arrangement of ideologies on the Left-Right scale for the Democratic trait. The green continuity line was formed by plotting the total number of trajectories for each ideology divided by 10. The continuity curve shows that the placement of ideologies does not violate continuity.

Ideological Trait: Authoritarian

An examination of the comparison of aggregated trajectories for the Authoritarian trait (fig. 3.14) indicated that the Fascist and Conservative ideologies were likely most associated with the Authoritarian trait than the Liberal and Socialist ideologies. Chi-square tests for curve types in the Authoritarian trait were not as definitive as those in the Democratic trait. The most significant difference was found in the Conservative-Liberal comparison, $X^2(4, N = 388) = 12.01, p = .0173$. The residuals (fig. 3.10.A) show the largest difference in the CM1 category. Difference in CM1 indicates that trajectories for Liberal selected trajectories were more angular than for Conservative selected trajectories. Angularity of Conservative selected trajectories was apparent in the heat map (fig. 3.11.1.B). The difference in angularity of trajectories was reflected in slight significance of curvature found in both MD, $t(100.39) = -2.185, p = .0312$ (Conservative: $M = 348.09, SD = 268.56$, Liberal: $M = 450.25, SD = 338.4$), and in MAD, $t(105.6) = -2.25, p = .0266$ (Conservative: $M = 314.7, SD = 309.37$; Liberal: $M = 429.55, SD = 364.33$). Angularity was also supported by slightly more x-reversals, $t(111.87) = -2.31, p$

3.14

Comparison of Aggregated Trajectories for Authoritarian Trait



Each line is an aggregation of trajectories for a selected target. All selected targets were remapped to the appear in the upper left corner for easier visual comparison. The response is the ideology selected by participants from two options.

=.0227, for Liberal selected trajectories ($M = 1.13$, $SD = 0.79$) than for Conservative selected trajectories ($M = 0.87$, $SD = 0.72$). These results were used to anchor the Conservative ideology on the right end of the RS scale.

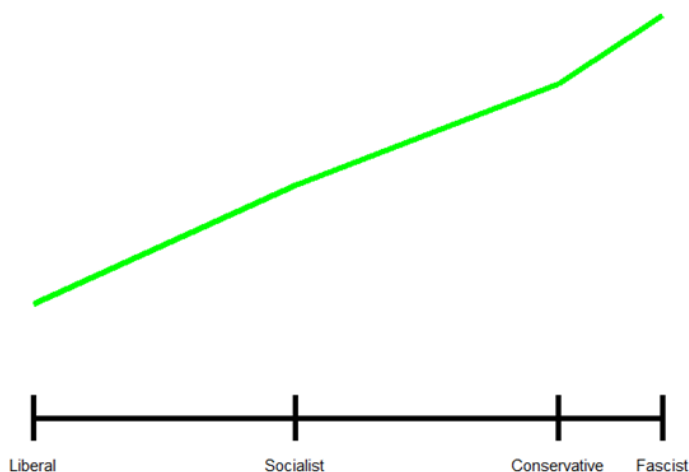
The comparison of curve types for Conservative and Fascist selected trajectories was barely significant, $X^2(4, N = 637) = 9.92$, $p = .0418$. Examination of the residuals (fig. 3.10.A) revealed very little difference in curve types (fig. 3.9.A) except for CM3 and CM1, with more Fascist selected trajectories, and CM3 with more Conservative selected trajectories. Lack of significance in complexity and lesser representation of trajectories in CM3 resulted in CM3 difference being disregarded. Curvature variables did not show significant differences, but the heat map (fig. 3.11.1.A) did show a concentration of Fascist selected trajectories angling to the right, which would support the difference in CM3. Overall, the results provide little to suggest a separation between the Conservative and Fascist ideologies. Because there was a possibility of difference in curve type, a comparison of Conservative selected trajectories and Fascist selected trajectories from trials where Conservative and Fascist targets were paired was compared. The sample sizes were too small (Conservative: 63, Fascist: 95) for reliable chi-square of curve type results. Because they are most relevant to difference of curvature between selected

ideology and opposition ideology, only MD and AD t-tests were evaluated. Both showed difference in curvature between Conservative selected trajectories (MD: $M = 253.93$, $SD = 379.51$; AD: $M = 100.68$, $SD = 191.98$) and Fascist selected trajectories (MD: $M = 445.12$, $SD = 298.58$; AD: $M = 222.88$, $SD = 121.58$), for MD, $t(145.74) = -3.267$, $p > .01$ ($p = .00136$), and AD, $t(155.72) = -4.9$, $p < .001$, which suggested the Fascist ideology should be placed to the right of the Conservative ideology.

Difference in curve types between Fascist selected and Liberal selected ideologies was so small that rounding could eliminate significance, $X^2(4, N = 447) = 9.52$, $p = .0492$. Differences are found in CM1 and CM3 with Fascist selected trajectories being less represented than Liberal selected trajectories. The number of CM3 categorized trajectories was too small to support acceptance of difference in CM3. Additionally, there were so few Liberal selected trajectories (55) that they represented only 12% of the trajectories in the comparison. This reduces the likelihood of the accuracy of separation between selected ideologies if there is not significance in many variables. The heatmap (fig. 3.11.1.D) shows fewer trajectories in the upper right. Slight significance was found in MD, $t(97.48) = -2.07$, $p = .0401$, with Fascist selected trajectories ($M = 392$, $SD = 252.95$) showing less extreme curvature than Liberal selected trajectories ($M = 450.25$, $SD = 338.4$). Significant differences were not found in other curvature variables. Comparing these results to the Conservative-Liberal and Conservative-Fascist

3.15

Relative Spacing of Ideologies for Authoritarian Trait



A comparison of t-test results for measurements of curve types, curvature, and complexity resulted in this arrangement of ideologies on the Left-Right scale for the Authoritarian trait. The green continuity line was formed by plotting the total number of trajectories for each ideology divided by 10. The continuity curve shows that the placement of ideologies does not violate continuity.

comparisons provided stronger placement of the Liberal ideology to the left of the fascist ideology.

The Conservative-Socialist comparison did not show significance in difference of curve types, but did show a difference in complexity established by x-reversals, $t(244.82) = -3.15$, $p < .01$, with fewer Conservative selected trajectories ($M = 0.87$, $SD = 0.72$) than Socialist selected trajectories ($M = 1.19$, $SD = 0.99$). Curve eccentricity for Conservative selected trajectories (MD: $M = 348.09$, $SD = 268.56$; AD: $M = 142.74$, $SD = 138.63$) was found to be slightly less than curve eccentricity for Socialist selected trajectories (MD: $M = 420$, $SD = 330.66$; AD: 178.56 , $SD = 169.69$) in both MD, $t(563.71) = -2.04$, $p = .0424$, and AD, $t(264.59) = -1.98$, $p = .0492$. The only difference found in the heat map (fig. 3.11.1.E) was a concentration of Socialist selected trajectories with vertical and right-arc'd directionality. A targeted examination of trajectories from only the Conservative-Socialist target pairing was not warranted due to the small number (52) of Socialist trajectories. With low confidence it appears the placement of the Socialist ideology would be to the left of the Conservative ideology on the RS scale.

The Fascist-Socialist comparison suggested separation with a slight difference in complexity (fig. 3.9.A). Because the difference in complexity is not coupled with difference in curvature or curve type, they were dismissed as being relevant to RS scale placement.

The resulting RS scale includes an estimation of the order of ideologies but the placement is less certain (fig. 3.15).

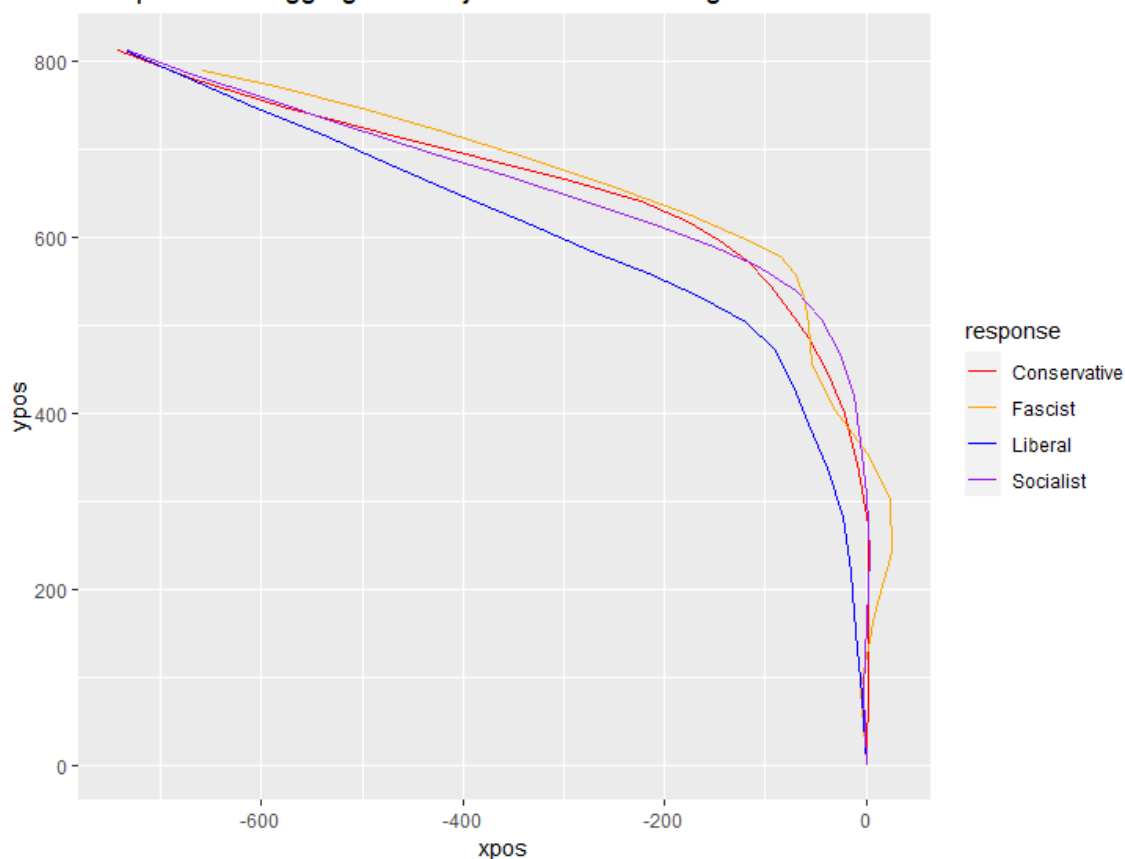
Ideological Trait: Civil Rights

An examination of the comparison of aggregated trajectories for the Civil Rights trait (fig. 3.16) indicated that the Liberal ideology was more closely associated with the trait than other ideologies. The Conservative-Liberal comparison resulted in strong separation of curve types, $X^2(4, N = 620) = 26.33$, $p < .001$, with differences being found across straight, curved, CM1 and CM3 categories. Liberal selected trajectories were much more direct than Conservative selected trajectories. The heat map (fig. 3.11.2.B) displays the separation quite well. All other variables, except AD, were strongly significant (fig. 3.9.A) with means (fig. 3.9.B) showing more eccentric curves and greater complexity for Conservative selected trajectories. The strength of the comparison allowed for the Liberal ideology to be anchored at the left end of the RS scale with the Conservative ideology placed to the far right.

The Liberal-Socialist comparison results did not show significant difference in curve type but did have significant differences in curvature and slightly significant differences in complexity. Curvature was less for Liberal selected trajectories (MD: $M = 340.57$, $SD = 242.23$; MAD: $M = 311.81$, $SD = 265.3$; AD: $M = 147.52$, $SD = 119.04$) than for Socialist selected trajectories (MD: $M = 421.72$, $SD = 309.51$; MAD: $M = 400.92$, $SD = 333.05$; AD: $M = 181.32$, $SD = 159.6$). Curvature results were MD, $t(313.75) = -2.67$, $p < .01$, MAD, $t(316.02) = -2.7$, $p < .01$, and AD, $t(307.05) = -2.19$, $p = .0296$. Complexity was slightly different for both x-reversals, $t(322.07) = -2.5$, $p = .013$, and xflips, $t(279.4) = -2.35$, $p = .02$, with greater complexity for Socialist selected trajectories (x-reversals: $M = 1.15$, $SD = 0.84$; x-flips: $M = 2.49$, $SD = 2.02$) than for

3.16

Comparison of Aggregated Trajectories for Civil Rights Trait



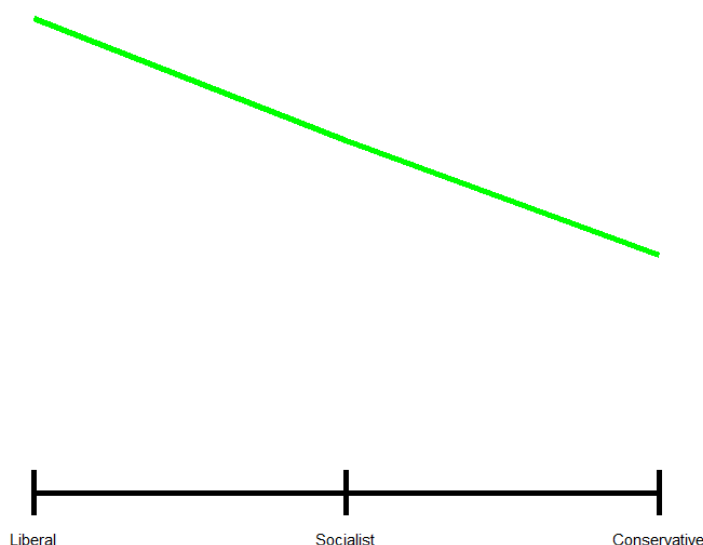
Each line is an aggregation of trajectories for a selected target. All selected targets were remapped to appear in the upper left corner for easier visual comparison. The response is the ideology selected by participants from two options.

Liberal selected trajectories (x -reversals: $M = 0.94$, $SD = 0.71$; x -flips: $M = 2.06$, $SD = 1.27$). The heat map (fig 3.11.2.F) also shows a clear separation between Liberal selected trajectories on the left and Socialist selected trajectories on the right. Due to these results, the difference in curve types, $X^2(4, N = 720) = 8.15$, $p = .0864$, was examined more closely. Residuals (fig. 3.10.B) revealed a difference in CM1 which can be seen in the concentration of Socialist trajectories arcing to the right. With these results, the Socialist ideology was placed to the right of the Liberal ideology on the RS scale.

X -reversals in the Conservative-Socialist comparison revealed greater complexity $t(262.52) = 2.98$, $p < .01$ for Conservative selected trajectories ($M = 1.48$, $SD = 1.05$) than Socialist selected trajectories ($M = 1.15$, $SD = 0.84$). This result, in conjunction with the greater differences in the Conservative-Liberal compared to the Liberal-Socialist comparison, resulted in the Socialist ideology being placed to the left of the Conservative ideology on the RS scale for the Civil Rights trait. No test data revealed where the Fascist ideology would be placed. Because there were so few Fascist selected trajectories (54) more targeted analyses eliminating opposition variables was not warranted. The continuity curve would suggest that the Fascist ideology is either to the right of the Conservative ideology or between the Socialist and Conservative ideologies (fig. 3.17).

3.17

Relative Spacing of Ideologies for Civil Rights Trait



A comparison of t-test results for measurements of curve types, curvature, and complexity resulted in this arrangement of ideologies on the Left-Right scale for the Civil Rights trait. The green continuity line was formed by plotting the total number of trajectories for each ideology divided by 10. The continuity curve shows that the placement of ideologies does not violate continuity.

Discussion

Prior research discussed in the introduction of this chapter lends credence to the idea that higher dimensional policy spaces are reduced to a single dimension for the public. Construction of relative spacing scales (RS) was successful for two of the three ideological traits and partly successful for the third. The construction of these scales provided evidence that the single dimension in which ideologies were ordered is representative of how young people of color in California perceive the political landscape and provides a path for examining bottom-up categorization of group political identities. The order of ideologies on the RS scale was different from the standard order of the Left-Right scale, which provides evidence for the primary hypothesis, that ideologies can be reordered. The RS scale was intended to be representative of the Left-Right scale in the minds of participants. Data for this study was collected in 2018 and 2019, a time when political discourse in the United States was extremely tense. So tense, in fact, that it led to a violent insurrection two years later. This level of polarization was evident in the RS scales. Extreme polarization might explain why the Liberal ideology was at the left end of the scale for all traits and why Conservative was sometimes on the right end.

Earlier in the chapter, Laponces's description of the political Left and Right being associated with the left and right hands of the body was an indicator of the embodied nature of the Left-Right political scale. The experiment included the randomization of the

appearance of ideologies on the left or right of the screen for participants. However, because the ideologies “Liberal” and “Conservative” have a strong Left-Right connotation in American culture, further analysis of curvature based on the appearance of an ideology on the left or right is necessary. Further, because comparisons were made across t-tests, future iterations of analysis of this experimental paradigm will include statistical corrections to the t-tests.

Political polarization in the public is exacerbated by identification with the Republican or Democratic parties (Westfall & Van Boven, 2015). Party affiliation for participants of this study was 53.4% Democrat and 2.4% Republican. It is possible that the sharp differences between Liberal and Conservative associations across all three traits was the result of more than half of participants identifying as Democrats. If polarization increases with party affiliation, then the inclusion of so many Democratic affiliated participants would push Liberal and Conservative parties further from each other on the RS scale. The race and ethnic identity of participants would have played a similar role due to the level of racist language and policy coming from the Republican party during the period the study was conducted.

The second hypothesis was that the Conservative and Fascist ideologies would be closer together. It was difficult to determine placement of the Fascist ideology in relation to the Conservative ideology across all three traits because there was little difference in Conservative-Fascist comparisons. For the authoritarian trait it was necessary to only examine trajectories resulting from the pairing of Conservative-Fascist targets presented to participants. The difference between Liberal and Fascist ideologies was most significant for the Democratic trait and slightly so for the Authoritarian trait, suggesting the Fascist trait was somewhere near the Conservative trait. The Fascist ideology appeared to the left of the Conservative ideology for the Democratic trait and to the right for the Authoritarian trait. This difference suggests a potential overlap between the ideologies. Popular and academic discussion of the Republican party as a fascist party has become more common and the Republican platform has adopted many qualities of fascism. The association of the Republican party with the Conservative ideology could have led to Conservative and Fascist ideologies becoming synonymous from the perspective of the population studied.

Even though the Liberal and Socialist ideologies were placed closer to each other for the Democratic trait, there was no evidence to support the third hypothesis that the Liberal and Socialist ideologies would move nearer to each other. There is evidence that the opposite might be the case, that the Liberal and Socialist ideologies are moving further apart. The separation of the ideologies might also be explained by partisan messaging by elites. The division in the Democratic party between Socialist leaning progressives like Bernie Sanders and Elizabeth Warren, and Conservative leaning Democrats like Joe Biden and Nancy Pelosi might be creating another polarizing effect for the public.

If the spacing of the RS scales described in this chapter is accurate, there is an implication that strategy by political elites fails simply because elites have not accurately tested the effect of messaging on the public. For example, attempts to appeal to the larger population by proposing centrist policies fails if elites and the public are using different mappings of the Left-Right scale. While academics and political elites place liberal and

conservative ideologies at the center of the scale, that placement does not hold in the public. This study has provided evidence that at least one population of voters would be more likely to view a successful centrist pivot for the Democratic Party as a move by Conservative Democratic leadership toward developing unifying policy with the left-leaning progressive half of the Democratic Party. Democrats who campaign on reaching across the aisle to Republicans might not realize that in the eyes of the public both parties have drifted so far apart that moving toward Republican Party policy positions is viewed as skipping over progressives to court the far right. This might explain the unpopularity of Democratic leadership within the party (Skelley, 2022, July 14; 2022, July 27).

Republicans, on the other hand, do not suffer as serious an internal disaffection problem as Democrats. Whether there is an understanding among Republican elites that Republican voters also utilize some sort of altered Left-Right scale is unknown, but it seems likely that propagandists like Alex Jones, Steve Bannon, and Dinesh D'Souza have impacted the public so effectively that the ideological positioning of Republican voters is clearer. While the Republican Party is also divided, between the far-right and not-as-far-right, both sides close ranks to maintain support from the public. Similarly, it seems likely that limited efforts by Republican elites to court Democratic elites are because far-right messaging frames Liberals as the far-left.

One of the more interesting findings of the study derives from the study design. The distance between ideal trajectories and more eccentric trajectories was used to establish spacing and placement for the RS scale. Mouse tracking is a successful embodied experimental paradigm that allows for the indirect examination of Cognitive processes in real time. The RS scale is a fuzzy mapping of the ideology-identity space that exists in the heads of humans and that is collectively constructed by humans through a dynamical process inherent to social systems. The ability to use mouse tracking trajectories to establish RS scales connects the dynamics of social systems to the cognitive dynamics of an individual. This experiment does not definitively establish this connection, but hints at it. More exploration of the potential is necessary and is something I will pursue in coming years.

This study was intended as a proof of concept, to show that RS scaling was possible. The next stage of research involves expanding the scope of research to larger and more divergent populations. It would be interesting to know if research of Republicans results in polarization effects creating an overlap between the Liberal and Socialist ideologies as well as a separation between Conservative and Fascist ideologies, the reverse of what was seen in this study. Sample sizes of ten thousand or so across multiple social groups will be necessary to fully establish the effectiveness of the RS scale. Increased size will allow for the use of many more ideological traits and ideologies.

While the RS scale has been discussed as a single dimensional representation, more accurate mappings are almost certain to be multidimensional. In fact, selecting the single Left-Right dimension was a choice made to best encapsulate simplified mappings in the public. The dimensionality of more accurate mappings will be determined by the addition of multiple vectors of ideology-trait association. Additional vectors will be added in future research that is also designed to include multiple populations. It might be possible to combine future iterations of this study with future climate crisis research discussed in chapter 2, however, the inclusion of multiple populations will require

collection outside that study as well. Approximately 10,000 participants are needed to create robust results.

After analyzing larger data sets, it will be possible to construct computational models that more accurately display the relative space for ideology. The result will be quite different from this early mechanistic approach. This study was a humble first attempt to spin a thread. A tapestry remains to be woven.

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Chapter 4

Applied Research as a Form of Social Justice in an Era of Climate Instability

The climate crisis is taking place now. For this reason, research on the human dimensions of climate change must include action or applied research. The previous chapters detailed two interacting lines of research. The first was an effort to learn how marginalized communities and marginalized laborers confronted effects of the climate crisis with a future goal of developing a dialogue or common language for cross cultural communication between academics and laborers. The second is a process of understanding ideological interactions that have implications for the types of messaging laborers have been receptive to, and how a common language might be impacted by ideological placement and the messaging of political elites. In conjunction with these lines of research, applied research is required that provides marginalized communities with the tools to confront the climate crisis. It is known that the effects of the climate crisis are already taking place and are largely unavoidable. It is imperative that adaptation efforts focus on communities that have little wealth. While education of marginalized people has been a focus for the development of wealth in marginalized communities, it is also necessary to develop wealth through the direct sharing of ownership of research data with marginalized communities. Sharing research data with marginalized communities provides these communities with greater potential for self-representation in policy discussions and establishes a decolonial process of repaying marginalized communities for wealth extracted from them. This chapter includes three approaches that address the above requirements.

Effects of the Climate Crisis are Unavoidable

On July 18, 2022, Secretary General of the United Nations, António Guterres, released a video statement for the Petersburg Climate Dialogue (United Nations). In this statement, he called for wealthy countries like the United States to do more than pay “lip service to the \$100 billion dollars a year pledge” made to fund the development of sustainable infrastructure in developing countries. The \$100 billion referenced was a pledge made by wealthy countries at the 2009 United Nations Climate Change Conference (COP 15) for developing countries between 2020 and 2025 (Goodman & Moynihan, 2021). The small amount of funding that has appeared has mostly been in the form of loans instead of aid. By 2022, it was clear that no progress was being made to address the climate crisis. At COP 26 in 2021, wealthy countries abandoned the more concrete plans (Chinyavanhu, 2021) previously developed and was largely considered a massive failure (McKibben, 2021; Masood & Tollefson, 2021). The conference concluded with corporate promises to reduce Carbon emissions by 2050, however, even if the goals established for 2030 were met, the Earth would still be on track for an increase in average temperature of 2.4° C above the pre-industrial baseline (Masood & Tollefson, 2021). The reality is that the window of opportunity to slow warming beyond manageable levels has probably already closed. Debates and agreements now focus on determining how severe the catastrophe will be allowed to become. Regardless of how

bad effects of the climate crisis prove to be or how quickly they take place, the people who will suffer most are those who are already suffering, the poor and less advantaged.

It is not necessary to look to developing countries to find examples of the severity of the impacts of climate change. The United States has experienced several climate disasters over the past few years. A crisis that illustrated impacts on people of color in the US was the SARS CoV2 (COVID) pandemic. While the debate continues over whether the pandemic was triggered by natural habitat loss, an environmental issue associated with climate change, the impacts of the pandemic were an excellent example of how escalating climate crises will impact societies (Khojasteh, Davani, Shamsipour, Haghani, & Glamore, 2022). The pandemic laid bare a comfortably hidden truth in the United States, that unequal access to income, healthcare, and healthy environments to live in, are an aspect of the structural racism of the country. The disparities in impacts on low-income people and people of color were dramatically different than other people in the United States (Chen, Byrne, & Vélez, 2022; Dickinson, et al., 2021; Lopez & Neely, 2021).

The failures of infrastructure, policy, governance, and supply chains seen during the pandemic will also affect the distribution of resources among the population of the United States during large scale climate disasters. The fact is that no matter how much adaptation research and investment takes place, adaptation will ultimately benefit sectors of society that already experience a level of stability unexperienced by people of color and low-income people (Zoll, 2022). Globally, this is already an issue with adaptation finance far below what it should be (Khan & Munira, 2021; Scoville-Simonds, Jamali, & Hufty, 2020). This is the funding that Secretary General, António Guterres referred to when demanding wealthy countries provide the funding the promised to developing countries.

We know that the effects of the climate crisis are unavoidable. We also know that the most impacted populations are going to receive the least amount of support for preparing for crises or for recovering from crises. This chapter is an exploration of how my research is intended to be applied to helping marginalized populations be more resilient in the face of climate change. The approaches outlined take place on two different time scales. The first is a near-term community engagement intended to create an impact for marginalized communities on the scale of years to within a lifetime. The second is a long-term community engagement strategy intended to address the imbalance create by the colonialist nature of academic research while providing physical resources. This strategy is intended as a recovery plan for future generations.

Community Ownership of Data

Harvard University was literally built upon the backs of slaves and colonized people. Slaves were used at the university from its founding in 1636 through the end of the 18th century and “During the first half of the 19th century, more than a third of the money donated or promised to Harvard by private individuals came from just five men who made their fortunes from slavery and slave-produced commodities” (Brown-Nagin, et al., 2022). This information came to light as an effort by the faculty and administration of Harvard to account for the university’s role in the history of slavery. The key point

here is that the wealth of Harvard university was extracted directly from slaves. Harvard is probably not alone in its funding history and is a more explicit example of how Academic institutions extracted wealth from marginalized groups of people.

Academia has played an instrumental role in sustaining systemic racism. Academic institutions and programs act as sorting mechanisms that first prevent the inclusion of people of color (Miller & Stassun, 2014) and then create social and professional barriers to advancement of people of color in competitive fields (Ong, Wright, Espinosa, Orfield, 2011; Bernard & Cooperdock, 2018, Dupree & Boykin, 2021). The persistence of such sorting mechanisms has long been justified by the need for neutrality or what Daniel Hicks refers to as “value free” science (2014), when the reality is that sciences have as much political impact as other forms of societal contribution. This point has been pointedly made through the interplay of scientific, policy, and public debates about the climate crisis and pandemic and dates far back to events like the 1925 Scopes Trial. In a show trial, John Thomas Scopes deliberately incriminated himself for teaching evolution to violate a Tennessee state law banning the practice. An effect of the trial that is not discussed as often in science history is that the trial also legitimized eugenics as a scientifically supported practice of segregating so called “inferior” races from important institutions like academia (Pavuk, 2018).

Federal funding for scientific research is less likely to be awarded to scientists of color (Hoppe, Litovitz, Willis, 2019; Erosheva, et al., 2020), which prevents the advancement of those researchers and their research. Research funding can be connected to the goal of research profitability in the form of patents. A problem with prioritizing academic research is that profitability and wealth creation for the university are the development of resources and should not be considered a goal of research (Hicks, Stahmer, & Smith, 2018). Applications for federal research funding require a social benefit to research. The social benefit is a goal that results in research impact outside the research unit or institution and should be considered a major goal in determining the value of research (Hicks, Stahmer, & Smith, 2018).

It has become more common for academic institutions to recognize their role in maintaining systems of internal colonialism, or systems that create differences in opportunity for different populations based on false perceptions of differences between populations. In the United States, internal colonialism overlays a history of colonial conquest that framed the physical separation of races. Development of community engaged research programs are an attempt to rectify the role academic institutions have played in maintaining both physical and economic divides.

Participatory research paradigms are models in which communities participate not only as subjects of research, but as research collaborators. The level of community contribution to research varies depending on the type of outreach used by academic institutions. Balazs & Morello-Frosch (2013) described a spectrum (fig. 4.1) of community involvement in research from “Helicopter Science,” where researchers briefly deposit themselves in a community to study the community and then leave, to “Community-Based Participatory Research” (CBPR) where the community is not just the subject of research but is also involved in study design and implementation and maintains shared or whole ownership of resulting data. Including marginalized communities in the development of research helps to eliminate the reification of communities observed. The

more involved a marginalized community becomes in research, the more likely it is that research results will be relevant and robust (Balazs & Morello-Frosch, 2013).

4.1 Community Based Participatory Research

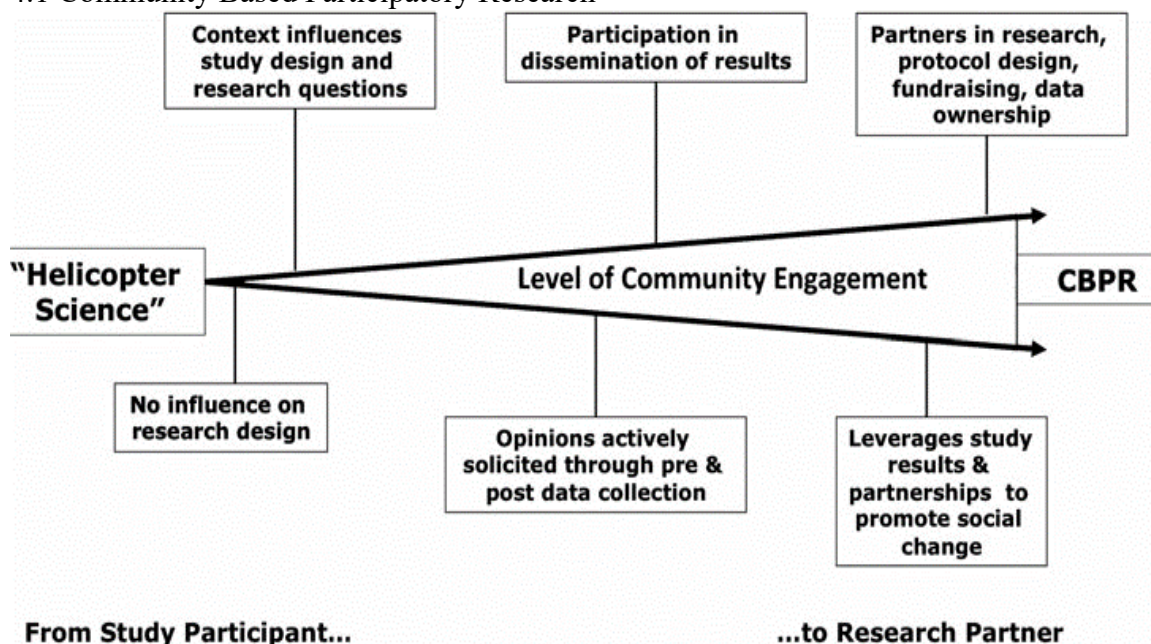


Image credit: Balazs & Morello-Frosch, 2013

A spectrum of community involvement in research from no involvement other than as the subject of research on the left, to full engagement with the research process on the right.

A fully engaged CBPR practice is necessary to positively impact a marginalized community. Further, the ownership of data resulting from CBPR strengthens a community while addressing past injustices and ensuring future equity.

Community Self-Representation

Historically, marginalized groups have had difficulty impacting policy decisions. For the interests of a community to be represented, that community requires access to institutions that create opportunities for representation, either directly through the electoral process, or indirectly through policy advocacy (Besley & Case, 2003). Marginalization is defined as lack of access to such institutions. In the San Joaquin Valley (SJV), race and income level are strong predictors of institutional access to organizations that determine water use and water safety policy (Dobbin & Lubell, 2021).

Ownership of data allows communities to better advocate for themselves on environmental issues. In this way, community ownership of data enhances environmental justice. Because they did not have institutional access, marginalized SJV residents were unable to convince regulatory agencies and policy makers that their drinking water was contaminated. When these residents were offered the opportunity to work with the Community Water Center (CWC) and the University of California, Berkeley (UCB), ownership of data regarding water quality and the institutional access granted by joint

ownership with CWC and UCB resulted in the ability of marginalized residents to advocate for themselves and impact policy (Balazs & Morello-Frosch, 2013).

Compensating Communities for Wealth Extraction

While academic institutions have been more likely to recognize the role they have played in colonial and white supremacist systems, efforts to compensate the communities that wealth has been extracted from have often been transformed into profit motivated investment plans (Baldwin, 2021). These plans are a scaled down version of the adaptation investment plans criticized by UN Secretary General, António Guterres. As with adaptation finance at the global level, profit motivated investment deepens the injustice inflicted on the community being invested in. Because academic institutions have extracted wealth from marginalized communities, the only way to remedy the injustice is to compensate communities from which wealth was extracted. The sharing of data ownership increases the potential wealth within the community in the same way data creates wealth for academic institutions. While not as powerful a compensatory mechanism as reparations, shared ownership of data begins to address some of the historical wealth extraction while creating a path toward future equity. When combined with strategies for increasing successful pathways to advanced degrees and research funding for marginalized academics, sharing of data ownership becomes a strategy for addressing systemic white supremacy and internal colonialism.

Increased Community Resilience

Improving the resilience of a community should enable the community to better withstand the pressures of the climate crisis and the systemic failures that occur during climate shocks. A climate shock is a climate disaster induced failure of multiple social systems, such as economic systems, infrastructure, etc., that occur regionally or globally. The failure of supply side economics and social support systems during the COVID-19 pandemic is an example of such a shock. Disaster response planning at the state, national, and international levels has focused on community resilience for many years (Koliou, et al., 2020). To maintain community cohesion when regional systems failures occur, it is necessary for local systems of many types to be strengthened. This includes social, economic, cultural, and infrastructure systems (Jordan & Javernick-Will, 2012).

Community engaged academic projects help to improve many community systems. Increased access to an academic institutions and shared research ownership lead to increased wealth which improves local economics systems. The engaged academic institutions also serve as a community center, increasing cultural capital in the community. The CBPR projects themselves strengthen community organizations, which strengthens social and civic systems. The resilience of local and marginalized communities is strengthened by the impact a community engaged academic institution has on local systems.

Three Community Engagement Strategies

Over the past few years, I have worked on a number of community engaged projects. My experience has provided a roadmap for three approaches to applied research I will engage in during the coming years. Projects utilizing these approaches will be housed in an Illinois based non-profit organization called the Institute for Social Systems Dynamics (ISSD). The three approaches are outlined here as methods for satisfying the desired outcomes of CBPR projects described in the previous section.

Research Education Approach

Establishing research training programs for people who are not enrolled in universities is a direct approach that can be easily conducted by academic departments or research institutes. I organized such a program for high school students in Colorado, but future development of these types of programs will be for multiple age groups, including adults. These programs have four main goals:

Develop an understanding of interdisciplinary research based on systems sciences.

As discussed in chapter 2, a key component to engaging students in science education is to ensure education is relevant to the experiences of students. Focusing on interdisciplinary approaches, especially in systems sciences, creates a flexibility in defining the scope of research to include the experience of a student. A focus on local events and histories will be more familiar for students and embeds the academic institution as an experience within the community rather than a separate entity. As an example, a key goal of the Colorado program was to increase student awareness of environmental issues. Students worked with a glaciologist and a water rights research group to develop an understanding of glacier retreat in Colorado and how it was related to the environmental justice issues surrounding water access for marginalized communities across Colorado.

Create a pipeline of marginalized students into higher education.

When students in a research education program become familiar with the physical and conceptual spaces of a university, they are more likely to be engaged with the university after the program ends. The goal is to recruit undergraduate students, or possibly graduate students to increase the demographic diversity of the student body. An increase in diversity also increases the exposure of all students to diverse cultural traditions and diverse forms of problem solving which is critical for a decolonial approach to science education (Jessen, Ban, Claxton, & Darimont. 2022; Neeganagwedgin, 2022; Sundararajan, 2015; Mignolo, 2011). To compliment an increase in diversity among students, an increase in diversity in equitable pedagogical approaches and cultural knowledge among faculty is required. This means that for a research education program to be successful, it must be conducted at an institution that is committed to correcting internal racial disparities among faculty and researchers.

Provide the tools for marginalized people to become competitive students.

As students in a research education program become familiar with the social aspects of scientific research processes, they will later be more comfortable with pursuing research opportunities as undergraduate students. While it is critical to have experience working with faculty and research staff to be able to successfully apply to graduate programs, university administrations tend to focus more on completion of a degree rather than preparing students for the reason they are completing the degree. Students from marginalized communities are less likely than other students to have mentors who can guide them through the nuances of social engagement with faculty and graduate students. By implementing a highly social aspect to research education, students of a research program will later have the skill set necessary to compete for undergraduate positions in research labs.

Create research education opportunities that empower indigenous communities.

Indigenous students in North America often prefer to remain close to their homes when engaged in education opportunities. Because the history of colonialism in the United States has stranded indigenous communities in places that are not usually economic hubs, it is less likely that students from indigenous communities will be close to a university. The Mentoring & Encouraging Student Academic Success (MESAS) program at Utah State University successfully pioneered methods of creating education access for students in indigenous communities.

Based on the MESAS model of combining local education, online education, and cultural engagement, a focus of my work with research education programs was to develop a relationship with the school district of an indigenous community (the name of the school and tribal affiliations are not disclosed here to protect the interests of the community). The district was actively pursuing science education for their students that would later result in increased self-reliance and self-representation in resource extraction and production. An online program was tailored to the interests of the district. Incidentally, their interests were mostly in computational sciences. The development of this portion of the research education program also generated interest for students outside the indigenous community which led to greater cultural exposure for all students. The ultimate goal of working with indigenous students is to give them the opportunity to develop research-based wealth for their communities. Academic institutions, like all American institutions benefitted greatly from the land and resources stolen from indigenous communities. A focus on serving the needs of indigenous communities is a starting point to compensate indigenous communities for what was taken.

Research Mediation Approach

Restorative Justice (RJ), a practice of Social Work, is a mediation practice that originated in the legal system and became official legal process when it was endorsed by the American Bar Association in 1994 (Armour, 2012). RJ was initially used to mediate

agreements between two parties in cases where one had wronged the other. Since that time, the RJ framework has expanded and is now used as a mediation practice in multiple areas. Of particular interest is an RJ methodology used to examine partnerships between a university and a community (Samimi & Silva, 2019). As interest in community engaged research has grown, it has been found that engaging communities is not as easy as researchers envision. Researchers and staff are often unprepared for the reality of working with people outside the academic setting and often have difficulty communication with outside communities (Curwood, Munger, Mitchell, Mackeigan, & Farrar, 2011).

It is necessary to have a shared cultural, economic, and social experience between members of the university and the engaged community (Iwama & Fritz, 2019). In practice, it is very difficult to develop such connections because efforts to decolonize academic institutions and to diversify faculty are still in very early stages of development. The development of a non-profit agency outside the university as an organization that mediates research interests and translates academic and non-academic language might be essential to successful community engaged research projects. In particular, the mediating organization would be able to educate community partners about the advantages of working with the university, such as why data ownership is beneficial. The organization could then help develop an agreement specifying the level of engagement expected from community partners, ethical parameters requested by community partners, division of ownership, and determination of how data is used.

A problem that I experienced in developing a mediation organization in Merced, California was that academic interest in the organization was high, while community outreach regarding the purpose of the organization remained low. The low outreach was largely due to the inherent disconnect between academic and local communities. In a sense the development of a mediating organization simply removes the problem of disconnection between institution and community one step from the source but does not fully solve the problem. It is important for the organization to be independent of the university. Too much influence on the development of the mediating organization, or control of the organization by academics, reintroduces the disconnection problem. An issue faced by the organization in Merced was that it was difficult to recruit community leaders to serve on the board of the organization because the board was entirely comprised of white people associated with the University of California, Merced. To address this issue, we targeted members of the community that would have a strong interest in a community based board and then stepped aside as board members so the community leaders would have greater control of the board thus making the organization more representative of marginalized communities in Merced.

While a mediating organization must be developed with specific goals in mind, it must also develop through organic connections to community organizations. The development of the organization is a slow process that requires recruitment of community figures that can in turn influence organizational development. One way to accomplish such development is to base previously discussed research training programs in the organization. From that interaction connections will naturally develop, and the mediating organization will develop an identity separate from the university.

Scientific Archives as a Tool for Sustaining and Rebuilding a Community

It is possible that the climate crisis will be severe enough to cause the collapse of not only academic institutions, but of most civil institutions. Long term planning is required to protect scientific knowledge. A project that is in a conceptual phase of development is the establishment of research archives on indigenous lands. Of course, these projects would only be initiated in communities that agree to their development.

The labor power required to establish archives is immense. The creation of durable physical records of data and publications alone is a monumental task. The construction and maintenance on indigenous lands would provide economic support for indigenous communities. The archives themselves would be housed in buildings built to the specifications of the communities maintaining archives. These buildings could be used for any purpose the community deemed necessary.

ISSD would provide funding and other resources to construction projects. Control over the development of projects would be left to the communities in which they are established. This includes construction, planning, maintenance, etc. The timeline of development will be long enough that education pathways that students from target communities choose will be instrumental in the development and maintenance of the archives. The community, in conjunction with academics, will determine what information to archive.

Over the course of years and decades, the archive buildings will be a community resource. As the climate crisis escalates there is a possibility that electronic resources will be lost. The only remaining locations for such information would be physical archives. There might come a time when archives such as what is described here are the only remaining repositories of scientific information. In that case, ownership of the mass of scientific production since the colonization of the Americas will be fully owned by the indigenous people who had first claim to the land. Archives can be used as a history of what existed before, or they can be used to jump start the development of reborn scientific disciplines.

While this concept sounds like science fiction, it might be a necessary scientific realization. An effort must be made to create repositories of data, research, philosophy, and other forms of information. Maintaining accumulated knowledge is a critical step in confronting the climate crisis. The survival of marginalized communities can be linked to the survival of scientific information. Both will be more likely to make it through the storm if the survival of both is part of the same project.

Conclusion

The three pathways outlined in this chapter will be a core component of the operation of the Institute for Social Systems Dynamics. One organization alone can only help develop resilience in a local community. It takes a network of organizations and institutions to have larger impacts and to ensure marginalized communities have the tools to survive the climate crisis. This chapter was intended as a conversation starter and networking tool.

Confronting the colonial heritage of academic institutions is a cause that is necessary for institutions to advance. While community engaged research is not the only option, it is an option that addresses the issue of wealth extraction from marginalized communities, as well as some of the other negative effects a university has in a local area. Community engaged research can be a process of recentering the academic institution in the community. A community-based university strengthens the community rather than drawing resources from the community. Shared control of research and data empowers the community through wealth creation and allowing more opportunity for self-representation of the community. The climate crisis is already here. It is time to begin preparing people, rather than capital, for adaptation and helping communities develop a path forward. In the end, it might be all we have.

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Chapter 5

A Path for Human Adaptation

As António Guterres, Secretary General of the United Nations said, “We have a choice. Collective action or collective suicide” (2022). Effective adaptation strategies are an embodiment of collective action. For academic institutions collective action means partnering with community organizations, especially organizations in marginalized communities. Community based participatory research provides a means for universities to share ownership of research with marginalized communities and to create pathways for marginalized students to succeed in academia. The pairing of marginalized communities with academic institutions improves community resilience, which in turn, assists in the survival of the institution, the community, and scientific research. Successful engagement of marginalized communities requires improved communication strategies based on a recognition of cultural knowledge and the fundamentals of how communities identify themselves within ideological frameworks.

In chapter 2, dyadic conversations based on prompts about the climate crisis were recorded and analyzed. Participants of this experiment were University of California Merced (UCM) students who were also members of marginalized communities in the San Joaquin Valley (SJV). The conversations provided an insight into the lived experiences of the students taking part in the study, as well as the work experiences of their families. Many of the participants came from families of farmworkers or labor that was related to agricultural work.

Students were not as likely to remember climate science information from science courses as readily as they were to remember climate science information from humanities courses, such as ethnic studies, where the science of climate change was combined with socially salient issues of climate justice. Because students have suffered or been exposed to climate injustice, the lessons were more meaningful to students. This finding suggests that science courses should incorporate the human dimension into climate science education as a method of improving learning outcomes. Additionally, the finding suggested that humanities play a larger role in climate science education than they are given credit for. Climate science-based education and research funding for humanities programs should be considered an integral part of funding structures.

Marginalized laborers in the SJV might not have had a scientific understanding of climate change (although at least one mentioned in the study did) but are very familiar with the effects of seasonal shifts and extreme weather events on their labor. There was even evidence of generational knowledge of the effects of climate change. Such knowledge is a form of expertise and should be recognized as such by academics. Until non-academic expertise is recognized, cross-cultural communication between academics and marginalized laborers is going to be difficult. It is only when we academics recognize ourselves as members of the community that we can truly interact with the community in a meaningful way.

Chapter 3 involved a journey into political communication. It is easy to become lost in the political arena of debate and accusation surrounding the climate crisis, but the politics are a game with a different purpose. Political elites develop centers of power by manipulating signaling to the public for various purposes. The form of the messaging

typically involves collapsing complex policy topics that represent a multidimensional position, into a single dimension of ideological space. The resulting simplicity of the message could be a distillation of facts with ideological talking points to make a complex policy more accessible to the public, or it might be a directive that policy is unfavorable because it is associated with a specific ideology.

Using a mouse tracking methodology, an experiment was designed in which participants were asked to associate an ideological trait with an ideology that best represented the trait. The four ideologies included in the experiment, Conservative, Fascist, Liberal, and Socialist, were compared to each other in pairwise comparisons. The movement of the mouse by participants created a trajectory that was used for analysis. The primary measurement was curvature type. Various curvature and complexity measurements were used to support differences in curvature type. For each ideological trait, all trajectories for a given selected ideology were compared with the trajectories of every other selected ideology. These comparisons were used to create a relative spacing (RS) scale based on the traditional Left-Right ideology scale. The RS scale was designed to represent how a population, in this case primarily marginalized students, perceive the ideological landscape of the Left-Right scale to be. In all cases, it was found that the Liberal ideology was at the left end of the scale, while either the Fascist or Conservative ideologies were at the right end of the scale. Polarization between the Liberal and Conservative ideologies was strongly apparent.

Applied research intended to improve community resilience was the focus of chapter 4. It was argued that community based participatory research models increase the engagement of academic institutions with marginalized communities in a way that addresses historical injustices. Through colonial and internal colonial practices, academic institutions have enriched themselves by extracting wealth from marginalized communities. Community engaged research practices can increase community involvement in research to the point that ownership of data is shared with community organizations. Along with developing successful pathways for marginalized researchers and students to succeed in academia, shared ownership of data results in increased wealth production, leading to stronger community resilience.

The chapter introduced three applied research approaches that satisfy the requirements for community engagement. Research education programs introduce members of the community to the fundamentals of research and allow students to conduct research with expert mentors. Developing such programs in marginalized communities removes some of the barriers to success for marginalized students by training them how to pursue advanced opportunities as university students. The program can act as a pipeline of students into the university and should be paired with institutional resources that help advance academic careers.

Structuring non-profit organizations as mediating organizations between a community and an academic institution allows the community to lead engaged research negotiations, balancing the power dynamics that exist between a wealthy university and struggling community organizations. The process of mediation was based on an adaptation of restorative justice from social work in the legal system. Ideally, a mediating organization should be the place where the university directs its efforts for community outreach and engagement and the place where community members can easily access

university resources. The structure of a mediating organization naturally draws the community and university together through increasing partnerships.

The final approach proposed was the establishment of data archives designed to withstand the climate crisis. Such archives would be built in indigenous communities by indigenous communities for the use of indigenous communities using funding external to the indigenous community. The idea is to create physical structures that represent physical resilience. The archives themselves would function as a repository of knowledge to be used as the community sees fit.

A Path Forward

It has been shown that testing how the public categorized ideological traits reveals how the identity of individuals has interacted with messaging from elites to redistribute the order of ideologies on a single dimensional scale. The resultant RS scale was a representation of how a group of students identified themselves in relation to the ideological world. RS scales can be used to determine popular directions for climate policy proposals that a polarized public might accept. After all, 76% of Americans believe that climate change is occurring (Leiserowitz, et al., 2021) and 58% of American would prefer to vote for a candidate who supports policies to address climate change, while only 17% would prefer to vote for a candidate who opposes climate change policy (Leiserowitz, et al., 2022).

The mouse tracking methodology used in chapter 2 is incredibly robust. After analysis of the qualitative study was completed in chapter 3, there were many interesting points that could be studied using mouse tracking. For example, because laborers have expertise in adapting to the effects of climate change, it would be possible to conduct a mouse tracking study of farmworkers that first established RS scales for farmworker populations, then used those scales to evaluate responses to farming terminology associated with the climate crisis. This set of responses could be compared to responses using only scientific climate change terminology to determine the level of resistance or acceptance of the scientific language among farmworkers. In general, a qualitative study functioned as a nice catch-all method that can be used to develop more specific quantitative/qualitative mouse tracking studies.

The research included in chapters 2 and 3 highlighted an interesting possibility. When rating the impact of climate change, all participants rated the impact at the top of the scale. When categorizing ideologies, the hand movements of participants revealed a greater polarity between the Liberal and Conservative ideologies than was expected. The extremity in both examples was unexpected and could indicate a strong shift in the way young people, especially young people of color perceive the world around them. It will be important in future iterations of research to compare age and demographic groups to see if the extremity in response is specific to the younger group or is universal across another dimension.

The mouse tracking paradigm and RS scale are also going to be used to track the development of the applied science projects discussed in chapter 4. Mouse tracking is useful in gauging support for or against a program and its outcomes due to the possibility of identifying falsified trajectories (Tabatabaeian, Dale, & Duran, 2015). Much of the

research conducted will be about controversial topics. Falsification strengthens mouse tracking experiments where it weakens the use of surveys. It seems likely that any type of study that might use a Likert scale can be made more precise using mouse tracking.

Additionally, mouse tracking produces multiple dimensions that are useful in developing computational models of larger social systems dynamics based on data produced by individuals. If it can be proved that there is an accuracy in translation from the individual to group dynamics, modeling social systems dynamics will be greatly strengthened by having robust experimental data to base models on. A major next step in all lines of research is using collected data to establish predictive models of group behavior

The research included in this dissertation provided insights into the various types of expertise regarding climate change that exist outside academia. Recognizing this knowledge allows scientists and academics to communicate more efficiently and less arrogantly with marginalized communities. The foundation of grasping the ideological landscape as it is recognized by individual populations is a move toward using embodied continuous measurement methods of research to draw conclusions about group identities and how they interact. Chapters 2 and 3 provided implicit and explicit knowledge about how humans respond to the climate crisis and provided potential tools to expand research on the human dimensions of climate change. Chapter 4 introduced three types of applied or engaged research practice that will be used in conjunction with future iterations of research. Each of us, whether we be academic and scientists, agricultural workers, or engaged citizens are working furiously to solve our piece of the climate puzzle. One day we will be able to easily work together to save the communities that most deserve to be saved, the communities that were robbed of their wealth to create a planet destroying money machine.

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Appendix: Heat Maps

Heat maps were generated from the trajectories of each comparison of selected ideologies as a visual tool to compare curve types. The heat maps are based on the individual trajectories created by the movement of the mouse from the starting point to the selected trajectory, as can be seen in the first column below. All trajectories for both selected ideologies are mapped to end in the upper left corner of the image. This means that trajectories that move toward the right side of the image are moving toward the opposing ideology in the choice that was made by a participant for the specific trajectory. Individual trajectories determined placement of coloring for selected ideologies in the heat map, meaning coloring appears where trajectories are present. The brighter the color the more trajectories for the given ideology are present. The dimmer the color, the fewer trajectories for a given ideology are present. In some cases, there are very few trajectories for an ideology so there is very little coloring for the ideology in the heat map. When the trajectories of one selected ideology are more prevalent than those of the other ideology, the color of the prevalent ideology is stronger. Equally weighted trajectory areas tend to cancel each other out for dimmer coloring or no coloring at all. Trajectories that are more direct tend to be on the left and center of a heat map, while trajectories that display indecision or change of mind tend to be further to the right and at the top of the heat map. Coloring at the top indicates several trajectories where the mouse cursor moved toward one ideology and then moved across the top of the screen to the other ideology.

The first ideology in a comparison is colored yellow and the second is colored red. For the Conservative vs Liberal comparison of the Democratic trait, there is a strong red coloration that approximates a line from the bottom center to the upper left corner of the heat map. This indicates that trajectories for Liberal selected ideology tend to be more straight or slightly curved than trajectories for the Conservative selected ideology. There is more yellow coloring at the top and right of the heat map indicating that trajectories for Conservative selected ideology were more likely than trajectories for the Liberal selected ideology to move toward the opposing ideology and then across to the Conservative choice.

For the Liberal vs Socialist comparison of the Civil Rights trait, clear separation of coloring occurs between the left and right, but both sides of the heat map are covered with colorless mottling, meaning that there is roughly an equal number of trajectories for each selected ideology present in that portion of the heat map. So while separation of color is present, the chi square test for difference in curve type is not significant, $X^2(4, N = 720) = 8.15, p = .0864$.

A.1 Constructing Heat Maps

