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Environmental Socialization In College: A Survey Research And Network Analysis Of Changes In Climate-Conscious Concerns And Behaviors

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Environmental Socialization in College: A Survey Research and Network Analysis of Changes in Climate-Conscious Concerns and Behaviors

Independent Study Thesis

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Abstract

Studies have established that socialization takes place in different stages of life. This study explores how political socialization occurs at The College of Wooster by examining changes in students' political identities as well as their perceptions towards a politicized issue, that is, climate change. These shifts in beliefs and concerns among students were evaluated by implementing quantitative research tools present in the Statistical Package for Social Sciences (SPSS) and constructing a similarity network using Gephi to explore similarities across students at this institution. The results revealed that students have become more liberal after joining this college. The study also found that students have become more concerned about environmental issues, and have become more likely to practice behaviors that favor environmental sustainability. The findings also disclosed that the students' college peers were the most influential in inducing these shifts. The majority of the students had liberal-leaning identities before joining this college, so this study infers that students have adjusted their attitudes in order to adapt to this new social environment. Consequently, they have created a student body that is more liberal and pro-environmental.

Acknowledgements

I do not know if I can put into words how grateful I am to be surrounded by the best support system in the past four years and throughout my life, but I will try.

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Chapter 1

Introduction

As I reflect on my time at The College of Wooster, I realize how my friends and I have changed over the years at this institution. I have noticed more people take steps to mitigate climate change, become more accepting of diverse identities, and, in general, become more liberal now than they were when they first joined this college. I realize that, at a personal level, my beliefs have changed because of the interactions that I have had with different people across campus, especially those with whom I spent a significant amount of time. This realization made me wonder how influential people who are the closest to us can be in shaping our beliefs and identities.

Hence, in this project, I explore how political beliefs among students at The College of Wooster have shifted due to interactions with people who are the closest to them by focusing on one politicized issue: climate change. I hypothesize that a significant number of students have become more liberal than

they were before they joined the College, and that they have become more conscious about the environment and their behaviors towards it. In this chapter, I first describe the purpose of my study and offer rationales regarding the significance of this project. Then, I introduce some key definitions and explain my method. Finally, I provide a layout of the chapters that follow.

1.1 Purpose Statement

The aim of this study is to examine shifts in political beliefs and environmental behaviors and concerns among college students based on their interactions with their closest ties—that is, families, peers, and mentors. For the first part of this study, I draw on past research to inspect how those ties influence political beliefs, specifically in terms of climate change. Then, I design a survey based on the research to assess the responses of 312 students at The College of Wooster who participated in the survey. I examine how the students have altered their political opinions and approaches regarding climate change based on their interactions with the people closest to them. I use standard survey research approaches to interpret the patterns that emerge among respondents who experienced shifts in political opinions. The second part of the study involves a mathematical interpretation of the responses to the survey. I construct a similarity network of respondents and use network analysis techniques to evaluate responses from a graph theoretic perspective.

1.2 Rationales

The first rationale behind conducting this study is to add to the scholarly work that focuses on how close ties influence shifts in political beliefs among college students. A study conducted by Matthew Woessner and April Kelley-Woessner [54] found that "students' ideological change over four years has a slight liberal drift" (663). Their research complemented studies by Tamkinat Rauf and Eric L. Dey that have found that an increase in liberal views is related to college attendance (Dey 400; Rauf 1). Similar to Rauf's approach, this study focuses on how closest ties in college, as well as within families, influence political beliefs. In addition, this study takes into consideration the suggestion made by Woessner and Woessner for future studies to focus on specific politicized issues in order to analyze shifts in beliefs (657), and therefore, examines changes in behavior and practices related to climate change. By integrating recommendations provided by these scholars, this project compares changes in political beliefs among college students before and after they pursue higher education. Hence, this research expands findings from past research to improve our understanding of how close ties influence political attitude changes among college students.

Additionally, another rationale for this study considers the unique features of The College of Wooster: a small, private liberal arts institution where students reside on campus throughout their time at the College [1]. This study, hence, aims to understand whether conversations that take place in a residential community that emphasizes liberal arts education changes the residents' political beliefs. Woessner and Woessner's study suggested that "students with more

liberal peers tend to move more to the left on ideological self-placement, abortion, and affirmative action when compared to students with more conservative peers" ([54] 663), so this project explores whether living in a community where people reside in a close proximity to their friends has an influence over their political beliefs.

Furthermore, the third rationale for this study considers the severity of climate change and, subsequently, intends to examine the extent to which interactions that take place in higher education institutions can influence people to become more aware about climate-friendly behaviors and practices. A report prepared by the Yale Program on Climate Change Communication describes two types of social norms—injunctive and descriptive—that have an influence on our behaviors. Injunctive norms are the beliefs we hold regarding our friends' and families' expectations for us, while descriptive norms are the beliefs we hold that our friends' and families are behaving the same way ([24] 18). The report states that "43 percent of Americans perceive injunctive norms and 38 percent of Americans perceive descriptive norms" to reduce climate change ([24] 18). Therefore, this study explores whether the norms that exist at The College of Wooster influence students to behave in ways that favor the environment.

The final rationale behind this study is to explore shifts in political beliefs using social science as well as mathematical approaches. By bringing together these two disciplines—mathematics and communication studies—this project aims to understand how changes in beliefs can be studied using different methods and analytical tools.

1.3 Definitions

In this section, I introduce some key definitions for concepts that are important in this project and appear throughout the course of the study. First, let us explore the concept of socialization, and more specifically, political socialization. **Socialization** is the process through which we "acquire knowledge, habits, and value orientations that will be useful in the future" ([10] 398). **Political socialization** is the process of acquiring an enduring political orientation, which is mediated through interactions with people in our society ([34]).

In addition to analyzing shifts in political beliefs through the lens of socialization, this project also incorporates a mathematical theory called graph theory to create a similarity network that examines how students at The College of Wooster have experienced similar or different shifts in their political beliefs. **Graph theory** is the study of graphs that consist of a set of vertices—that is, points—and lines known as edges between those points. The graphs form networks that represent various relationships between vertices, and interpreting those networks provide compelling information about such relationships. Social networks, for example, can be used to analyze social relationships. In addition to social networks, graphs can represent many different types of networks, including road networks, flight networks, and similarity networks, the latter of which is relevant to this study. **Similarity networks** are networks that represent similarities between vertices in a network. These networks are created by adding edges between two vertices that meet a specific similarity criterion [48]. While social networks and similarity networks can both examine relationship between

people, they examine different aspects of relationships between individuals. Similarity networks are distinct in a sense that they examine similar characteristics of two entities, whereas social networks examine social relationships between them.

1.4 Methods

The data collection process for this study consists of distribution of an electronic survey to students at The College of Wooster. The survey includes questions regarding the participants' political identity as well as their environmental attitudes and practices before and after joining college. Over 290 respondents filled out the survey in its entirety, and the respondents included students from class years between 2021 to 2025.

I then implement a quantitative analysis to compare the similarities and differences between the participants' shifts in beliefs. Furthermore, I create a similarity network to visualize and interpret the responses to the survey using properties of graph theory. Chapter 4 further clarifies the methods of this study.

1.5 Chapter Summary

This chapter details the purpose of this study, the rationales behind the significance of this project, and lays out some key definitions. It then describes the methods that I implement to conduct this research. Moving forward, Chapter 2 provides an in-depth introduction to graph theory and its properties. Likewise,

Chapter 3 includes background information regarding the politics of climate change, socialization, and climate change attitudes and practices among college students. The same chapter also provides context to social networks and their significance in examining relationships, and also provides more detailed information regarding similarity networks and their algorithms. Chapter 4 focuses on the methods used in this project before delving into the analysis portion of this study, which is detailed in Chapter 5. Finally, Chapter 6 summarizes this study.

Chapter 2

Introduction to Graph Theory

When we think about graphs, a variety of images can appear in our minds. After all, graphs are visual representations that include bar diagrams, graphs of functions, charts, and more. In this study, however, we will focus on graphs that represent networks and explore the resulting network using graph theory. Graph theory has been applied in many different fields, including mathematics and computer science, as well as chemistry, biology, sociology, and more. For example, graph theory can be used to analyze molecules, as atoms can be represented as vertices and their bonds as edges. An example of the use of graph theory in biology can be seen while analyzing migration behaviors of species [44], where vertices and edges represent regions and migration paths respectively, which is important while interpreting breeding patterns, spread of parasites, etc. Another interesting application of graph theory can be found in Google Maps [47], where two locations and the streets between them represent

vertices and edges respectively, and an algorithm of graph theory is applied to find the shortest route between those locations. Graphs can also be employed to represent social relationships and behaviors, and hence, graph theory can be used to make interpretations about such social phenomena. In this way, the seemingly simple method of representing objects as vertices and their relationships as edges serve as a basis to establish patterns as well as make complex analysis between those objects.

This section introduces some fundamental concepts and properties of graph theory. Additional details may be found in introductory graph theory textbooks such as Gary Chartrand and Ping Zhang's *A First Course in Graph Theory* [4], as well as Mitchel T. Keller and William T. Trotter's *Applied Combinatorics* [20].

Definition 1. *A graph $G = (V, E)$ is a pair of two sets V and E, where $E = [V]^2$, that is, elements of E are a 2-element subsets of V. The elements of V are the vertices (or nodes, or points) of the graph G, and the elements of E are the edges (or lines).*

For example, see graph A in which $V = \{a, b, c, d\}$ and $E = \{\{b, c\}, \{c, d\}, \{b, d\}\}$. The elements of E can also be written as bc instead of $\{b, c\}$ for convenience. The total number of vertices in a graph $|V|$ is called the **order** of the graph, and the total number of edges $|E|$ is called its **size**. In Figure 2, the order of graph A is 5, and its size is 4. When a graph has an order of one, it is considered a trivial graph, while graphs with an order greater than one are considered nontrivial.

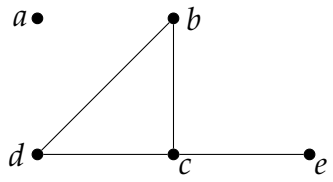


Figure 2.1: Graph $A = (V, E)$, where V=$\{a, b, c, d, e\}$ and $E = \{bd, dc, ce\}$

2.1 Graph Types

Graphs can be categorized in several ways. Simple graphs are graphs that do not have self-loops or multiple edges between the same two vertices. Graphs with loops or multiple edges are called multigraphs. Moreover, graphs can also be directed or undirected. An undirected graph G is one in which the edges are reflexive. That is, if there exists an edge ab in E, then ba also represents the same edge. In other words, if ab is an edge in graph G, so is ba. These graphs can be identified by the lack of direction of the edges, and are used to study networks where relationships between nodes that are not oriented. As we can observe, graph A is an undirected graph, which means that it is possible to travel to and from any vertices that are connected by an edge. Another example of an undirected graph is friendship networks, where if vertices A and B represent people who are friends, the edge between them would not have a direction assigned to it. On the other hand, a **directed graph** or **digraph** H is a pair (V, E) where E is a subset of $V \times V$ such that every $(x, y) \in E$ is an ordered pair. Digraphs are easily identifiable and can be distinguished by arrows in the edges that indicate the ”direction” of the edge. For instance, these graphs are

commonly used to visualize airline networks to indicate flights that travel from destination X to Y, but not from Y to X.

2.2 Relationship Between Vertices and Edges

Two vertices u, v are said to be adjacent if $uv \in E$. For example, vertices b and c are adjacent in graph A, whereas vertices d and e are non-adjacent. The vertices that are adjacent to each other are considered neighbor, and these neighbors form a neighborhood which can be interpreted as open or closed neighborhood. An **open neighborhood** of v, $N(v) = \{u \in V : uv \in E\}$, is a neighborhood that does not include v itself. On the other hand, a **closed neighborhood** of v, $N(v) = \{u \in V : uv \in E \text{ or } u = v\}$, is a neighborhood that includes v. For example, vertices b, c, and d are neighbors in graph A, and the neighborhood of vertex b contains vertices c and d. Likewise, two edges that share a common vertex are called adjacent edges. Every graph reveals an interesting relationship between vertices and edges, and this relationship establishes a fundamental proposition of graph theory. Let us explore this relationship by first defining the degree of a vertex.

Definition 2. *The degree of a vertex v is the number of edges incident with v, and is denoted by $deg(v)$.*

A vertex v is said to be **incident** to an edge e if v is one of the two vertices that is connected to e. The degree of vertex c in graph A is 3. The sum of all vertex degrees in a graph discloses information about the size of the graph as well. This relationship forms the basis of The Handshaking Theorem, which is also known

as the Fundamental Theorem of Graph Theory.

Theorem 1 (Handshaking Theorem)**.** *If a graph G has a total of n vertices, where* $V = \{v_1, v_2, \ldots, v_n\}$*, and a total of m edges, then*

$$\sum_{v \in V} deg_{(v)} = 2m.$$

Proof. Let e be an edge between vertices x and y in G. When we add the degree of x, we count e. Similarly, when we add the degree of y, we count e again. In this way, e gets counted twice, and so does each of the m edges between two vertices. As $V = \{v_1, v_2, \ldots, v_n\}$, every edge is counted twice for each v_i incident to it, where $1 \leq i \leq n$, then $deg_v 1 + deg_v 2 + ... + deg_v n = 2m$. Hence, the sum of the degree of every vertex is twice the size of a graph. □

To illustrate this theorem, let us examine the sum of the degrees of vertices and the size of graph A. $deg_a = 0$, $deg_b = 2$, $deg_c = 3$, $deg_d = 2$ and $deg_e = 1$. We observe that the sum of the degrees of vertices of A is 8. We also notice that A has 4 edges.

2.3 Paths and Connectivity

A sequence $(x_1, x_2, ..., x_n)$ of vertices in a graph G = (V, E) is called a **walk** when $x_i x_i + 1$ is an edge for every $i = 1, 2, \ldots, n$ - 1. That is, we begin at vertex x_1 and end at vertex x_n by following a sequence of consecutively adjacent vertices. In graph A, (b, d, c, e, c) is a walk from b to c. A walk is considered a **path** when all of

the vertices that are transversed are distinct. For example, (d, b, c, e) is a path from d to e, whereas (d, b, c, d, c, e) is a walk but not a path since vertex c is transversed twice. When two paths do not share a common edge, they are said to be disjoint paths. For example, (b, d, c) and (b, c, e) are disjoint paths in graph A.

Definition 3. *A graph $G = (V, E)$ is connected if, for all pairs of vertices $u, v \in V$, there is a path from u to v.*

Graph A is a disconnected graph because there are no paths between vertex a and vertices b, c, and d. On the other hand, graph B_1 in Figure 2.3 is a connected graph because all of the vertices are connected by some path. Connected graphs are important properties that reveal crucial information about a network. For example, we can examine the departments that exchange messages in an organizational network by analyzing whether the overall network is connected or disconnected. If a network is disconnected, we can infer that there is a department in the organization that does not exchange messages with other departments. On the other hand, if a network is connected, messages can be exchanged between every department in the organization. Let us assume that graph B_1 represents an organizational network's exchange of messages, where the vertices represent the departments. In this case, we can see that vertices a and c as well as a and d do not have an edge between them. However, these departments can still transfer messages between them because a and c, for instance, can exchange messages through department b.

A graph $H = (W, F)$ is a **subgraph** of G when $W \subseteq V$ and $F \subseteq E$. Graph A consists of two connected components: vertex a and the subgraph induced by

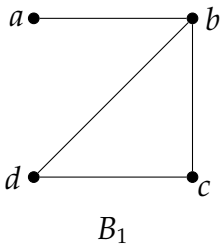


Figure 2.2: Graph B_1 is connected, as there is a path between all pairs of vertices

vertices b, c, and d. Figure 2.3 shows a connected graph B_2 and its subgraphs, B_3 and B_4. There are two types of sub-graphs: vertex-induced and edge-induced. A **vertex-induced** subgraph of graph G is a subgraph that contains some vertices of G along with all of the edges of the selected vertices from graph G. Likewise, an **edge-induced** subgraph of graph G is a subgraph that contains some edges of G along with all of the vertices that are the endpoints of the edges. When graphs are disconnected, we can also make interpretations based on the individual subgraphs that are connected. In a friendship network, for example, every individual supgraph could represent friendships between people who are connected, where as disconnectedness would represent that friendship does not exist across groups. In this way, analyzing the connectivity of a graph is useful to understand relationships as well as lack of relationships that exist between nodes.

Definition 4. *A connected component of a graph G is a subgraph where every pair of vertices within the subgraph is connected by a path.*

Since Graph B in Figure 2.3 is a connected graph, it only consists of one component, which is the graph itself.

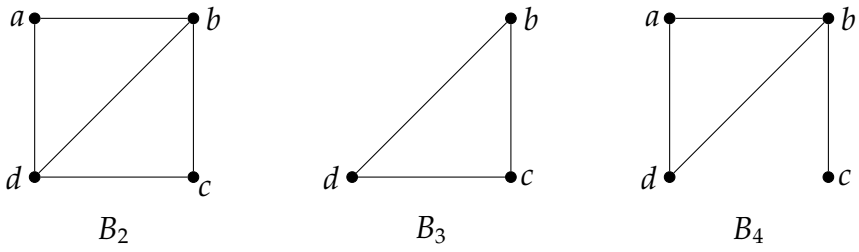


Figure 2.3: Graph B_2 and its subgraphs, B_3 and B_4

2.4 Generalized K-Connectivity

We can also examine the generalized connectivity of a graph, which is a function of whether a graph remains connected when the nodes, edges, or both are removed ([51] 112). Thus, connected graphs are 1-connected.

Definition 5. *A vertex v is a **cut-vertex** if the number of components in graph G that contains v is less than the number of components in the subgraph that results after the removal of v.*

In Graph B_1 in Figure 2.3, vertex b is a cut-vertex as its removal will increase the total number of connected components from one to two. A nontrivial graph that does not have a cut-vertex is called a nonseparable graph or a bi-connected (that is, a 2-connected) graph. When graphs contain cut-vertex, the maximal nonseparable subgraph of the graph is called a **block**. For example, graph C in Figure 2.4 contains three blocks: C_1, C_2, and C_3.

Likewise, graphs that contain cut-vertices also contain edges whose removal results in a disjoint graph. In Graph B, the edge ab is a bridge as its removal creates a disjoint graph and increases the total number of components from one

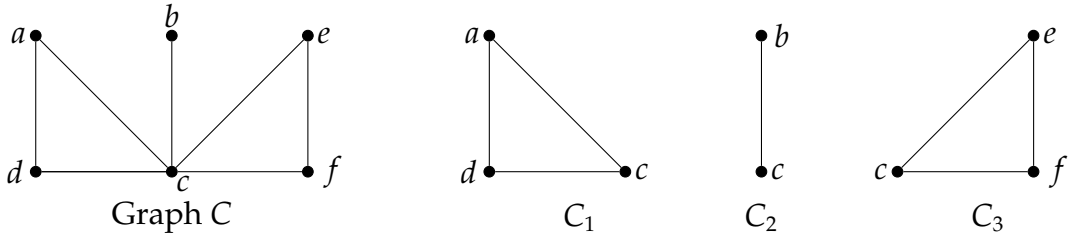


Figure 2.4: Graph C and its blocks C_1, C_2 and C_3

to two.

Definition 6. *An edge e is a bridge if the number of components in graph G that contains e is less than the number of components in the subgraph that results after the removal of e.*

As graph C in Figure 2.4 illustrates, a connected graph that has one or more cut-vertices can be disconnected by removing one vertex. While nonseparable graphs do not contain cut-vertices, removing one vertex in a nonseparable graph can result in a subgraph with cut vertices. The K-connectivity of a graph provides us with a method to measure the connectedness of a graph. 2-connected are more highly connected than 1-connected graphs. Moreover, 2-connected graphs that result in a 1-connected subgraph after removing one vertex are less connected than graphs where more vertices have to be removed to result in a 1-connected subgraph. This process of removing a vertex from a graph is called a **vertex-cut**, where a set U of vertices in a graph $G = (V, E)$ is removed such that the graph induced by U - V is disconnected.

A graph with the strongest connectivity is a **complete graph** K_n, which is a graph on n vertices where $xy \in E$ in G for every distinct $x, y \in V$. Every complete

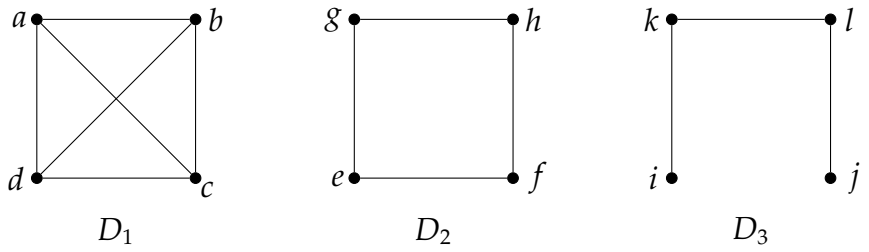


Figure 2.5: Graphs D_1, D_2, and D_3, where D_1 is 3-connected (the most highly connected), D_2 is 2-connected, and D_3 is 1-connected (minimally connected)

graph K_n contains the maximum possible size for a graph with n vertices. K_n is (n - 1) connected.

Figure 2.4 illustrates three graphs D_1, D_2, and D_3, where D_1 is the most highly connected whereas D_3 is the least connected.

As we observe, D_3 is the least connected graph because removing of either of the vertices k or l results in a disconnected graph. In contrast, D_1 is the most connected graph since removing any vertex does not result in a nonseparable graph until the graph becomes trivial, that is, only one vertex remains. Although D_2 is nonseparable, removing any one of the vertices results in a separable graph, which is a property common in graphs that have structures similar to D_2. Graph D_2 is a cycle.

Understanding how strongly connected a graph is can give us an idea of the strength of networks that have high connectivity, which is useful to comprehend relationships between nodes. Let us illustrate the significance of connectivity using an example. Suppose the graphs in Figure 2.4 represent three groups of students working on a group project for one class, where edges are drawn

between nodes that interact with each other when their groups meet for a project. Let us also assume that the success of the project lies in students actively collaborating with each other. In D_1, all of the members of the groups interact with each other, which means they have a higher chance of successfully completing their project. However, in group D_3, if students l and k are not present in the meetings, interactions between i and j would not occur either, which would impact how the project would be completed. We can observe from the graphs that group D_1 is most likely to succeed, followed by D_2, and D_3 is least likely to succeed among three groups. This example illustrates one of the ways in which connectivity plays an important role in exploring relationships between nodes in within a graph.

2.5 Distance Between Vertices

In addition, how far apart two vertices are from each other also reveals important information about a graph. This length of separation between two vertices is called their distance.

Definition 7. *The distance $d(u, v)$ between two vertices u and v in a connected graph is the length of the shortest path between u and v.*

In graph C in Figure 2.4, the distance between vertices a and c is 1, and so is the distance between a and d. The distance between a and all of the other vertices is 2. This means that the eccentricity of a is 2.

Definition 8. *The eccentricity of a vertex $e(v)$ is the distance between v and the vertex that is the farthest away from v [4].*

The eccentricity of vertices a, b, d, e, and f in graph C is 2, while that of vertex c is 1. Vertex c is said to have the minimum eccentricity in the graph. The minimum eccentricity among vertices is called the **radius** of a graph. Hence, the radius of graph C is 1. Likewise, the maximum eccentricity among vertices is called the **diameter** of a graph. The diameter of graph C is 2. Since the eccentricity of vertex c is the same as the radius of the graph, c is said to be the **central vertex**.

Analyzing distance between vertices provides helpful insights in many networks. For example, we can examine networks to establish facilities in the most accessible locations. Let us assume that a city is planning to build a new hospital, and that we have a map with all the residential areas highlighted. The vertices would be these highlighted areas as well as the potential locations for the hospitals. Let us assume the edges represent roads that connect two areas. In order to identify the optimal location for the hospital, we can check the eccentricity of all of the potential locations, and choose an area that has the lowest eccentricity.

2.6 Trees

Definition 9. *For a graph of order $n \geq 3$, a path $(x_1, x_2, ..., x_n)$ of n distinct vertices is called a cycle when $x_i x_i + n$ is also an edge in G, for all $i \in \{1, 2, ..., x - 1\}$.*

Graphs that do not contain cycles are called acyclic graphs. Connectivity of a

graph can also be analyzed by exploring a special type of acyclic graphs called trees. A tree is an acyclic connected graph [4]. Similarly, a collection of trees is called a forest. A forest is distinguished from a tree in the sense that the trees that form a forest are not connected to each other. In Figure 2.6, graphs T_1, T_2, and T_3 are trees, and graph T is a forest, consisting of subgraphs T_1, T_2 and T_3.

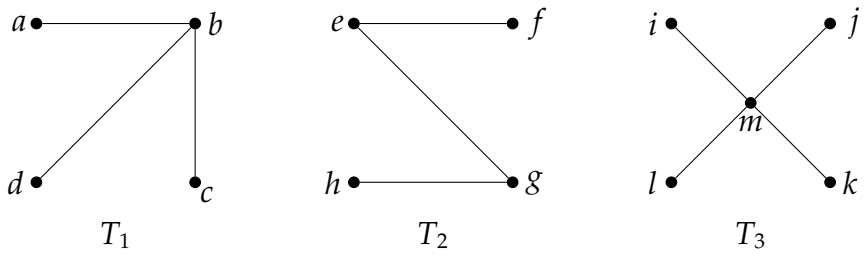


Figure 2.6: Forest T with its trees, T_1, T_2, and T_3

Theorem 2. *The following statements are equivalent for any graph T:*

a. T is a tree.

b. T is connected and acyclic.

c. There is a unique path between any two vertices of T.

Proof. We know that *a* and *b* are equivalent by definition. Let us prove that parts *b* and *c* are equivalent using contradiction. First, suppose a graph T is connected and acyclic. Let us also assume that $x, y \in V(T)$, and that they are connected by two unique paths. Now, we can take one of the paths to get from x to y, and the other path to get from y to x. However, this forms a cycle. This is a contradiction. Hence, there is a unique path between any two vertices of T.

Likewise, suppose there is a unique path between any two vertices of a graph

T, but assume T is not acyclic. Let $x, y \in V(T)$ are contained in a cycle. This means that we can either get from x to y from two different paths or that there are no paths between them, which is a contradiction. Hence, if there is a unique path between any two vertices of a graph T, then T is connected and acyclic.

Finally, assume T is disconnected but that T has a unique path between any two vertices. Suppose two arbitrary vertices t_1 and t_2 are disconnected, that is, they do not share an edge between them. This means that a unique path between t_1 and t_2 does not exist. This is a contradiction. Hence, the theorem holds. □

2.7 Graph searching with BFS

Graphs reveal many important properties regarding relationships that exist between the vertices and edges within them, and these relationships can be examined using various algorithms. Two of such algorithms are breadth-first search (BFS) and depth-first search (DFS), where we ”explore” and ”visit” different vertices within a graph. In particular, BFS is the process of exploring the edges of a graph G to reach other vertices from a distinguished vertex v by visiting all of the vertices adjacent to v before visiting other non-adjacent vertices [6]. This algorithm analyzes the distance—that is, the smallest number of edges between two vertices—from vertex v to every other vertex that is reachable from v. In doing so, it produces a spanning tree rooted at v that contains all of its reachable vertices. Let us now apply this algorithm in graph E in Figure 2.7 to understand this method. To search graph E using BFS, we first visit one of the

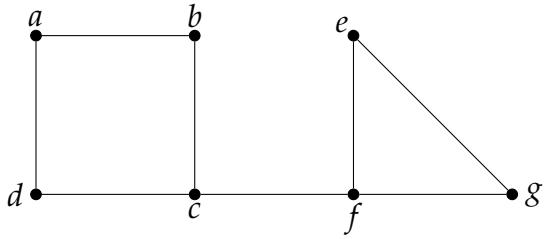


Figure 2.7: Graph E

vertices to explore. We can start by choosing any vertex; in this case, let us start by visiting vertex c first. By "exploring" vertex c, we mean that we will now visit all of its adjacent vertices, that is, vertices b, d, and f. After we visit these vertices, we look for and visit the vertices that are yet to be explored, specifically, vertices a, e, and g. Since all of the vertices have now been visited, we conclude our search. BFS are useful to identify connected components in graphs because the nodes that are reachable from a vertex through this search form a connected component within the graph.

2.8 Chapter Summary

This chapter introduces some of the key definitions and concepts that play a crucial role for us to analyze the similarity network that we will ultimately examine in this study. In the next chapter, I provide context to the history of political polarization in the U.S., specifically in terms of climate change, and examine how socialization affects people's beliefs. Then, I detail some of the ways that graphical networks have been used to analyze social relationships.

Chapter 3

Background

3.1 The Politics of Climate Change in the United States

In their study regarding shifts in political beliefs in college students, Woessner and Woessner suggest that future research should focus on "shifts in issue positions" to distinctly analyze how changes in such beliefs occur during students' time at their educational institutions ([54] (663)). The rationale behind the scholars' recommendation is that although past studies have assessed some shifts in general political opinions, the factors of influence have not always been clear ([54] 663; [46] 2). However, analyzing shifts in political beliefs in terms of a particular politicized issue has been helpful in interpreting the overall change in political ideologies among college students ([54] 659). This is because people's ideological identities—for instance, their self-identification as "conservative" or

"liberal," resist change, even when their actual attitudes start to shift; moreover, attitudinal shifts are more apparent in stances on politicized issues, such as abortion ([54] 658). Hence, this research focuses on examining differences in political beliefs in terms of behaviors and attitudes specific to one politicized issue: climate change.

Although 73 percent of people in the U.S. believe in climate change, this issue has been heavily politicized in recent years [50]. A report published in 2020 revealed that while 94 percent of adults who identify as liberals believe in climate change, only 45 percent of adults who identify as conservatives do so [50]. The same report showed that this issue was much less politicized in 2008, where 64 percent of liberals and 50 percent of conservatives agreed this crisis was real.

Climate change was a nonpartisan issue before the 1980s, but the issue began becoming politicized when the Reagan administration "labeled environmental regulations as a burden on the economy" ([29] 26). The Reagan administration cut the budget of the Environmental Protection Agency (EPA) by 27 percent between 1980 and 1983 and launched "interventions into science-based decision-making" ([11] 97). However, climate change concerns had not become a completely politicized issue then, and the administration's emphasis on diminishing pro-environmental actions was met with heavy scrutiny and criticisms ([11] 98). The criticisms prompted the Reagan administration to implement policies and appoint leaders who were deemed more pro-environmental by the public; however, the EPA's budget was not fully restored, and the "White House authority over the agency was sustained" ([11] 98).

Reagan's successor, George H.W. Bush, created an administration that was more pro-environment, and Bush even battled with his opponent, Bill Clinton, in the 1992 presidential campaign "over who had the best environmental record" ([11] 98). While the Bush and the Clinton administrations established several policies to protect the environment—for instance, Bush strengthened the Clean Air Act and acknowledged the role of humans in the climate crisis, while Clinton signed an executive order that addressed climate injustice ([11] 98)—progress once again slowed after the Republicans became the majority in Congress in 1994 ([11] 98).

As Republicans returned to power, the U.S. conservative movement—including the conservative media, some of which were funded by the fossil fuel industries—became responsible for the polarization of climate change attitudes ([30] 158). Beginning in the 1990s, the conservative movement had begun actively challenging the legitimacy of climate change as an issue by amplifying the voices of the few scientists who challenged the severity of climate change ([30] 156).

Furthermore, after George W. Bush became the president, his administration often delayed environmental protection policies ([11] 99). For example, EPA employees mentioned that the administration would avoid making decisions related to the environment instead of directly rejecting actions ([11] 99). Moreover, the administration also famously edited internal documents and governmental scientific reports related to climate change to downplay the crisis [15].

In addition to Democratic and Republican administrations taking increasingly different approaches to address the issue of climate change, media coverage has perpetuated the polarization of climate change beliefs as well ([5] 123). Over the years, the U.S. media have given equal coverage to both scientific consensus as well as scientific disagreements regarding climate change ([29] 28; [2] 152), which has created an impression in the general public that skepticism about climate change is high in the scientific community ([28] 366), even though the majority of the scientists share consensus regarding this issue ([29] 28). The U.S. media, in part, presented climate change as an issue that was debatable to expand its audience and protect their self-interest as well as the policy status quo ([2] 152). In doing so, the media "validated—or at least helped enable—the efforts of a minority of contrarian scientific voices" ([2] 152). This is not to imply that media portrayed the issue of climate change in a specific way solely to expand its audience. Several frames had been implied in media to cover this issue, including economic as well as environmental consequences, self-efficiacy, and more ([2] 150). Nevertheless, the polarization of people's perceptions of climate was amplified between 1990 and early 2000s ([2] 152). Moreover, McCright and Dunlap also argue that conservative think tanks and the fossil fuel industries were the most significant players to challenge the science behind climate change (348). These players lobbied for climate change to be framed as a "scientifically uncertain" issue ([2] 151), increasing the confusion among the general public regarding the severity of climate change.

Although it is apparent that the fossil fuel industry lobbied against

pro-environmental policies because was driven by its self-interest to sustain and maximize profit in the industry ([28] 368), the reasons why the conservative movement was adamant about challenging the severity of climate change may not be as obvious. To understand why, we must analyze how foundational values create a difference in ideologies between liberals and conservatives. A significant element of conservatism is that government action is seen as a threat to economic libertarianism ([28] 353). Since environmental protection requires government intervention, conservatives have been more skeptical about supporting pro-environmental policies ([28] 353). McCright and Dunlap also argue that conservatives tend to hold "a worldview in which modern societies are seen as able to control nature, making it difficult to accept that global warming poses an unprecedented danger" (353). Taking these foundational beliefs into consideration, conservative movements and think tanks have successfully created a rhetoric that downplays the severity of climate change. Furthermore, different news sources have also covered climate change with varied levels of concerns, which has amplified the polarization of this issue as conservative viewers consumed more media that challenged climate science ([30] 159). In a study conducted in 2016, investigators presented participants with a list of 23 issues and found that climate change ranked as the sixth most important issue among liberal Democrats, twenty-first among moderate and liberal Republicans, and twenty-third among conservative Republicans ([24] 5).

Since we tend to seek information that confirms our prior beliefs ([2] 155), conservative news media that present ideas about climate change enable their

viewers to reaffirm the notion that the issue of climate change is not serious. Fox News, which primarily consists of conservative viewers, is known for dismissing climate concerns ([45] 2; [2] 155). Likewise, although climate change denial is not prominent in the *Wall Street Journal*—a news source that is considered the "flagship newspaper of the conservative movement" ([45] 8)—the organization relies on arguments focused on the economic cost of adopting climate mitigation policies, which reduce support for such policies among its viewers ([45] 10).

As a consequence of the conservative movement—and lobbies by for-profit anti-environmental actions and the emphasis of news media in preserving and expanding their audience—climate change has now become a politicized issue ([29] 31). Perpetuated by these factors and the tendency to seek and accept information that confirms our perceptions, people in the U.S. now have an increasingly varied understanding of the severity of climate change based on their political views, despite the consensus in the scientific community regarding the impact of human activity on the environment.

3.2 Shifts in Political Beliefs: Environments and Agents Who Influence Our Perspectives

Political discourses in small groups primarily consist of discussions between and among individuals with similar opinions and beliefs ([32] 86). Furthermore, the participants of such discussions are often "relationally close" ([32] 87), such as families, good friends, and intimate partners. This is why, although we are more

likely to engage in disagreements with our close ties, these ties do not often challenge our beliefs since we share similar opinions. Furthermore, we are also behaviorally resistant to accepting ideas that challenge our beliefs ([12] 446). Engaging in dialogues with those who share similar beliefs and our psychological inclination to resist ideas that challenge our beliefs can limit us from seeking and accepting new ideas. In terms of political beliefs, our tendency to primarily engage in discourses with the people who share similar ideologies explains why our "basic outlooks and orientations are set fairly early on in life" [9] and remain consistent over the years.

However, our resistance to accepting opposing ideas does not mean that it is impossible to change our beliefs. Prior studies had presumed that knowledge acquired in early years formed our ideologies and that "attitudes and behaviors acquired prior to adulthood remained unchanged in later life" ([34] 2), but those presumptions have been challenged in recent years. Research conducted by Sears and Brown regarding how people's political orientations evolve throughout their lives found that significant political events and personal changes such as marriage, immigration, and educational attainment, can influence changes in political views [42]. Several research studies also indicate that beliefs acquired in childhood are revised in later life ([34] 3). For instance, research studies have documented a positive relationship between college attendance and an increase in liberal views ([10] 400; [38] 1; [54] 657). More importantly, Woessner and Woessner's study alludes to the idea that the "liberalizing effect of college is not tied to a student's major but rather is a byproduct of the college experience

common to all students" ([54] 663). Likewise, recent studies have established that although we resist ideas that challenge our beliefs, we are still capable of forming new beliefs. In the following paragraphs, we explore the factors that drive us to change our ideas and opinions.

One of the most significant factors that influence our beliefs is our social environment. The role of the social environment in shaping our beliefs can be understood through the concept of socialization, which is the process through which we "acquire knowledge, habits, and value orientations that will be useful in the future" ([10] 398). In terms of political beliefs, shifts in ideologies can be understood by the concept of political socialization, which is the process of acquiring an enduring political orientation, which is mediated through interactions with the people in the society ([34] 1). Political socialization is a part of the general socialization process where our social identities are formed because of interactions with different societal agents. One of the biggest agents of belief influence is our closest ties, and family is the most influential in shaping beliefs and identities in the early years of a person's life ([26] 298; [27] 20). By imposing rules and establishing accepted norms and values, families irreplaceably impact the identities of a person by influencing "how they relate to themselves, their peers, and the society in which they live" ([27] 20).

Despite a family's strong influence, however, individual identities are dynamic and susceptible to change based on their social environment ([26] 297). As we grow older, we are typically exposed to new social environments and hence, new ways to acquire value orientations. This is because other agents in

our social environment become just as significant in shaping our beliefs ([26] 299) since the people who are relationally close to us change over the years. For instance, many children spend the majority of their time with their parents, acquiring information and conforming to norms that are accepted in their families. However, when they move out of their household—for example, for college—their strongest ties become their close friends, and their value orientations may shift based on the conversations that they have with their peers. Moreover, while a considerable number of studies argue that the biggest sources of influence on our ideologies are our closest ties, some also argue that people who share similar social and structural positions generate greater influence on one another, regardless of their relational ties ([26] 298). These agents of influence include our neighbors, coworkers, as well as peers ([26] 300). While these agents may not necessarily be considered one's closest ties, the information they share, the pressure to conform they create, and the norms that they establish as a group can equally influence an individual's behaviors and beliefs ([26] 300).

These pressures and norms that are pertinent to new environments often compel people to change their attitudes. Lyons explains that when a person assimilates into a new social environment, they may face either harmony between their previous and new social environment, or conflict between the two ([26] 297). In cases where a person moves into an environment similar to the previous one, their past judgments may strengthen after socializing with the agents of the new environment ([33] 1). However, when a person's new social environment presents ideas that conflict with the ideologies that they had

developed prior, they are compelled to adjust their attitudes in order to integrate into this new environment ([26] 300). In addition, social pressures influence an individual the longer they stay in a social environment ([26] 300).

Although people's social behaviors are highly influenced by their parents in the early years of their lives, socialization occurs in various stages and consequently influences how we perceive our surroundings. In this way, understanding socialization allows us to comprehend the extent to which people's beliefs are susceptible to change, especially when they move into environments that present contrasting opinions and attitudes from the ones they had developed in their early years.

Furthermore, in regard to political beliefs, changes are more prominent among young adults between 14 to 24 years of age ([34] 4). Known as the formative age, young adults in this age range are more susceptible to effects from political events ([34] 3). For instance, a study revealed that the 2016 presidential election increased stress and anxiety among youths ([8] 2). In addition, people in their formative years do not have concrete political habits, which is why their political affiliations are more likely to change ([34] 7). Since young adults frequently expand their social environment by developing extra-familial relationships and expose themselves to new environments—such as new educational institutions—this malleability of their beliefs often leads to alterations in their perception of the world, including their political views ([16] 673).

In addition, since the Internet has become increasingly accessible to people of

all ages, social media have also contributed to identity development of individuals in their formative years ([16] 673). A study regarding the influence of social media found that people are turning to social media to "consume, produce, and distribute news and political information" ([52] 229), and that people who engage in social interactions on social platforms carry "considerable political influence" (230) to affect other users' political perceptions. In terms of individuals in their youth, social media use appears to increase "political messaging, discussion, disruption and the presentation of the political self" ([25] 837). As online social platforms provide opportunities for young people to participate in political discussions, the increase in accessibility to social media has also become a factor that influences the overall identity formation of youths, including their political ideologies.

In this way, change in our social environments—and consequently, our close ties—and interactions with people who share similar social standings with us play a key role in shaping our political beliefs. Likewise, the development of social media platforms has been significant in political identity formation, especially among youths. These interactions with various social agents and exposure to political events during the formative years are some of the key factors that affect how young people perceive politics. Therefore, in this research, I analyze how the process of socialization influences college students' political opinions and attitudes. Since this research participants will be students at The College of Wooster, I examine how socialization occurs at the College by considering its unique living situation. As most of the students live on campus, I

hypothesize that the influence among socializing pressures is high, and that causes the students to drift in a particular direction on the political spectrum. Acknowledging that students' political shifts may not be apparent while asking them about their overall political identities, I focus on changes in environmental behaviors to explore how socializing agents may have influenced students to drift politically.

3.3 Climate Change and Mitigation Practices Among College Students

Although climate change is an issue at present, its impact on the general population will be significantly higher as the years progress. The Intergovernmental Panel on Climate Change (IPCC) projects that by 2050, climate change could cause temperatures to rise by 1.5 °C and disproportionately affect disadvantaged groups and "local communities dependent on agricultural or coastal livelihoods" [31]. Even among privileged groups, IPCC projects that climate crisis will affect human health, reduce food availability, and increase risks to the global economy [31]. Although the severity of the impacts of climate change will depend on the overall rise in temperature, exposing youths to their future means raising difficult questions in relation to climate change, as the younger generation will experience the most impact of climate change [35]. However, while older generations share varying levels of concerns regarding the climate, youths often struggle to establish the right approaches and actions to

address this issue [35].

While political polarization regarding climate change is stark among adults in the U.S., a consensus in terms of climate change attitudes exists among students who pursue higher education. A study published in 2019 reported that over 96 percent of college students believe in climate change, as well as the fact that humans are responsible for causing it ([22] 13). The difference in attitude, however, lies in how people approach this reality [35], and common responses often "include fear or grief, overconfidence in the potential for technology to solve the problem, the assumption that they will be able to adapt to negative impacts, concern about an inability to effect change, frustration with existing political processes, denial of the problem, distractions and diversion of attention to more immediate social, economic, cultural, and political issues; or disinterest or disbelief in the science of climate change" [35]. This range of emotions that young people feel regarding the climate crisis is also visible in how they participate in climate crisis mitigation efforts, which is why acknowledging that climate change is a concern does not always translate into adopting personal practices to combat climate change ([17] 97).

A study published in 2014 revealed that only 15 percent of the participants—all of whom were college students—had altered their actions to lessen climate change, and only three percent were living a "low-carbon life" ([49] 136). Another study stated that around 50 percent of the participants recycled "as much as possible" while nine percent of the respondents did not "recycle at all" ([53] 105). This shows that although most students believe in

climate change, individual efforts in mitigating this change are significantly low. The reasons for this gap between acknowledgment and action include pessimism about the future, but also a lack of control or motivation they feel regarding the climate threat ([36] 909).

Many youths may also distance themselves from engaging in pro-environmental practices as a response to being excluded from decision-making processes, which disproportionately affect communities that lack access to ”institutional support for civic participation during childhood and adolescence” [35]. For instance, youths from minority groups may disregard national institutions due to their unjust norms and policies [35]. Furthermore, several studies point to a gap in knowledge among college students regarding basic causes of climate change as well as practices to mitigate climate change ([49] 137). Although most students acknowledge that climate change is an issue, attitudinal orientation varies among students based on academic orientations as well as racial, cultural, and ethnic demographics ([41] 805). For example, Hodgkinson and Innes found that “sociology, biology, and environmental studies students consistently displayed stronger positive beliefs and attitudes toward the environment than students from other disciplines” ([18] 39). Another study revealed that the students who pursue a degree in the arts, humanities, and social science fields shift more leftward in their political beliefs during their time at college than the students who pursue hard sciences degrees ([54] 663).

However, Levy and Michel argue that research that has established an association with taking environmental classes and responsible behaviors is

susceptible to selection bias as students choose the courses they want to study, and hence, they might already have some motivation to learn about the environment ([37] 5). In order to address the issue of selection bias, the scholars applied the opportunity to learn (OTL) concept in their study regarding environment and sustainability. The OTL concept accounts for student learning opportunities by examining variables such as the content of a course and a student's time commitment to the course ([37] 6). The scholars had applied OTL to their study by "gauging student reports about the frequency that professors and instructors have mentioned 'environmental issues' and 'sustainable development,' or discussed 'ways to protect the environment'" ([37] 6). The findings of the scholars' study indicate that increasing engagement in environmental content in college is related to adopting pro-environmental behaviors (19). In this way, the socio-cultural demographics of individuals, as well as their educational attainment, affect the extent to which students may participate in pro-environmental behaviors as well as contemplate the severity of climate crisis.

Despite a high rate of consensus among youths—and college students in particular—regarding the existence of climate change, individual efforts to adopt pro-environmental behaviors vary even among the younger population. Therefore, in this study, I examine how climate change behaviors and concerns vary among students at The College of Wooster based on their interactions with their closest ties as well as access to courses that have focused on addressing environmental issues.

3.4 Significance of Social Networks in Examining Relationships

Social networks can be used to make interpretations about social systems by examining how systems are established based on the relationships that exist among entities ([3] 1), and mathematical foundations of network methods consist of three major theories: statistical theory, probability theory, and graph theory ([51] 15). For the purpose of this study, we will explore social network analysis with regard to graph theory, where networks often consist of a collection of graphs where each graph represents a social tie ([51] 13). The ties within a network could be represented many ways. Some of the types of relationships that people have examined through social networks are role-based relations—such as friendships, interactions—such as communication between employees, affect ties—such as likes and dislikes, and more ([3] 264). Network analysis draws on several key concepts that are fundamental to the discussion of social networks, and these concepts are described below.

Actor. The actors in a social network are the social entities that could be ”discrete individual or collective social units” ([51] 17). For example, if we were analyzing a friendship network, each individual within a friend group would be an actor in the network.

Relation. Relations are specific ties among members of a group. A network could contain several different types of ties among actors. A friendship network, for instance, could reveal whether actors within a group are friends or not, but

they could also reveal the strength of friendships between actors as well. These two ties would be considered two separate relations in the network.

Social Network. Formally, a social network is one or more finite sets of actors and the relations that are defined between the actors.

Social networks have been used to analyze relationships among social entities, and these networks can also provide us with compelling information about the structure of the networks. Structures of the networks are the patterns that exist within the network ([51] 3). Social networks are widely seen in fields of various social sciences to study psychological and sociological phenomena.

3.4.1 Similarity Networks

Several types of relations can exist between actors within a network. Borgatti, Everett, and Johnson categorize them into four groups: similarities, relational roles, relational cognition, and relational events ([3] 5). For the purpose of this study, we will focus on similarities. They explain that the similarities category "refers to relational phenomena that are not quite social ties but can be treated as such methodologically, and which are often seen as both antecedents and consequences of social ties" ([3] 5). These networks explore how actors within a network share similarities in characteristics, practices, and more. In other words, similarity networks are not based on relationships between two actors. Instead, these networks represent how definitive characteristics between the actors are similar. For example, while a social network signifies that two actors are friends, a similarity network could signify the common characteristics between these

friends.

Similarity networks have been used in the social sciences as well as for analysis in other sciences, such as biology. For example, a 2010 biomedical research study analyzed protein sequences and structure-sets using similarity network-bed methodology that included measurements such as network-degree, clustering coefficient, characteristic path length and vertex centrality [48]). The 2010 research regarding the analysis of protein sequences consisted of an examination of average number of degrees of vertices and betweenness of a vertex. In the study, each of the vertex represented proteins, and edges were drawn between proteins that met the researchers' criteria of similarity ([48] 258). The researchers created two networks to explore similarities at structural and sequence levels. The resulting network analyzed clustered groups of proteins—that is, proteins that shared similar characteristics—and explored the interconnections between the proteins ([48] 259). Moreover, similarity networks have also been used in geoinformation sciences. One study applied this form of network analysis to explore relationships between geographical locations and discovered that some low-income communities in Manhattan had distinctive restaurant cultures by analyzing how clusters were formed [56]. These examples are two of the many different types of research that analyze relationships between actors using similarity networks, and they point to the significance of such network analysis methods across different fields.

Despite their use in a wide range of fields, however, similarities in networks are analyzed using several key properties of graph theory. One of the most

significant concepts of graph theory that is employed in similarity network analysis is clustering. For instance, a study regarding how places shared similarities also implemented clustering analysis to find groups of places that were semantically similar ([56] 25). The network in this study also contains graphs that are weighted, where the weight of each edge represent a "similarity score" ([56] 7). Although analyses of similarity networks and their clusters can be conducted using many algorithms, the foundations of such algorithms stem from two primary concepts: assortativity, which was introduced by M.E.J. Newman, and vertex similarity, introduced by E. A. Leicht, Petter Holme, and M. E. J. Newman.

3.5 Background Summary

This chapter provides an analysis of the United States' perception of climate change over the years, and explains how various environments and various social agents influence our political beliefs. It then explores the varying levels in which college students have adopted pro-environmental practices. Finally, this chapter examines the significance of social networks and similarity networks by reviewing how network analysis has been implemented in several fields, including social sciences to understand social relationships.

Chapter 4

Methods

An electronic survey was distributed among students at The College of Wooster. The survey received over 350 responses, but a significant number of the responses were incomplete and had to be removed. In the end, a total of 312 responses were considered for SPSS analysis and 294 responses were considered to construct and analyze a similarity network. In this chapter, I detail the types of questions that were included in the survey and describe some of the responses, which I analyze further in Chapter 5.

4.1 Questions

The survey consisted of several Likert-type questions about participants' political identities and climate change attitudes. These survey items were measured on a 7-point scale. For example, two of the questions asked about how likely the respondents were to be involved in pro-environmental practices—such as buying

second-hand items and reducing meat consumption—before as well as after they joined the College. The survey also included items from an Environmental Awareness Survey published by Global Issues in Language Education that asked how concerned the participants were about air pollution, climate injustice, carbon dioxide emissions, and oil drilling [43]. The respondents were asked to evaluate the extent to which they agreed with statements related to climate change, statements that were taken from an article published by Shannon M. Cruz and Brian Manata titled ”Measurement of Environmental Concern” [7]. For example, one of the items in this survey was ”the current concern regarding the state of the environment is justified,” and the respondents could select a response varying from ”strongly disagree” to ”strongly agree.” Furthermore, participants were also asked about the extent to which specific people in their lives had influenced their climate-conscious practices, whether positively or negatively. Students were asked to complete the survey relative to their life before attending the College of Wooster, as well as after joining this institution. In addition, the survey also contained a question that asked respondents to indicate the total number of environmental and earth sciences classes they had taken in college. Moreover, taking into consideration that COVID-19 may have affected students' college lives—especially in their interactions with others—the survey included items that asked respondents to mention the total number of semesters they had studied remotely. Finally, respondents were asked questions about their demographics, such as their race, gender identity, and class year. A copy of the survey questions is included in Appendix A.

4.2 Procedures

Before contacting the potential participants, the survey was sent for review by the Human Subjects Research (HSRC) committee at The College of Wooster for approval, along with a draft of the email that I used to reach out to participants. The HSRC application also contained a research protocol detailing the statement of purpose and methodology, which included the survey instrument, as well as a description of the age demographics of the sample population. The HSRC approval process additionally entailed completing a human subjects protection training module and uploading the certificate of completion to the documentation page in the application portal.

After receiving approval from the HSRC committee, I reached out to students currently studying at the College with the help of Dean of Students Dr. Jennifer Bowen, who sent a mass email to the student body on my behalf. The email included the purpose of the survey, the time required to complete it, and mentioned the raffle respondents could participate in to win an Amazon gift card. Finally, it included a link to the survey and the contact information of my advisors as well as myself in case the respondents had any questions. A copy of the email is included in Appendix B.

4.3 Responses

Out of 312 students at The College of Wooster who completed at least 94 percent of the survey, 92 (29.49%) belonged to the class of 2025, 56 (18.06%) belonged to

the class of 2024, 64 (20.51%) from the class of 2023, 91 (29.17%) from the class of 2022, and seven (2.24%) of the respondents were from the class of 2021. Two (0.64%) of the respondents did not mention their class years. In the sample, 205 (65.71%) of respondents stated that they were White or European, 33 (10.58%) were South Asian, 30 (9.61%) were Black or African American, 12 (3.85%) were Latinx or Hispanic, 11 (3.53%) were East Asian, two (0.64%) were Native American or Alaska Native, two (0.64%) were Caribbean, and two (0.64%) were Middle Eastern. Eight (2.56%) of the respondents checked off that their race or ethnicity was ”other,” while seven respondents (2.24%) chose not to respond to the question. Table 4.3 shows the breakdown of the demographics.

With regard to their current political beliefs, 135 (43.27%) of respondents stated that they were liberal, 76 (24.36%) responded that they were extremely liberal, 49 (15.71%) said that they were somewhat liberal, 36 (11.54%) responded that they were at the center of the political spectrum, nine respondents mentioned that they were somewhat conservative (2.88%), five (1.60%) responded that they were conservative, and two (0.64%) responded that they were extremely conservative. On the other hand, with regard to the respondents' political beliefs prior to joining the College, 131 (41.99%) respondents mentioned that they were liberal, 43 (13.78%) said that they were extremely liberal, 58 (18.59%) stated that they were somewhat liberal, 50 (16.30%) stated that they were at the center, 19 (6.09%) responded that they were somewhat conservative, nine (2.88%) responded that they were conservative, and two (0.64%) responded that they were extremely conservative. Table 4.2 includes the details.

Sample	N	Percent	Total
Class year			
2021	7	2.24	
2022	91	29.17	
2023	64	20.51	
2024	56	17.95	
2025	92	29.49	
Not mentioned	2	0.64	312
Race/ethnicity			
White or European	205	65.71	
South Asian	33	10.58	
Black or African American	30	9.61	
Latinx or Hispanic	12	3.85	
East Asian	11	3.53	
Native American or Alaska Native	2	0.64	
Caribbean	2	0.64	
Middle Eastern	2	0.64	
Other	8	2.56	
Prefer not to say	7	2.24	312

Table 4.1: Demographics

Political Identity	**Past** N, %	**Present** N, %
Extremely liberal	43, 13.78	76, 24.36
Liberal	131, 41.99	135, 43.27
Somewhat liberal	58, 18.59	49, 15.71
Center	50, 16.30	36, 11.54
Somewhat conservative	19, 6.09	9, 2.88
Conservative	9, 2.88	5, 1.60
Extremely conservative	2, 0.64	2, 0.64

Table 4.2: Frequency table of political identities

4.4 Similarity Network

Finally, the respondents' shifts in political beliefs were also analyzed via a similarity network. The network was created using Gephi, an open-source software that visualizes graphical networks and contains several features that allows users to interpret such networks. In order to create a resulting network based on the survey responses, I considered 294 responses of students who had completed the survey in its entirety. The reason why less number of responses were considered was to prevent creating a network that would represent an inaccurate level of similarity between respondents due to missing data points.

In the next chapter, I analyze these responses more deeply using Statistical Package for the Social Sciences (SPSS) and a similarity network created by Gephi, where I explore the properties of the network by identifying the degrees of various nodes, the network's diameter, radius, and eccentricity, as well as average path length. I then compare the network to several other networks based on different criteria for similarity.

Chapter 5

Analysis

In this chapter, I interpret the survey responses using SPSS as well as a similarity network created using Gephi to understand students' political and environmental experiences on campus.

5.1 Reliabilities

Several multi-item factors had reliabilities run to check their Cronbach's Alpha scores. Reliability is the analysis of how accurate a measure is to produce a "stable, consistent measurement" ([55] 214). For example, checking the reliability of the the group of items that ask students about their current level of concerns regarding environmental issues entails evaluating whether items 10.1 - 10.4 generate similar scores every time the survey is administered. Several approaches exist to assess the reliability score of survey items. One of the most common approaches is to determine the Cronbach's Alpha score ([55] 223), and

the reliabilities of items in this survey were evaluated by measuring their Cronbach's Alpha scores. A high Cronbach's Alpha score implies that the reliability of the group of items is high, whereas a low score implies that a group of items is not reliable. A breakdown of the range of Cronbach's Alpha scores and their implications is listed in Table 5.1 ([55] 223).

Alpha	Implication
0.90+	Excellent
0.80 - 0.90	Good
0.70 - 0.80	Respectable
0.65 - 0.70	Minimally acceptable
0.60	Unacceptable

Table 5.1: Cronbach's Alpha scores range and implications

Before conducting the reliability analysis, the survey was reevaluated to ensure appropriate steps had been taken to produce an accurate Alpha score. First, the dummy items from the survey were removed. Dummy items are items that are not relevant to the survey but are included to somewhat disguise the purpose of the survey, so that respondents provide honest answers. The dummy items in this survey were items 3.2, 3.5, 3.6, 9.2, 9.5, and 9.6. These questions were removed before beginning the analysis. Then, the scores of each item were evaluated to ensure that they were based on 1–7 Likert scale, and that higher scores signified a higher amount of each factor. For example, for the item "BEFORE enrolling in The College of Wooster, how concerned were you about the following issues: air pollution," a value of 1 represented "extremely unconcerned" while 7 represented "extremely concerned."

Finally, I ran reliabilities on factors that involved students' behaviors and concerns before joining the College, and then after they joined this institution. The first factor was students' climate change practices; for example, how likely they were to use reusable water bottles. Likewise, the second factor was students' concerns towards climate issues, such as air pollution and climate injustice. See Table 5.2 for results.

The Alpha scores for all of the factors were over 0.70, so composite scores were created for all of the factors. A composite score provides a measurement of a variable by "aggregating scores on several observable variables into an overall score" ([19] 34). The score for each factor was then used to conduct correlation and t-test analyses.

Factors	Items	Alpha	*M*	*SD*
Behavior				
Before	3.1, 3.3, 3.4, 3.7 - 3.11	.728	4.47	1.16
After	9.1, 9.3, 9.4, 9.7 - 9.11	.779	5.40	1.04
Concerns				
Before	4.1 - 4.4	.902	5.28	1.34
After	10.1 - 10.4	.919	6.12	1.05

Table 5.2: Cronbach's Alpha scores range and implications

5.2 Correlations

Correlations determine four types of relationships between two independent variables: positive, negative, curvilinear, and neutral ([55] 418). One of the ways in which correlations are measured is using the Pearson product-moment

correlation coefficient (r), which is a measure of "the degree to which two quantitative variables are linearly related in a sample" ([55] 417). A positive r value, where the correlation coefficient is greater than zero, indicates that when the score on one of the variables goes up, the score on the other variable goes up as well. On the other hand, a negative correlation, where the correlation coefficient is less than zero, implies that when a score on one of the variables goes up, the score on the other variable goes down ([55] 419). A curvilinear correlation can be both "positive or negative to a certain point, and then starts to go in the other direction" ([55] 419). Finally, a neutral relationship means that two variables are not related in any way ([55] 419), and the correlation coefficient is zero. Two of the other important notations that appear in correlations as well as t-tests are the degree of freedom (df) and the probability (p) value. A df is the "number of participant scores in a sample that are free to vary" ([55] 350). The p-value of a test represents how confident we are about the results ([55] 333). This value ranges from 0 to 1, where p-values that are closer to 0 represents higher confidence. For this study, we establish that a test is not statistically significant when the p-value is greater than 0.05.

In this study, several correlations were run to determine the factors that influence change in college students. Specifically, correlations between the following factors were examined: past environmental behaviors and interactions with close ties, present environmental behaviors and interactions with close ties, present environmental behaviors and the number of environmental classes taken, present environmental concerns and the number of environmental classes taken,

present environmental behaviors and remote learning, and finally, present environmental concerns and remote learning. The results indicated that a significant relationship existed for all but two sets of variables: present environmental behaviors and remote learning, and present environmental concerns and remote learning.

5.2.1 Climate Change Concerns and Behaviors, and Interactions With Close Ties

Past behaviors	*r*	df	*p*
Interactions			
HS teacher	.158	312	.005
HS peer	.102	312	.073
Relatives	.206	312	<.001
Household member	.269	312	<.001
Neighbors	.147	311	.010
Present behaviors	*r*	df	*p*
Interactions			
Professor	.339	306	<.001
College peer	.375	306	<.001
Staff member	.284	305	<.001
Roommate	.213	306	<.001

Table 5.3: Correlation between climate change concerns and behaviors and interaction with close ties

5.2.2 Environmental Classes and Climate Change Behaviors and Concerns

In addition, the results revealed that a significant relationship existed between taking environmental classes and the likelihood of adopting climate change behaviors, as well as taking environmental classes and environmental concerns. Table 5.4 lays out the results.

Let us explore these results by initially examining the first correlation on the table. We can observe that there is a positive correlation between taking environmental classes and environmental behaviors, which means that the more environmental classes that a student takes, the more likely they are to practice climate-change behaviors. Similarly, the result also implies that taking more environmental classes is related to being more concerned about the environment.

We can observe that the correlation between taking environmental classes and the respondents' likelihood to adopt climate-friendly behavior is less than that of climate concerns. One reason why the correlation for concerns may be higher could be that learning about how climate change is affecting the world can make people take environmental issues more seriously; however, barriers might exist to adopt pro-environmental behaviors. As discussed earlier, students may not feel like their actions will make significant changes to mitigate climate change. They could also have faith in technology to solve this issue or in their ability to adapt to the impacts of climate change [35]. As Heiser and Lynch stated, this range of attitudes towards perceiving the severity of climate change may not always translate to adopting behaviors that prioritize the environment

([17] 97). The relationship between taking environmental classes and climate change behaviors and concerns are discussed in more detail in sections 5.3.1 and 5.3.2 by comparing the mean scores of the factors.

Env. classes	*r*	df	*p*
Present behavior	.138	300	.017
Present concerns	.166	301	.004

Table 5.4: Correlation between taking environmental classes and climate change behaviors and concerns

5.2.3 Remote Learning and Climate Change Behaviors and Concerns

Finally, the results revealed no significant relationship between remote learning during the pandemic and environmental behaviors and concerns. The absence of a significant relationship between these factors can be interpreted in several ways. See Table 5.5 for results.

Remote learning during COVID	*r*	df	*p*
Present behavior	-.099	248	.119
Present concerns	.046	249	.468

Table 5.5: Correlation between remote learning and climate change behaviors and concerns

Let us examine the findings. Survey items regarding remote learning and environmental behaviors and concerns were incorporated in this study to determine whether a new social environment—that is, a virtual learning

setting—would have an impact on students' perceptions of climate change. The lack of a significant relationship between these factors can be explained by understanding that the challenges imposed by the pandemic have compelled people to perceive the environment from multiple approaches. On the one hand, regulations enforced during the pandemic have led to a decrease in commutes and emphasized the importance of a healthy environment ([23] 6). However, people have also had to rely more on private transportation and non-degradable biomedical equipment—such as disposable masks and gloves—to protect themselves from the virus. Hence, as the pandemic has imposed practices that can both foster as well as impair the environment, the relationship between remote learning and environmental perceptions may not be as straightforward. In addition, human behavior adapts to changes "gradually and over time" ([23] 6). Since remote learning is a fairly new concept that has gained significance because of a global crisis, its relationship to our environmental behaviors and concerns may take longer for us to understand.

5.3 Paired Samples T-tests

Next, several paired samples t-tests were run to analyze whether there was a significant difference between students' behaviors and concerns regarding climate change before and after they joined the College. Similarly, paired samples t-tests were run to examine whether there was a significant difference between students' political identities before and after they joined this institution. One of

the reasons why paired samples t-tests are conducted is to ”compare the mean of a single group examined at two different points in time” ([40] 17). T-tests are relevant in this study because these tests interpret how students' beliefs and concerns may have changed after they joined The College of Wooster. T-tests can also be used to examine how different close ties may have influenced people's climate-conscious practices. See Table 5.6 for results.

In the sections that follow, I evaluate the results of each paired samples t-test individually.

Factors	N	*M*	*SD*	df	t	*p*
Env. Behaviors						
Before	306	4.48	1.16			
After	306	5.40	1.04	305	17.35	<.001
Env. Concerns						
Before	304	5.28	1.34			
After	304	6.12	1.05	303	13.58	<.001
Influence						
HS teacher	311	5.07	1.22			
Professor	311	5.54	1.17	310	-5.58	<.001
Influence						
HS peer	310	5.03	1.23			
College peer	310	5.71	1.22	309	-8.15	<.001
Influence						
Household member	310	4.93	1.45			
Roommates	310	4.72	1.26	309	2.20	.028
Political identity						
Before	312	2.70	1.28			
After	312	2.33	1.20	311	7.52	<.001

Table 5.6: Pair samples t-tests across several factors

5.3.1 Change in Climate-Conscious Behaviors

Regarding change in environmental behaviors, the results reveal a t-value of 17.35, a degree of freedom (df) of 305, and p-value that is less than .001. This means that a significant difference exists between students' likelihood to practice environment-friendly behaviors before (M = 4.48, SD = 1.16) and after (M = 5.40, SD = 1.04) they joined The College of Wooster. By observing the mean scores, we can deduce that the students' likelihood to adopt behaviors that favor sustainability is higher after they joined the College than it was before they joined this institution.

Several factors could have led to this increase in students' likelihood to adopt pro-environmental behaviors through college. One of the factors is the courses related to the environment that students have taken after they joined The College of Wooster. The survey results revealed that 32.1 percent of 306 students have taken at least one environmental and earth sciences class since they joined this institution. Various studies mention that taking one course that focuses on issues concerning the environment and sustainability is related to an increase in the students' pro-environmental behaviors [37]. Hence, this study's result could be a reflection of an increase in environmental knowledge and a sense of responsibility people feel after taking courses related to the environment.

However, the reasoning that taking environmental classes increases the likelihood of students adopting pro-environmental behaviors has its limitations. First, we must take into consideration Levy and Michel's argument that selection bias may have impacted students course choices, and hence, they might already

have some motivation to learn about the environment ([37] 5). In their study, the scholars had deduced that a student's class standing is a predictor of environmental attitudes—that is, students who have been in college longer report higher care for the environment. Hence, to address the limitation, I examine the number of environmental and earth sciences classes that students across different class years have taken in college. An increasing number of people who take environmental classes the longer they are in college could mean that selection bias occurred because more students cared about the environment and decided to learn more about it.

An analysis of the environmental classes that students across different class years have taken showed that 51 (56.67%) out of 90 respondents from the class of 2022 have taken at least one environmental and earth sciences class during their time at The College of Wooster. Out of the sample, 27 (30.0%) students had taken at least two such courses. Likewise, regarding respondents from the class of 2023, 22 (34.92%) of the 63 students had taken at least one environmental and earth sciences course, and 9 (14.28%) students had taken at least two such courses. In contrast, 10 (17.86%) out of 56 respondents of the class of 2024 had taken at least one of the courses in discussion, while 46 (82.1%) of students in the sample had not taken any class related to the environment. In addition, 12 (13.19%) out of 91 students from the class of 2024 had taken exactly one of such classes, while 79 (82.22%) students had not taken such class yet. Finally, 5 (71.43%) out of the 7 respondents from the class of 2021 also mentioned that they had taken at least one environmental and earth science courses, although this evidence may not be

reliable since the sample size for the class of 2021 is small as most of the students from the class year have already graduated. Nevertheless, this analysis elucidates that students take more environmental courses the longer they are in college and indicates that selection bias may be a result of an increase in the motivation to learn about environment itself.

In this way, while taking environmental classes is a factor that increases students' pro-environmental behaviors, other factors may lead to the students' inclination to take more environmental classes over the years. Another factor that has led to an increase in students' pro-environment behavior could be related to political socialization ([10] 400; [38] 1; [54] 657), and more specifically, the prominence of liberal ideologies on campus. Table 5.6 also reveals that students have become more liberal after joining the College. Since climate change has become a politicized issue where more liberals believe in the severity of climate change than conservatives, another explanation for an increase in pro-environmental behaviors could be that more students adopt liberal ideologies after joining the College due to political socialization. In doing so, they could also adopt views that increase their climate change concerns and behaviors as well.

5.3.2 Change in Environmental Concerns

Likewise, the results for change in environmental concerns reveal a t-value of 13.58, a df of 303, and p-value that is less than .001. This means that a significant difference exists between students' concerns regarding climate issues before (M =

5.28, *SD* = 1.34) and after (*M* = 6.128, *SD* = 1.05) they joined the College. By observing the mean scores, we can deduce that the students' concerns for environmental issues have overall increased after they enrolled into this college compared to their level of concerns in the past. Similar to increase in pro-environmental behavior, the factors that increase environmental concerns could also be political socialization that increases climate-conscious views, as well as taking more environment and earth sciences classes over the years.

Moreover, comparing the means between past environmental behaviors (*M*= 4.48) and concerns (*M* = 5.28), and present behaviors (*M* = 5.40) and concerns (*M* = 6.12) aligns with studies that state that concerns regarding the environment tend to be higher than the likelihood for people to adopt environment-friendly practices. The findings suggest that students at the College have similar coping strategies as young adults throughout the country. As common responses regarding the reality of climate change include fear, faith in technology to solve this issue, and frustrations with existing political systems, learning more about the environment and perceiving climate change with more seriousness could be stopping students from taking actions at a personal level. Hence, students' concern for the environmental issues is higher than the likelihood for them to adopt climate-friendly habits.

5.3.3 Change in Climate Practices due to Influence

Furthermore, the results also reveal a significant difference between how instructors and peers influenced students' climate-conscious practices in school

and in college. In terms of instructors' influence, the result shows a t-value of -5.58, a df of 310, and p-value that is less than .001. By observing the mean score for high school teachers (M = 5.07, SD = 1.22) and college professors (M = 5.54, SD = 1.17), the test shows that college professors have a higher level of positive influence on students' pro-environmental practices than high school teachers. Similarly, regarding peer influence, the result displays a t-value of -8.15, a df of 310, and p-value that is less than .001. The mean scores of influences by high school peers (M = 5.03, SD = 1.23) and college peers (M = 5.71, SD = 1.22) indicate that college peers have a higher level of positive influence on students' pro-environmental practices.

Socialization could explain the reasons why college peers may have a stronger influence on students' pro-environmental practices, specifically in terms of students at The College of Wooster. First, the proximity of students to college peers is closer than their high school peers since this institution is a residential campus. Since most students have to live on campus throughout their college lives, they are more likely to interact with their peers outside their classrooms. In high school, however, students might have been limited to interacting with their peers in school. Furthermore, the residential aspect of The College of Wooster allows students to notice and support peers who raise awareness regarding the environment. For example, Environmental Justice Coalition (EJC), a student organization at The College of Wooster, organized a climate strike on campus as a part of the Global Climate Strike movement [14]. The strike was initially previewed by *The Wooster Voice*, the College's student-run newspaper, and many

students across campus ultimately joined the members of EJC to take part in the strike [14].

Moreover, students' increasing environmental awareness could also be another factor that influences their peers' behaviors and concerns towards the climate. As more students care about the environment the longer they are in college, the student body could collectively establish a norm on campus that fosters discussions related to climate change within their groups. This increase in environmental awareness across campus could also pressure students to adjust their practices—or initial nonchalance—towards the environment and make them more aware of climate change, ultimately increasing their likelihood to practice behaviors that favor the environment.

Now, let us examine the difference between high school teachers' and professors' influence on students' climate change practices and concerns. One of the most important reasons why college professors have a higher level of positive influence could be that students have more flexibility to choose courses in college than they did in high school. As we have observed that more students take more environmental classes over the years, the instructors that teach the classes could also play a crucial role in shaping the students' perceptions and practices towards the environment. However, the mean scores of college peers' positive influence is higher than that of college professors, which suggests that college peers are more influential than professors in shaping how students perceive and approach climate change issues.

The group of ties that were more influential in the past compared to a similar

group in the present were household members. The results revealed that household members had a higher positive influence on students' climate practices than college roommates. One of the reasons why household members had more influence could be because of the strong influence household members, such as families, have in shaping our beliefs and identities since childhood. However, this explanation could be contradictory to other results in this study, which reveal that college peers have the most positive influence, and roommates are often peers. Hence, we must first understand the contexts in which students at The College of Wooster have had roommates. First, when students join college as first-years, they are randomly assigned a roommate. Since 91 of the 312 students who completed the survey were first-year students, roommates may not have spent enough time together to have a significant influence on each other's beliefs. Additionally, the pandemic compelled many students across all class years to study remotely, which could limit the roommates' influence. Out of 254 who answered the question regarding the total number of semesters they had studied online during the pandemic, 161 (63.38%) mentioned that they had studied at least one semester remotely. Therefore, the lack of interactions with the roommates among first-year students and due to the pandemic could have affected the level of influence roommates could have on climate conscious practices among college students.

5.3.4 Change in Political Identity

Finally, the result for change in political identity revealed a t-value of 7.52, a df of 311, and p-value that is less than .001. This means that there is a significant difference between students' political identities before (M = 2.70, SD = 1.28) and after (M = 2.33, SD = 1.20) they joined the College. The mean scores suggest that the students' political identity has an overall leftward shift; that is, their political identities have become more liberal after they joined this institution.

Although we observe a leftward shift in students' political beliefs, it is important to note that the mean score of students' political identity prior to joining the college also indicated a higher number of liberal-leaning identities. This suggests that many students who come to The College of Wooster join the College with identities that are more liberal. As Woessner and Woessner explain, the liberalizing effect of college is the product of common college experiences ([54] 663). Hence, this large number of liberal identities could have an influence on the political atmosphere on campus, and this influence could affect how students adapt to college. More specifically, the large group of people who have liberal views may have collectively established liberal norms on campus. Lyons states that the norms that exist in new environments often drive people to change their attitudes since people are compelled to adjust their attitudes to integrate into new environments ([26] 300). In this way, socializing into a liberal campus could have influenced more students' political beliefs and influenced a liberal shift throughout the students' time in college.

5.4 Analysis Using Similarity Network

In this section, I first analyze how similar respondents were to one another by creating a network where edges are connected based on the similarity between two nodes. Each node represents a respondent, and an edge between two nodes was added if the both of the respondents' responses to some of the survey items were at least 50 percent "similar." The similarity was established when 50 percent of the responses between two actors were the same. The items considered were $3.1 - 3.11, 4.1 - 4.4, 5.1 - 5.5, 6.1 - 6.5, 7, 9.1 - 9.11, 10.1 - 10.4, 11.1 - 11.5$, and 14. After analyzing this network, I explore how resulting networks would be different based on more restrictive criteria by providing a few examples of such networks. Finally, I compare the results of this network with the results in the previous sections of this chapter.

5.4.1 Degree Distribution

This network, pictured in Figure 5.1, consists of 294 actors and 1260 edges, and the average degree of an actor is 2. Recall that the degree of a vertex is the total number of edges incident with it. In this network, on average, one actor is similar to two other respondents based on the established criterion. The five actors with the highest degrees are labeled in Figure 5.1, where $deg_a = 46$, $deg_b = 36$, $deg_c = 34$, $deg_d = 33$, and $deg_e = 30$. The network also consists of 181 (61.56%) actors who are connected to at least one other actor. On the contrary, 113 (38.43%) out of the 294 actors are not connected to any other actors, which means that they

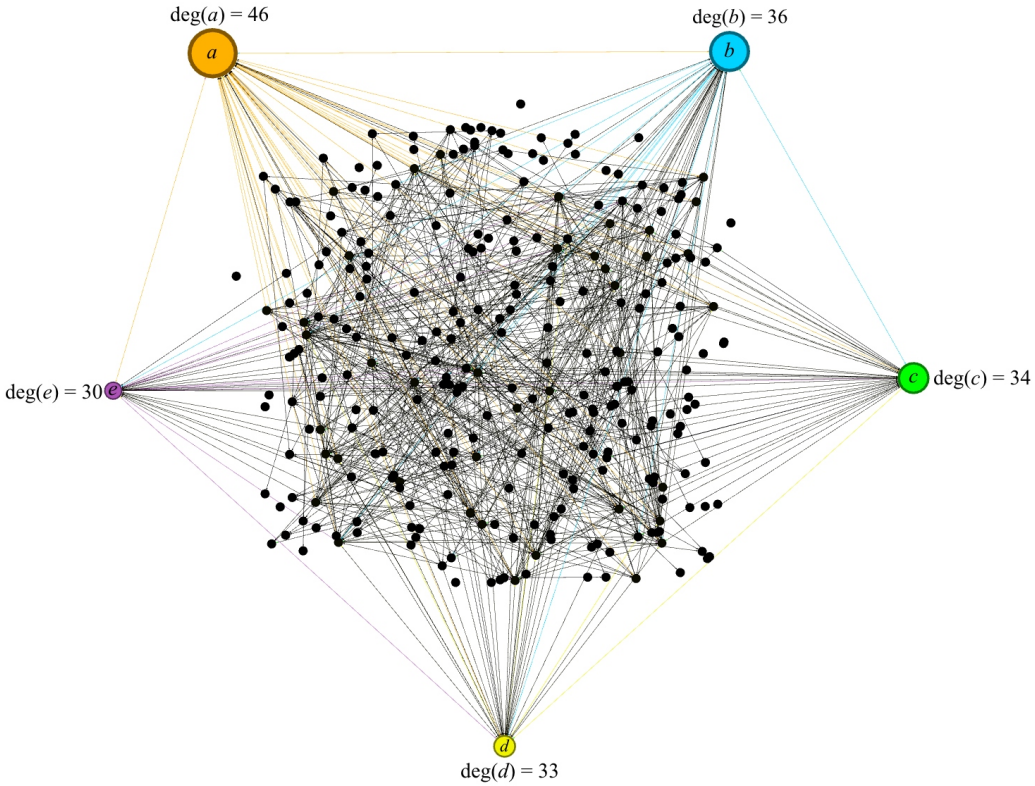


Figure 5.1: Similarity Network

are not similar to any other students in the network. Figure 5.2 shows the overall degree distribution of the actors in this network. This similarity network has a few actors with a high number of neighbors and a high number of neighbors with a fewer neighbors. We notice that most of the actors, 225 (76.53%) of them, are similar to five people or less. This high percentage of dissimilarity between actors could be attributed to the way that the criterion for the network was established. Since the survey items considered were based on a 7-point Likert scale, the current criterion deems necessary that two actors had the exact same

responses for at least 50 percent of the items. For example, if actor X had chosen the first option in the scale for all of the selected items, actor Y would only be considered similar to X if Y had also selected the first option for at least half of the items. If the criterion was based on similarity within specific intervals, however, we could have received a network with a higher level of similarities among actors. For instance, for items 7 and 14, if options "extremely liberal," "liberal," and "somewhat liberal" could be considered as responses that fell into the same category, such categorizations could increase the similarity between actors. Although this study does not explore networks based on these characteristics due to time constraints, one of the sections that follows will evaluate how various types of categorizations produce networks with different levels of similarities.

5.4.2 Actors With the Highest Degrees

First, let us examine the responses of the five actors with the highest degrees. The actors formed a group, that is, they were connected to each other. Actors a, b, c, and d shared similar political beliefs. Actor a mentioned that they were liberal in the past as well as present; actor b was liberal, and is extremely liberal at present; actor c has been extremely liberal even before joining the College, and actor d has shifted from being liberal to extremely liberal currently. Although four of the five actors have liberal leaning political identities in the past as well as present, the political identity of actor e has shifted to the center of the spectrum from being liberal in the past. Interestingly, all of the actors also identified as female. Several studies have mentioned that women and individuals who identify as female

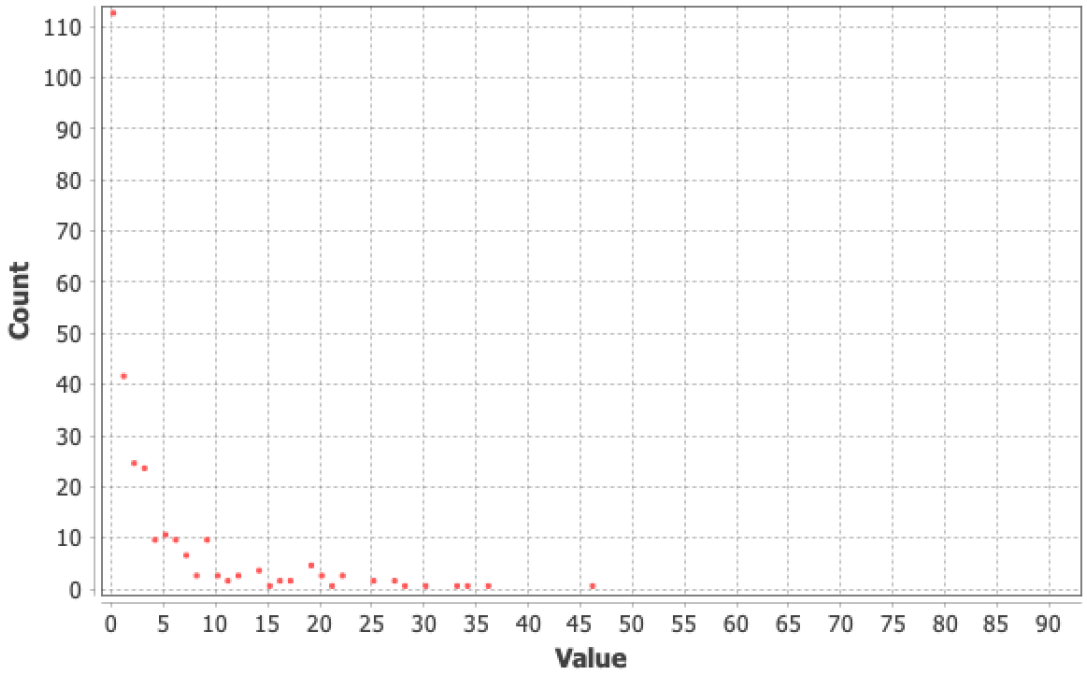


Figure 5.2: Degree distribution of nodes in the network

show more concerns for the environment ([39] 65), and these responses reflected similar sentiments as well. Actors *a*, *b*, and *d* also identified as "White or European," actor *c* identified as "Black or African American," and actor *e* identified as "South Asian." Actors *a* and *d* belong to the class of 2025, *c* and *e* were from the class of 2023, and *b* belonged to the class of 2022.

All of these actors shared similar levels of concern for environmental issues. All five actors had responded that they were "extremely concerned" about air pollution, climate injustice, carbon dioxide emissions, and oil drilling at present. Before enrolling at the College, all five of the actors were "extremely concerned" about air pollution and climate injustice. Four of the actors were also "extremely

concerned" concerned about carbon dioxide emissions and oil drilling, while actor *a* was "moderately concerned" about the issues.

The actors experienced similar types of influences by their ties as well, especially after joining The College of Wooster. High school teachers had a positive influence on the climate conscious-practices of actors *b*, *c*, *d* and *e* and a "somewhat" positive influence on actor *a*. Members of the household also had a positive influence on the practices of actors *b*, *c*, and *e* and an "extremely" positive influence on actor *d*. Meanwhile, actor *a* noted that household members had neither a positive nor a negative influence. The influence of high school peers and relatives varied among actors.

The actors also specified that professors had a positive influence on their practices: actors *a*, *c* and *d* mentioned that at least one college professor had influenced their practices "extremely positively," while actors *b* and *e* mentioned that professors had somewhat positive and positive influence respectively. Likewise, actors *a* and *d* also mentioned that at least one staff member at The College of Wooster had an "extremely positive" influence on their pro-environmental practices, and actor *c* experienced a positive influence, while actors *b* and *e* experienced neither positive nor negative influence by a staff member at this institution.

All of the actors also noted that at least one peer in college had positive influence on their practices—actors *b*, *c*, and *e* indicated that the influence was positive, while actors *a* and *d* mentioned that the influence was extremely positive. On the other hand, the influence of roommates were not as positive.

Actors *a*, *b*, *c*, and *e* responded that their roommates had neither positive nor negative influence on their climate-conscious practices. However, actor *d* indicated that their roommate had an "extremely positive" influence on their practices. Residence hall neighbors did not have a significant influence on most of these actors' practices: actors *a*, *c*, *d* and *e* mentioned that their residence hall neighbors had neither a positive nor a negative influence, while actor *b* noted that one of their neighbors had a "somewhat" positive influence.

Moreover, although these actors have experienced a positive shift in their environment-friendly behaviors, analyzing their responses shows that they were likely to practice such behaviors before joining the College as well. All of the actors responded that they were "extremely likely" to buy second-hand clothes, use environment-friendly detergent, turn off electrical appliances when not in use, use a reusable water bottle, and bring a reusable bag while shopping. Four of the actors also replied that they were "extremely likely" to recycle clothing and participate in an environmental organization, while actor *c* responded that they were "moderately likely" to do so. Actor *e* responded that they were "moderately likely" to reduce meat consumption, while the rest of the actors indicated that they were "extremely likely" to do so.

At present, all of the five actors noted that they were "extremely likely" to buy second-hand items, recycle clothing, use environment-friendly detergent, reduce meat consumption, use a reusable water bottle, and bring a reusable bag while shopping. While actor *b* was "moderately likely" to turn off electrical appliances when not in use, the rest of the actors were "extremely likely" to

engage in this behavior as well. Most of the actors also mentioned that they were "extremely likely" to participate in environmental organizations, except actor *e*, who mentioned that their participation was "slightly likely."

Surprisingly, although professors had a positive impact on the actors' pro-environmental practices, only actors *a* and *d* had taken an environmental and earth science course in college. Furthermore, only one of the five actors has been a member of The College of Wooster for over three years, and the actor *a*, who has the highest degree, is currently a first-year student. The actors' responses indicate that they had a high level of concern for environmental issues and had pro-environmental behaviors before they joined this institution, and that these behaviors and concerns have either remained consistent or increased after the students joined this institution. Hence, one of the reasons why these actors share similarities with other actors in this network could be because they share similar levels of concerns and practices. As noted in Table 5.6, the mean score for each of the factors related to the environment behaviors and concerns is greater than 4. The scores indicate that, on average, the actors' behaviors and concerns favored the environment in the past, and that ties have positive influences on their climate-conscious practices. Likewise, the scores also show that, on average, actors have adopted more pro-environmental behaviors since they joined the College. Since actors a, b, c, d, and e all portray pro-environmental behaviors and concerns before as well as after joining the College, one of the reasons why they have high degrees could be because many actors in this network have similar behaviors and concerns regarding the environment.

Similarly, Table 5.6 also indicates that in most cases, the ties in college have had a more positive influence on the actors' climate-conscious practices than the ties outside the College. Among the actors with the highest degrees, professors and college peers had positive influence on their climate-conscious practices at present, while the influence of their present roommates were not significant for most of them. With regard to ties outside college, four of the five actors mentioned that high school teachers and household members had a positive impact on their practices. Their responses reflect the general perceptions of actors in this network as well, who have mentioned that professors and peers in college have had a positive influence on their climate-conscious practices, followed by high school teachers, and household members. The findings of these independents tests complement each other.

In this way, the actors with the highest degrees could also be similar to many other actors because they experienced a similar type of influence across several ties on their climate-conscious practices. Since the network is based on the criterion that 50 percent of the attributes from the defined categories are the same, actors a, b, c, d, and e have the highest degrees because their responses were same as at least 50 percent of other actors' responses. The consistent concerns and pro-environmental behaviors of actors a, b, c, d, and e may have been contributing to their similarities with other actors, who have become increasingly aware of climate issues and actions after joining this institution. Likewise, as the tie influence of actors a, b, c, d, and e reflect the types of influence mentioned by actors on average, this could have also contributed to their similarities with many

actors.

5.4.3 Eccentricity, Paths and Connectivity of the Network

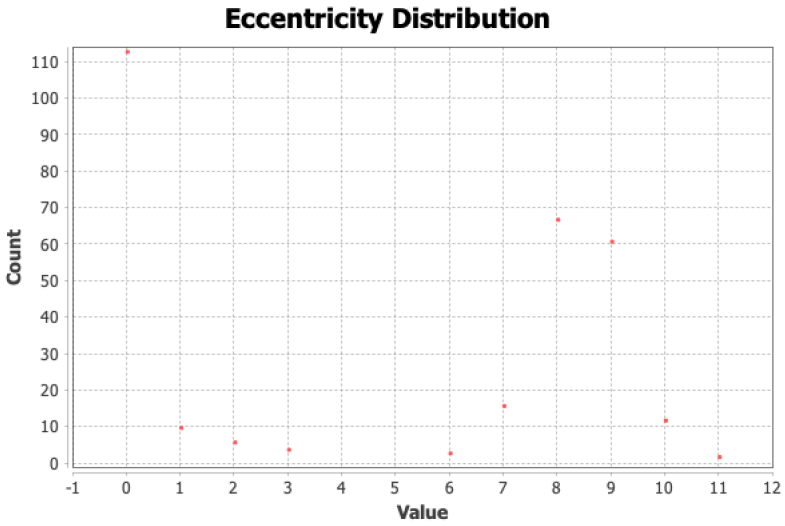


Figure 5.3: Eccentricity of the network

Let us first recall the definitions of distance, eccentricity, and diameter. The distance between two actors is the length of the shortest path between them. Likewise, the eccentricity of an actor is the distance between the actor and another actor that is farthest away from them. Finally, the diameter of a network is the maximum eccentricity present in the network. Since this network includes actors who are disconnected, the diameter is infinite. However, the diameter for the largest group of actors who are connected is 11. Figure 5.3 details the overall eccentricity distribution of the network. As we observe, eccentricity between

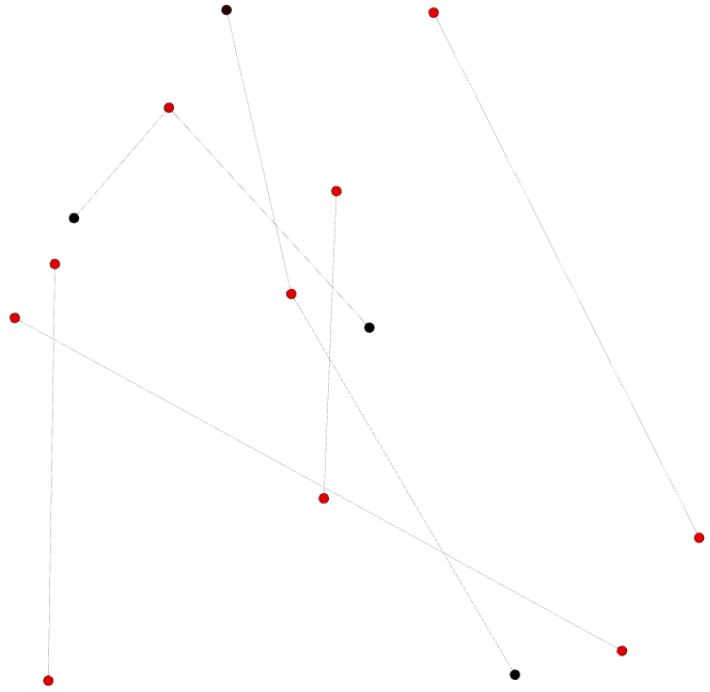


Figure 5.4: Actors with the lowest eccentricity

almost 140 actors is higher than 8, which shows that the dissimilarity between actors is high in that connected component. The high values of eccentricity between actors can also be attributed to the established criterion for similarity since the criterion does not account for a range of response options that could have been considered similar. Moreover, the minimum eccentricity in this network is zero in the case of trivial components with only one vertex. Since there are many connected components, there is a significant number of vertices with small eccentricity as well. This is a result of the fact that there are several subgraphs in this network that are disconnected. The actors with the lowest

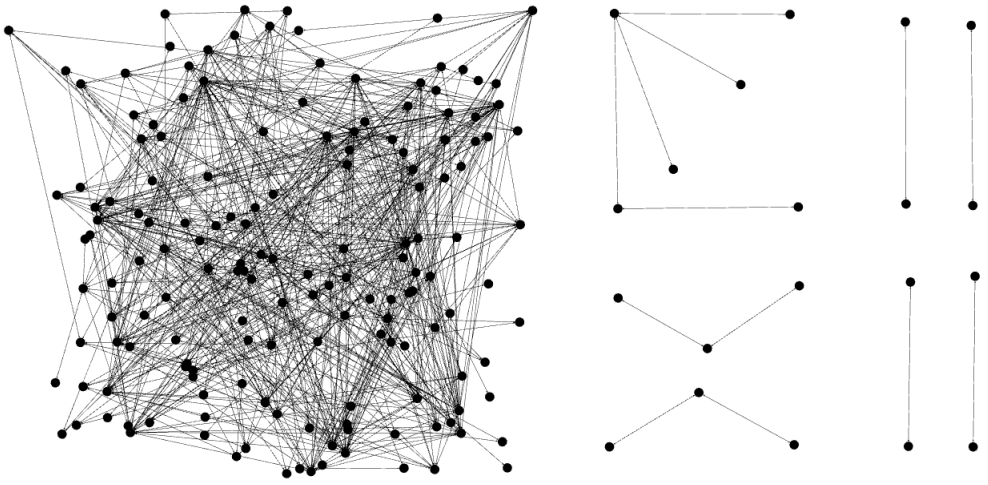


Figure 5.5: Connected components of the network

non-zero eccentricity are filtered in Figure 5.4, labeled in red. Furthermore, the average path length of the network is 3.675 and the density of the graph is 0.015.

Finally, the network consists of 121 connected components, where 113 of the components are actors who are not similar to any other actors in the network. The other connected components of the network are illustrated in Figure 5.5. All of these results suggest that the network is based on a strict criterion of similarity.

5.4.4 Resulting Networks with Stricter Similarity Criteria

Although the network presented in Figure 5.1 revealed limited results due to the established criterion, it has proven to be useful in analyzing the characteristics of the overall network by examining the responses of actors with higher degrees. Prior to choosing this network, this study also considered other networks that had stricter criteria. The networks that were initially considered are included in

Figures 5.6, 5.7, and 5.8. Network *Z* had the strictest criterion of the four networks, where the actors shared an edge only if 50 percent of their edges for the following categories were the same: items 3.1 – 3.11 and 9.1 – 9.11, 4.1 – 4.4 and 10.1 – 10.4, 6.1 – 6.5 and 11.1 – 11.5, 7 and 14 and, finally, item 5.1 – 5.5. This categorization entailed that the responses for a question that asked about a specific behavior, concern, or belief, the respondents' responses before and after they joined the College had to be at least 50 percent same. For example, if actor *A* had mentioned that they were "somewhat concerned" for items 4.1 – 4.4 and "extremely concerned" for items 10.1 – 10.4, another actor *B* would have to have provided at least 50 percent of the same responses to these set of question, and fulfill the same requirement for other categories, to have an edge between them. The size of Network Z is 38.

Network *Y* had a less strict criterion than *Z*, and hence, the size of *Y* was 68. Although most of the requirements were the same, this network did not consider the category of items 7 and 14 that asked about students' political beliefs. Removing this category resulted in a network with a bigger size because the items did not have sub-items, so the actors must have had the exact same political identity either before or after they joined the College in order for two actors to have an edge between them in network *Z*.

Finally, the size of network *X* is 560, which is bigger than that of *Y* and *Z*, but smaller than the network in Figure 5.1. For this network to have an edge between two actors, 50 percent of the responses should have been the same for the following categories: items 3.1 – 3.11, 4.1 – 4.4, 5.1 – 5.5, 6.1 – 6.5 and 7, and items

9.1 – 9.11, 10.1 – 10.4, 11.1 – 11.5, and 14. In other words, two actors shared an edge if 50 percent of their responses before and after they joined the College were the same. Unsurprisingly, the number of connected components of Networks X, Y, and Z were 172, 260, and 275 respectively. Likewise, the average path length between two actors for Network X was 3.66, that of Y was 3.41, whereas the average path length of Z was 1.39. The path length of Z is shorter than that of the other networks because the algorithm does not consider actors who do not share an edge with any other actor, and network Z has 262 (89.1%) actors with zero degree.

Interestingly, the actors with the highest degrees varied across all of the actors, although actor A in the Figure 5.1 had the highest number of degrees in Network Y (5), and the second highest degrees in Networks X (25) and Z (2). The highest degrees for Networks X, Y, and Z were 25, 5, and 3 respectively. Perhaps analyzing comparisons between these networks would reveal more about the relationship between actors.

5.5 Summary of Findings

In this chapter, some quantitative analysis tools were implemented to examine how students' behaviors, concerns, and beliefs have shifted after they joined The College of Wooster. The results show that students have become more liberal and have shown an increase in environmental concerns and behaviors. The increase in such perceptions can be attributed to how socialization occurs on this campus

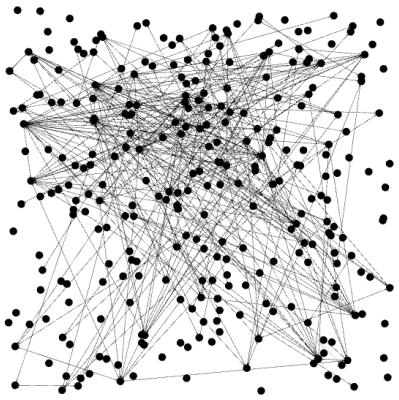


Figure 5.6: Network X

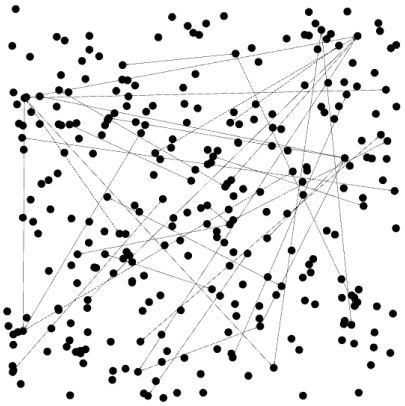


Figure 5.7: Network Y

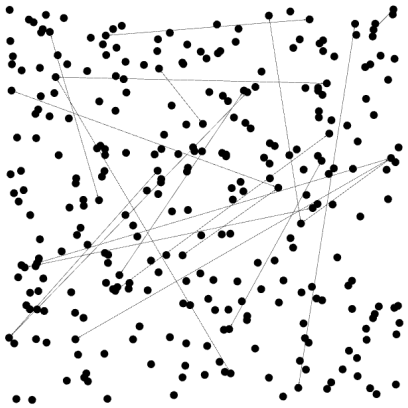


Figure 5.8: Network Z

in relation to the strong influence certain ties have on people's behaviors. Examining the responses of students who shared similarities with many other respondents also supported the idea that students become more liberal and pro-environment after they join the College. In the next chapter, I conclude this study by detailing some major findings, limitations, and recommendations for

future research.

Chapter 6

Conclusion

The purpose of this study was to analyze the shifts in political beliefs and environmental behaviors and concerns among college students, and examine how close ties influence such changes. Over the first few chapters, this study provided context about the history of political polarization and its effects on people's perception of climate change, as well as introduced concepts such as socialization and graph theory and explained its applications in networks. Then, it analyzed climate change attitudes among students at The College of Wooster using several quantitative tools and creating a similarity network. In this chapter, I summarize the major findings of this study, detail the implications, and then lay out some limitations. Finally, I provide some recommendations for future research.

6.1 Major Findings

This study supports the findings of past research that have established that college students experience an increase in beliefs and attitudes that lean liberal. Since environmental concerns and climate-conscious practices have become more common among people with liberal ideologies, the finding that students experienced an increase in pro-environmental attitudes further strengthens the argument that they adopt liberal perceptions in college. Moreover, the findings that suggest students become more concerned about the environment as well as more likely to adopt pro-environmental behaviors after they join the College provide optimism for the future in relation to mitigating the impacts of climate change.

Furthermore, another major finding of this study illustrates how political socialization takes place on this campus, where peer influence plays the most significant role. The results of this study established that majority of students had identities that leaned liberal before they joined this institution, and that peers had the highest level of influence on students' climate-conscious practices. Hence, the tendency for students to adopt more liberal stances and pro-environmental behaviors during their time at the College connects to the characteristic of socialization where people adjust their attitudes to integrate into a new environment ([26] 300). Since more students on campus were liberal even before they started college, other students could have adjusted their attitudes in order to adapt to this new social environment.

Finally, analyzing shifts in beliefs and practices using a similarity network

also proved to be useful in understanding why some students are similar to many other students on campus. Importantly, examining the responses of the actors with the highest degrees revealed significant social environments that existed on campus. The actors with the highest degrees shared similarities with many of the respondents because they reported high levels of pro-environmental behaviors and concerns. We noticed that four of the five actors also had liberal-leaning identities. They also reported that they had at least one peer in college had a positive influence on their climate-conscious practices. These findings further support the argument that students become more liberal and adopt pro-environmental behaviors and concerns after joining The College of Wooster, and that peers have a high influence in the socialization process. Likewise, comparing networks with different criteria revealed that making comparisons between such networks could provide significant information regarding different characteristics of the population at this institution. As the four resulting networks had different actors with the highest degrees, the findings indicated that making comparisons across these networks could provide useful information regarding the ways in which actors are similar. This study does not include an in-depth comparisons of such networks; however, even the minimal analysis indicated that such comparisons would be useful.

6.2 Implications

Although the acknowledgement of climate change is high among college students, the concerns do not always translate into actions to mitigate this issue ([17] 97). The findings of this study reveal two important ways in which peers and institutions can address this inaction among adults. First, the study found that peer influence can play a significant role in making students more likely to adopt pro-environmental behaviors. Hence, groups that promote pro-environmental practices could incorporate ways to provide college students—especially those who feel strongly about the environment—with a platform and resources to influence other students to adopt climate-friendly behaviors. For example, institutions such as The College of Wooster can provide student advocates with adequate training and resources to promote pro-environmental practices on campus. Advocates as well as institutions should leverage the power of peer influence to address this barrier of inaction among college students.

Moreover, the study also disclosed how an individual's social environment can shape their perceptions. Therefore, organizations where people are exposed to new social settings, such as colleges and new workplaces, should create social environments where making personal choices that address climate change are the norms. If institutions are proactive about providing pro-environmental training and information sessions, as well as establishing a culture that focuses on improving people's climate-conscious practices, individuals who become a part of such institutions may socialize into adopting practices that favor the

environment.

6.3 Limitations

This study has several limitations, the first few of which are related to the survey distribution process. First, all of the 312 respondents to this study were students at The College of Wooster, which is a small, private institution where students are required to live on campus throughout their college careers. Hence, the findings of this study could be unique to the College, and hence, not generalizable to other institutions with different characteristics. Another potential limitation includes the study's employment of an incentive to encourage student participation, which poses a threat to the reliability of survey responses ([21] 36). In order to increase survey responses, students were provided with an opportunity to enroll in a raffle where they could win Amazon gift cards. Although providing incentives encouraged a large number of students to complete the survey, respondents may have done so in haste only to enroll in the raffle, which could have affected the findings of this research.

6.4 Recommendations for Future Research

Some of the recommendations in this chapter include addressing the limitations of this study, but this section also includes additional recommendations. First, researchers should continue studying the roles of peers in prompting pro-environmental behavioral changes among college students. Peers may have

a significant role in breaking the barrier between students' environmental concerns and actions, so more studies should focus on ways that peers can influence each other to address environmental issues.

Secondly, since the population studied in this project only includes students from The College of Wooster, future research could recruit students from multiple types of institutions—for example, a public university, a non-residential college, and a large private university—and compare how political socialization occurs in these institutions.

Thirdly, in order to address measurement bias, researchers could evaluate the average amount of time it takes to complete the survey, and then notify respondents that the time taken to complete the survey would be taken into consideration while enrolling them in the raffle. For example, participants who spent around the average time to fill out the survey could have their names included in the raffle twice.

Additionally, due to time constraints, the analysis of the similarity networks in this study were not as in-depth as they could be. While this study analyzes one of the networks thoroughly, I later recognized that comparing different networks would have revealed more information regarding the ways in which participants shared similarities. Identifying the different ways in which respondents were similar could reveal information regarding how similar they were in the past and present to make more accurate inferences about shifts in beliefs.

Furthermore, future studies could also make comparisons across networks based on different similarity criteria to examine the different ways in which

actors are similar to one another. For example, researchers could create a network that would illustrate similarities in the past and another that illustrates the present similarities to examine whether same actors experience similar shifts in their beliefs.

Moreover, research should also continue to identify ways students can adopt climate-friendly practices and focus on increasing accessibility to such findings. While this study found that respondents were more likely to practice environmental behaviors after joining the College, studies have shown that adoption of pro-environmental practices is still low. Hence, future research should also focus on examining how students come to adopt such practices and continue to promote such results. In addition, integrating the approaches of two seemingly different fields, communication studies and mathematics, revealed interesting ways in which the findings of different methods can complement one another. Hence, researchers from these fields could also increasingly work together to quantitatively and qualitatively analyze various issues and explore potential solutions.

My final recommendation is for all researchers and publications to make academia more accessible to the general public. Since research papers are often inaccessible to various groups of people [13]—for example, people with limited financial resources, vocabulary in a particular language, or little knowledge of academic jargon—studies that address issues that impact a large group of people, such as climate change, should be accessible to everybody.

6.5 Final Thoughts

I first started working on this project believing that I would be solely analyzing how students drift politically after joining college. Looking back, however, I realize that while I have preserved the political aspects, this study has become largely about college students' relationships with the environment: our beliefs, concerns, and practices. Although I decided to focus on one politicized issue to access overall political shifts in college students based on Woessner and Woesnner's recommendation([54] (663)), I may have subconsciously chosen climate change among other issues because of my personal concern for the environment. Nevertheless, this project soon became a part of my personal life as well, and I often find myself analyzing my behaviors towards the environment and tie them back to research. As I learnt about the hesitancy among college students to take personal actions to mitigate climate change, I took notice of my own responses to news regarding the climate as well as my climate-conscious behaviors. My personal inaction stemmed out of hopelessness, but it also often stemmed out of what was the most convenient for me, which has made me lose faith in myself as well as my surroundings for not trying hard enough. Completing this project, however, has reinstated my hope that everyone of us has the ability to mitigate climate change to some extent. This study has laid out the power that friends have to influence our behaviors, but we already know the strength of peer pressure—many of our parents warn us about it. We can all effectively utilize our positions as peers to learn from each other, take personal actions, as well as advocate for a world that preserves nature. One of the biggest

actions we can take on a personal level to fight climate change is to leverage on this power that we have as peers. So, if you care about the environment and know any climate-conscious practices, please tell your friends about them.

Appendix A

Survey items

Default Question Block

This survey is being used to gather information about changes in opinions and practices after joining college. Participants of this survey must be 18 years or older. Participation in this study is voluntary and responses will remain anonymous. If you decide to participate, you may change your mind about completing the survey at any time with no adverse consequences. There are no risks involved in this study. Completing the survey will take approximately 10 minutes. In completion of this survey, participants will get a chance to win a $25 or a $50 Amazon gift card by enrolling in a raffle. Two of the participants who enroll will receive a $50 gift card and six participants will receive a $25 gift card. In case you are interested to enroll in the raffle, please follow the link to a Microsoft Form at the end of the survey to provide your contact information.
If you have any questions, please let me know via email at blamichhane22@wooster.edu, or reach out to my advisors Dr. Denise Bostdorff and Dr. Heather Guarnera at dbostdorff@wooster.edu and hguarnera@wooster.edu. respectively.
Completion of this survey indicates that you have read, understand, and agree with the information above.
Do you understand and agree with the above?

- ◯ Yes
- ◯ No

For the following questions, please reflect on the behaviors and practices that you had before joining The College of Wooster.

BEFORE enrolling in The College of Wooster, how likely were you to practice the following:

	Extremely unlikely	Moderately unlikely	Slightly unlikely	Neither likely nor unlikely	Slightly likely	Moderately likely	Extremely likely
Buy second-hand items (ex. clothes, phones)	◯	◯	◯	◯	◯	◯	◯
Swim in a lake	◯	◯	◯	◯	◯	◯	◯
Recycle clothing	◯	◯	◯	◯	◯	◯	◯
Use environment-friendly detergent	◯	◯	◯	◯	◯	◯	◯
Go hiking	◯	◯	◯	◯	◯	◯	◯
Do your laundry	◯	◯	◯	◯	◯	◯	◯
Reduce meat consumption	◯	◯	◯	◯	◯	◯	◯
Turn off electrical appliances before going to bed	◯	◯	◯	◯	◯	◯	◯
Use a reusable water bottle	◯	◯	◯	◯	◯	◯	◯
Bring a reusable bag while shopping	◯	◯	◯	◯	◯	◯	◯
Participate in environmental organizations	◯	◯	◯	◯	◯	◯	◯

BEFORE enrolling in The College of Wooster, how concerned were you about the following issues:

	Extremely unconcerned	Moderately unconcerned	Slightly unconcerned	Neither concerned nor unconcerned	Slightly concerned	Moderately concerned	Extremely concerned
Air pollution	○	○	○	○	○	○	○
Climate injustice	○	○	○	○	○	○	○
Carbon dioxide emissions	○	○	○	○	○	○	○
Oil drilling	○	○	○	○	○	○	○

BEFORE enrolling in The College of Wooster, please indicate the extent to which you agreed with the following statements:

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
The current concern regarding the state of the environment is justified	○	○	○	○	○	○	○
The future of this planet is bright and hopeful	○	○	○	○	○	○	○
The so-called ecological crisis facing human kind has been exaggerated	○	○	○	○	○	○	○
Despite our special abilities, humans are still subject to the laws of nature	○	○	○	○	○	○	○
The balance of nature is strong enough to cope with the impact of modern industrial nations	○	○	○	○	○	○	○

My interactions with the following people influenced my climate-conscious practices BEFORE enrolling in The College of Wooster:

	Extremely negatively	Negatively	Somewhat negatively	Neither negatively nor positively	Somewhat positively	Posivitely	Extremely positively
At least one teacher in my high school	○	○	○	○	○	○	○
At least one peer in high school	○	○	○	○	○	○	○
At least one of my relatives (e.g. cousins, aunts, uncles, grandparent)	○	○	○	○	○	○	○
At least one person in my household (e.g. immediate family)	○	○	○	○	○	○	○
At least one of my neighbors	○	○	○	○	○	○	○

BEFORE enrolling in The College of Wooster, how did you identify yourself politically?

Extremely Liberal	Liberal	Somewhat liberal	Center	Somewhat conservative	Conservative	Extremely Conservative
○	○	○	○	○	○	○

For the following questions, please reflect on the behaviors and practices that you have developed after attending The College of Wooster.

Now that you have been at The College of Wooster, how likely are you to practice the following:

	Extremely unlikely	Moderately unlikely	Slightly unlikely	Neither likely nor unlikely	Slightly likely	Moderately likely	Extremely likely
Buy second-hand items (ex. clothes, phones)	○	○	○	○	○	○	○
Swim in a lake	○	○	○	○	○	○	○
Recycle clothing	○	○	○	○	○	○	○
Use environment-friendly detergent	○	○	○	○	○	○	○
Go hiking	○	○	○	○	○	○	○
Do your laundry	○	○	○	○	○	○	○
Reduce meat consumption	○	○	○	○	○	○	○
Turn off electrical appliances before going to bed	○	○	○	○	○	○	○
Use a reusable water bottle	○	○	○	○	○	○	○
Bring a reusable bag while shopping	○	○	○	○	○	○	○
Participate in environmental organizations	○	○	○	○	○	○	○

Now that you have been at The College of Wooster, how concerned are you about the following issues:

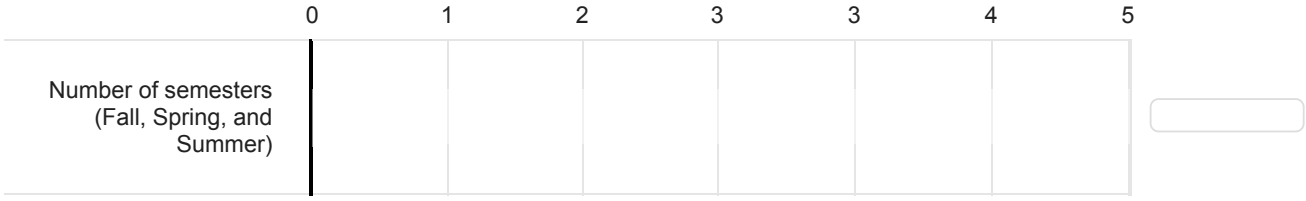
	Extremely unconcerned	Moderately unconcerned	Slightly unconcerned	Indifferent	Slightly concerned	Moderately concerned	Extremely concerned
Air pollution	○	○	○	○	○	○	○
Climate injustice	○	○	○	○	○	○	○
Carbon dioxide emissions	○	○	○	○	○	○	○
Oil drilling	○	○	○	○	○	○	○

My interactions with the following people at The College of Wooster have influenced my climate-conscious practices:

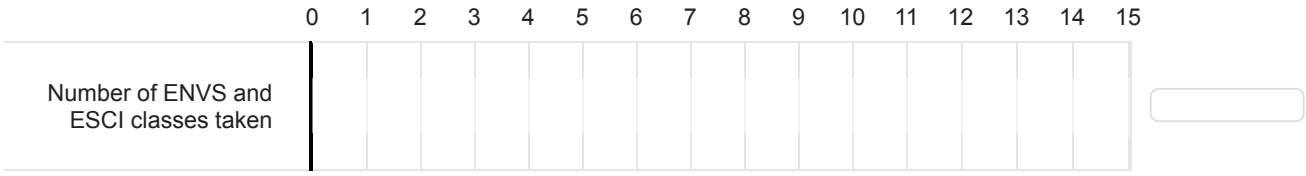
	Extremely negatively	Negatively	Somewhat negatively	Neither negatively nor positively	Somewhat positively	Positively	Extremely positively
At least one professor in college	○	○	○	○	○	○	○

	Extremely negatively	Negatively	Somewhat negatively	Neither negatively nor positively	Somewhat positively	Positively	Extremely positively
At least one peer in college	○	○	○	○	○	○	○
At least one college staff member	○	○	○	○	○	○	○
At least one of my roommates	○	○	○	○	○	○	○
At least one of the neighbors in my residence halls	○	○	○	○	○	○	○

In college, how many semesters did you study remotely during COVID-19?



Including this semester, how many environmental studies (ENVS) and/or earth sciences (ESCI) classes have you taken in college?



At present, how do you identify yourself politically?

Extremely Liberal	Liberal	Somewhat liberal	Center	Somewhat conservative	Conservative	Extremely Conservative
○	○	○	○	○	○	○

Please indicate your class year:

2021	2022	2023	2024	2025
○	○	○	○	○

What best describes your race and ethnicity?

- ◯ American Indian or Alaska Native
- ◯ Black or African American
- ◯ Carribean
- ◯ East Asian
- ◯ Latinx or Hispanic
- ◯ Middle Eastern
- ◯ South Asian
- ◯ White or European
- ◯ Other
- ◯ Prefer not to say

Which best describes your gender identity?

- ◯ Female
- ◯ Male
- ◯ Transgender female
- ◯ Transgender male
- ◯ Gender queer / Non-binary
- ◯ Intersex
- ◯ Prefer to self-describe
- ◯ Prefer not to say

Appendix B

Email

Subject: Survey + win $25-50 Amazon gift card

Hello,

I am Bijeta Lamichhane, a senior mathematics and communication studies major, currently conducting my Independent Study research at The College of Wooster. I am looking for individuals of age 18 years or older to participate in my research by answering questions to an electronic survey. The purpose of my study is to examine changes in behaviors and practices after attending The College of Wooster. The survey will take around 10 minutes to complete. Your participation throughout the study is completely voluntary, and you may withdraw from the study at any point with no adverse consequences. Your responses will remain anonymous. There are no risks involved with this study. In addition, participants will get the opportunity to enroll in a raffle for a chance to win an Amazon Gift Card. Two of the participants who enroll in the raffle will

win a $50 Amazon gift card each, and six participants will receive a $25 gift card each. If you have any questions, please contact me at blamichhane22@wooster.edu or my advisors Dr. Denise Bostdorff and Dr. Heather Guarnera at dbostdorff@wooster.edu and hguarnera@wooster.edu respectively.

Please follow this link to complete the survey.

Best,

Bijeta

Bibliography

[1] Office of residence life. `https://inside.wooster.edu/reslife/`.

[2] Toby Bolsen and Matthew A. Shapiro. The U.S. news media, polarization on climate change, and pathways to effective communication. *Environmental Communication*, 12:149–163, 2017.

[3] Stephen P. Borgatti, Martin G. Everett, and Jeffrey C. Johnson. *Analyzing social networks*. SAGE, 2013.

[4] Gary Chartrand and Ping Zhang. *A first course in graph theory*. Dover Publications, Inc., 2012.

[5] Sedona Chinn, P. Sol Hart, and Stuart Soroka. Politicization and polarization in climate change news content, 1985-2017. *Science Communication*, 42(1):112–129, 2020.

[6] Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein. *Introduction to Algorithms,* 3rd Ed. MIT Press, 2009.

[7] Shannon M. Cruz and Brian Manata. Measurement of Environmental Concern: A Review and Analysis. *Frontiers in Psychology*, 11, 2020.

[8] Melissa DeJonckheere, Andre Fisher, and Tammy Chang. How has the presidential election affected young Americans? *Child and Adolescent Psychiatry and Mental Health*, 12:1–4, 2018.

[9] Drew DeSilver. The politics of American generations: how age affects attitudes and voting behavior. *Pew Research Center*, 2020.

[10] Eric L. Dey. Undergraduate political attitudes: Peer influence in changing social contexts. *The Journal of Higher Education*, 68(4):398–413, 1997.

[11] Leif Fredrickson, Christopher Sellers, Lindsey Dillon, Jennifer Liss Ohayon, Nicholas Shapiro, Marianne Sullivan, Stephen Bocking, Phil Brown, Vanessa de la Rosa, Jill Harrison, Sara Johns, Katherine Kulik, Rebecca Lave, Michelle Murphy, Liza Piper, Lauren Richter, and Sara Wylie. History of US presidential assaults on modern environmental health protection. *American Journal of Public Health*, 108(S2):S95–S103, 2018. PMID: 29698097.

[12] A. C. Grayling. Psychology: How we form beliefs. *Nature*, 474:446–447, 2011.

[13] Maree Gruppetta. Disseminating dissertations: reducing inaccessibility to research findings. 2007.

[14] Linda Hall. College of wooster joins global climate strike movement. 2019.

[15] Paul Harris. Bush covers up climate research. *The Guardian*, 2003.

[16] Raffael Heiss, Johannes Knoll, and Jörg Matthes. Pathways to political (dis-)engagement: motivations behind social media use and the role of incidental and intentional exposure modes in adolescents' political engagement. *Communications*, 45(s1):671–693, 2020.

[17] Krista K. Hiser and Matthew K. Lynch. Worry and hope: What college students know, think, feel, and do about climate change. *Journal of Community Engagement and Scholarship*, 13:1–12, 2020.

[18] Shari P. Hodgkinson and J. Michael Innes. The attitudinal influence of career orientation in 1st-year university students: Environmental attitudes as a function of degree choice. *Taylor Francis*, 32:37–40, 2001.

[19] V. Jupp. *The SAGE Dictionary of Social Research Methods*. SAGE Publications, 2006.

[20] M.T. Keller and William T. Trotter. *Applied Combinatorics*. Creative Commons, 2006.

[21] Rhonda G. Kost and Joel Correa da Rosa. Impact of survey length and compensation on validity, reliability, and sample characteristics for ultrashort-, short-, and long-research participant perception surveys. *Journal of Clinical and Translational Science*, 2(1):31–37, 2018.

[22] Walter Leal Filho, Mark Mifsud, Petra Molthan-Hill, Gustavo J. Nagy, Lucas Veiga Ávila, and Amanda Lange Salvia. Climate change scepticism at universities: A global study. *Sustainability*, 11(10), 2019.

[23] Paul Lehmann, Silke Beck, Mariana Madruga de Brito, Erik Gawel, Matthias Groß, Annegret Haase, Robert Lepenies, Danny Otto, Johannes Schiller, Sebastian Strunz, and Daniela Thrän. Environmental sustainability post-covid-19: Scrutinizing popular hypotheses from a social science perspective. *Sustainability*, 13(16), 2021.

[24] Anthony Leiserowitz, Edward Maibach, Seth Rosenthal, John Kotcher, Jennifer Carman, Liz Neyens, Jennifer Marlon, Karine Lacroix, and Matthew Goldberg. Climate change in the American mind. `https://climatecommunication.yale.edu/visualizations-data/americans-climate-views/`, 2021.

[25] Brian D. Loader, Ariadne Vromen, Michael A. Xenos, Holly Steel, and Samuel Burgum. Campus politics, student societies and social media. *The Sociological Review*, 63(4):820–839, 2015.

[26] Jeffrey Lyons. The family and partisan socialization in red and blue America. *Political Psychology*, 38:297–312, 2016.

[27] Pescaru Maria. The importance of the socialization process for the integration of the child in the society. pages 18 – 26, 2018.

[28] Aaron M. McCright and Riley E. Dunlap. Defeating Kyoto: The conservative movement's impact on U.S. climate change policy. *Social Problems*, 50:348–373, 2003.

[29] Aaron M. McCright and Riley E. Dunlap. A widening gap: Republican and

Democratic views on climate change. *Environment: Science and Policy for Sustainable Development*, 50:26–35, 2008.

[30] Aaron M. McCright and Riley E. Dunlap. The politicization of climate change and polarization in the American public's views of global warming, 2001–2010. *The Sociological Quarterly*, 52:155–194, 2011.

[31] Graeme McRae. Global warming of 1.5 °C. The Intergovernmental Panel on Climate Change, 2018.

[32] Alyssa C. Morey, William P. Eveland Jr., and Myiah J. Hutchens. The "who" matters: Types of interpersonal relationships and avoidance of political disagreement. *Political Communication*, 29(1):86–103, 2012.

[33] Mehdi Moussaïd, Juliane Kämmer, Pantelis Analytis, and Hansjörg Neth. Social influence and the collective dynamics of opinion formation. *PLOS ONE*, 8:1–8, 2013.

[34] Anja Neundorf and Kaat Smets. Political socialization and the making of citizens. *Oxford Handbooks Online*, 32:1–26, 2017.

[35] Karen O'Brien, Elin Selboe, and Bronwyn Hayward. Exploring youth activism on climate change: Dutiful, disruptive, and dangerous dissent. *Ecology and Society*, 23, 2018.

[36] Maria Ojala and Hans Bengtsson. Young people's coping strategies concerning climate change: Relations to perceived communication with

parents and friends and proenvironmental behavior. *Environment and Behavior*, 51:907–935, 2018.

[37] Oren Pizmony-Levy and Jessica Ostrow Michel. Pro-environmental attitudes and behaviors in higher education: Investigating the role of formal and informal factors. 2018.

[38] Tamkinat Rauf. How college makes liberals (or conservatives). *Socius*, 7:1–13, 2021.

[39] Bruce Rideout. The liberal arts and environmental awareness: Exploring endorsement of an environmental worldview in college students. *International Journal of Environmental and Science Education*, 9:59–76, 01 2014.

[40] Amanda Ross and Victor L. Willson. *Paired Samples T-Test*, pages 17–19. SensePublishers, Rotterdam, 2017.

[41] Jonathon P. Schuldt and Adam R. Pearson. The role of race and ethnicity in climate change polarization: Evidence from a U.S. national survey experiment. *Climatic Change*, 136:495–505, 2016.

[42] David Sears and Sheri Levy. Childhood and adult political development. *Oxford handbook of political psychology*, 01 2003.

[43] Bob Simpson. Environmental awareness survey. `https://gilesig.org/newsletter/30sur.htm`.

[44] Marius Somveille, Rachael A. Bay, Thomas B. Smith, Peter P. Marra, and Kristen C. Ruegg. A general theory of avian migratory connectivity. *Ecology Letters*, 24(9):1848–1858, 2021.

[45] Dominik A. Stecula and Eric Merkley. Framing climate change: economics, ideology, and uncertainty in American news media content from 1988 to 2014. *Frontiers in Communication*, 4:1–15, 2019.

[46] Logan Strother. College roommates influence each other's political ideology. *Proceedings of the National Academy of Sciences*, 118:1–5, 2021.

[47] Josef Toman and Joanna Isabelle Olszewska. Algorithm for graph building based on google maps and google earth. *2014 IEEE 15th International Symposium on Computational Intelligence and Informatics (CINTI)*, pages 55–60, 2014.

[48] Ioannis Valavanis, George Spyrou, and Konstantina Nikita. A similarity network approach for the analysis and comparison of protein sequence/structure sets. *Journal of Biomedical Informatics*, 43(2):257–267, 2010.

[49] Sandra Wachholz, Nancy J. Artz, and Douglas G. Chene. Warming to the idea: University students' knowledge and attitudes about climate change. *International Journal of Sustainability in Higher Education*, 15:128–141, 2014.

[50] Xinrang Wang, Anthony Leiserowitz, and Jennifer Marlon. Explore climate change in the American mind. Yale School of the Environment, 2021.

[51] Stanley Wasserman and Katherine Faust. *Social Network Analysis: Methods and Applications*. Cambridge University Press, 2021.

[52] Brian E. Weeks, Alberto Ardèvol-Abreu, and Homero Gil de Zúñiga. Online influence? Social media use, opinion leadership, and political persuasion. *International Journal of Public Opinion Research*, 29:214–239, 2015.

[53] Mark A. Wilcox. A study of college student attitudes and behaviors related to recycling. 2014.

[54] Matthew Woessner and April Kelly-Woessner. Why college students drift left: The stability of political identity and relative malleability of issue positions among college students. *PS: Political Science & Politics*, 53:657–664, 2020.

[55] Jason Wrench, Candic Thomas-Maddox, V. Richmond, and J. McCroskey. *Quantitative methods for communication researchers: A hands on approach.* Oxford University Press, 2013.

[56] Xiaoyi Yuan, Andrew Crooks, and Andreas Züfle. A thematic similarity network approach for analysis of places using volunteered geographic information. *ISPRS International Journal of Geo-Information*, 9(6), 2020.