

3.16 Understanding Group/Party Affiliation Using Social Networks And Agent-Based Modeling

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Abstract: The dynamics of group affiliation and group dispersion is a concept that is most often studied in order for political candidates to better understand the most efficient way to conduct their campaigns. While political campaigning in the United States is a very hot topic that most politicians analyze and study, the concept of group/party affiliation presents its own area of study that produces very interesting results. One tool for examining party affiliation on a large scale is agent-based modeling (ABM), a paradigm in the modeling and simulation (M&S) field perfectly suited for aggregating individual behaviors to observe large swaths of a population. For this study agent based modeling was used in order to look at a community of agents and determine what factors can affect the group/party affiliation patterns that are present. In the agent-based model that was used for this experiment many factors were present but two main factors were used to determine the results. The results of this study show that it is possible to use agent-based modeling to explore group/party affiliation and construct a model that can mimic real world events. More importantly, the model in the study allows for the results found in a smaller community to be translated into larger experiments to determine if the results will remain present on a much larger scale.

1. INTRODUCTION

Political party affiliation is a huge part of the American political system, not to mention other political systems around the world. If it was possible to simulate party affiliation dispersion patterns, one could more efficiently promote political candidates. The following research project investigates political party affiliation dispersion patterns in local communities. As a side note, it needs to be mentioned that the original intent for the model changed as research progressed.

The original idea for the model was to look at all the factors that contribute to political party affiliation and essentially input these variables into a Netlogo [12] model. These variables looked at how people in a local community responded to influence from two different groups. The first of these groups are immediate neighbors. For this study neighbor is defined as an individual living in a person's immediate vicinity, i.e. next door or across the street. Also, immediate neighbors are not

chosen by individuals, they are simply the people already in place when a person moves into a local community. The second variable consisted of friends present in an individual's social network. A person's social network consists of friends and family that a person chooses to associate with, and chooses from whom they will receive advice or influence.

The concepts stated above include many complex ideas and attitudes that must be attributed to everyone in the system that is to be modeled. Based on this fact, the agent based modeling (ABM) paradigm made the most sense for this research project. ABM allows for many agents to be created in a single system. Since the research question looks at all of the individuals in a local community, agent based modeling allows for one agent to be created to represent each member in the community.

Aside from the number of individuals that need to be created within the model, a number of different attributes need to be assigned to each individual or agent. This is another key reason why ABM was chosen for this research project. For the

purpose of this effort, the individual agents need to be given several attributes that will accumulate values over time. These exact attributes and values will be described a bit later in the code explanation for the model. Because ABM incorporates the manipulation of these values, the model will allow for all of the agents to change in different ways, and at different rates. This allows the model to more accurately represent the real-world system, which increases the likelihood that the model will replicate the desired real-world behavior.

2. BACKGROUND

The model that was used for this research project required an extensive literature review to gather information on party affiliation. The initial literature review looked at the factors that were involved in how individuals decide which political party to affiliate with. As the research project changed, so did the need to find literature that was more closely related to the updated research question. As such, the initial literature review will not be discussed, but instead the literature relating to the updated research question will be reviewed in the following section.

The new research question focused on political party affiliation dispersion patterns, thus this was the area of literature that was reviewed. Many of the articles that were used for this research project claimed that political party dispersion patterns followed a couple of key patterns. First, the literature stated that individuals in different political parties would form tight groups within their local communities. These groups of individuals would often consist of people who shared the same political party affiliation [1]. The literature claimed that this is the case because of the influence these groups had on a new individual arriving to the neighborhood. If a new arrival to the neighborhood did not have a

high number of social network friends within that neighborhood, then the new arrival would tend to affiliate with which ever party their immediate neighbors did [5]. This affiliation tends to happen because; new individuals often tend to agree with the views of their neighbors in order to limit the degree of tension between themselves and their neighbors [2]. However, this does not tend to be the case if a new arrival to the neighborhood has several friends within their social network living in that neighborhood.

If an individual is new to a neighborhood and has several social network friends in the neighborhood, then the individual will tend to affiliate with the same political party as their friends [3]. The literature reveals that there are two possible causes for this particular affiliation pattern. First, when individuals move into a new neighborhood, in which they already have friends, the individual already has previous ties to those friends [11]. These previous ties may include the idea that a person chooses their friends based on similar political party affiliation [3]. If this is indeed the case, then individuals arriving to a new neighborhood may tend to care less about the tensions that may be created with their neighbors. This idea relies on another idea that an individual may not care as much about neighbor tensions because their neighbors are already their friends, and thus, they will affiliate with the same party [8]. The second reason individuals may tend to affiliate more with friends rather than random neighbors are; an individual's friends likely have more influence over that individual, compared to the new neighbors of that individual. If an individual receives, and accepts, more influence from their friends, then they will be more likely to follow the party affiliation of their friends [4]. The literature reveals that if this is the case, then the typical "group dispersion" pattern will not be

followed, and individuals may be outliers in otherwise tight groups of same party affiliates [4].

Overall, the literature provided a very good basis in which to start the model. Based on the literature, this research project models two separate dispersion patterns. First, the model simulates neighborhoods in which there are several tight groups of same party affiliates that tend to reside together. Also, the model simulates a situation in which there are several tight groups of same party affiliates, but those groups also include outliers, where individuals affiliate with the opposite party, as compared the majority of the group.

3. METHODS

The metacode from the research project model appears in the appendix, but a further explanation of the model may help readers to better understand the model. The ABM program Netlogo [12] was the software chosen to be used for this research project. The model initiates with 1,089 agents. The agents all initiate with a white coloring, representing the fact that these individuals do not currently have a specific party affiliation. Two of the agents are randomly chosen and given different colors, which represent different party affiliations. One agent is red, representing a Republican Party affiliation. Another agent is blue, representing Democratic Party affiliation.

Once the model begins to run, each agent looks at its surrounding neighbors and the members of their social networks, to determine the number of republicans and democrats that are present in these areas. Adjusting the appropriate sliders and choosers within the model can change the surrounding neighbors and social network variables. For every republican in an agents radius, that particular agent will add one to its “repub” variable and subtract one from its “demo” variable. This is the same for the

democratic agents, except the addition occurs on the “demo” variable and the subtraction from the “repub” variable. The system follows a similar pattern for an agent’s social network. The only change is that the social network carries more influence, so the agent will either add or subtract two instead of one. This again depends on the agents either being republican or democrat. Next, the agents look at their political threshold, this threshold is given to every agent, but the value of the threshold is random. The threshold variable is a number that determines the when a agent will changes its party affiliation. If an agent has a “repub” value that is higher than its threshold value, then the agent will become republican and change its color to red. If an agent has a “demo” value that is higher than its threshold value, then that agent will become democratic and change its color to blue. In the instances where agents have “repub” and “demo” values that are both higher than its threshold value, then the agent will affiliate with the higher of the “repub” and “demo” values and change to the necessary color. This process is repeated for every turn in the model. A turn represents one day, the model runs for a period of 365 turns, which is equivalent to a one-year period. At 365 turns the model completes and records results.

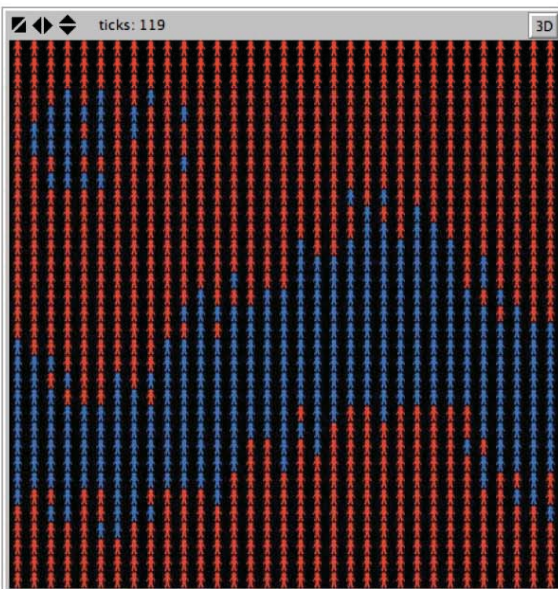
4. RESULTS

The affiliation model demonstrated many instances where all of the agents would conform to one group or another. These results were counter to the hypothesis proposed for this paper. The project hypothesis that the results would be a split dispersion, in which the project could examine the pattern in which the agents grouped, did not occur in almost all instances. The experiment had 108 different possible combinations of parameter values,

and only a couple of these parameters seem to produce the intended outcome.

The following parameter combinations were the ones that had the greatest affect on the emergent behavior of the model. First, the “starting-party-affiliates” variables was set to one. This makes the model start with only one democratic and one republican supporter. Second, the distribution of the link neighbors was set to uniform. Third, the “local-community” variables was set to three. Lastly, the “network-density” variable could be set to either one or three. These combinations of parameters were the only ones that produced results which confirmed the hypothesis.

The other 100 or so parameter combinations produced results that were not consistent with the reviewed literature. These combinations produced results in which all of the agents would conform to either the republican or democratic affiliation. These results do not allow for study of how individuals conform to party affiliation in the real world, an example would be the dispersion in a local neighborhood.



Finally, this paper will explain the process I used to determine parameter settings that produced the expected results. Since the goal of this project was to produce a model that had close to equal numbers of both republican and democrats, it was easy to determine which parameter combinations produce these results. By simply asking the behavior space, the program component of Netlogo which controls experimentation, to return the total number of republican and democratic agents, and also these percentages, comparing to determine which combinations produced these results was greatly simplified. This is also the basic way the project decided to test the relationship between the parameters and the emergence. It is known several research projects use statistical tests to confirm their results, but in the case of this project, so few parameter combinations produced the emergent behavior, that there was simply not enough information to test.

With this model, validation was somewhat complicated by the results of the experiments, but is none the less an important part of any experiment and requires explanation. The model expected an equal distribution of the number of democratic and republican supporters; the model also expected a pattern that followed a grouping effect with few outliers. The research conducted earlier in the experiment revealed that this is the most common type of distribution found in areas around the country, e.g. in a single neighborhood. This is the type of distribution the model produced, when the parameters were set to those described above.

With the results of the model collected and the prospective outcomes discussed, there are mixed feelings on the model's validity. First, if the model is set to the parameters discussed in section one above, then the model produces a result that is more valid than any other. The model not

only produces a close to equal dispersion of party affiliation, but it also follows the grouping pattern that was expected. On the other hand, if the model is run using any parameters, not listed above, it produces a less valid result. Most of the time all the agents affiliate with one group or the other, and do not have an equal dispersion. Also, if there are agents that affiliate with the minority group, they are often randomly spread out and do not follow the specific pattern that expected.

Considering all of the information above, with the right parameters, the model replicates a real-world system using a simulated mechanism. Of course this is only possible if the parameters discussed in the above section are used. Otherwise, the model does not accurately represent the real-world system. Based on this, it is clear that even though the model does not produce the desired outcome, unless the proper parameters are used, it does produce a very accurate representation of the real-world system, when the right parameters are used.

A next step for this model and experimentation is refinement of the model construct and the application of the model to a much larger group of agents. The initial model was meant only as a proof of concept that party affiliation amongst a group of individuals is replicable in simulation. The results of this experiment, while not completely aligning with the literature, do support this conclusion. As such, using the same parameter settings that produced expected results, but scaling the size of the populace up, would provide greater insight into group affiliation in populaces as large as cities or countries. During this process it would also be possible to modify portions of the model to create more reliable and valid results, especially for larger populations.

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6. APPENDIX

Metacode

Initialization

Create "threshold" variable, random between 50 - 90 (determines when agents will choose an affiliation)

Create "Demo" and "Repub" variables (determines which affiliation agents will choose)

Create one turtle for every patch (ask patches to sprout 1)

Ask turtles to change shape to person

Create random republican turtle(s) (red) - (based on the slider value)

Create random democratic turtle(s) (blue) - (based on the slider value)

Ask all other turtles to change color to white

Create random social network for each turtle (based on slider value, and chooser selection)

Execution

Loop (365 ticks) - model while be based on 1-year period, each tick represents one day

Each turtle:

Perceptions

Turtles will look at their immediate surrounding neighbors (based on distribution selected), and also the other turtles in their social network.

Turtles will count the number of "blue" and "red" turtles that neighbor them and the ones in their social network.

Turtles will then add 1 to the "Demo" and "Repub" variables for each "blue" and "red" turtle neighbor.

Turtles will also add 2 to the "Demo" and "Repub" variables for each "blue" and "red" social network turtle.

Also, if a turtle is "red", then they will subtract 1 from their

"Demo" variable for each turtle in their radius and social network.

This will be the same for each "blue" turtle, subtracting 1 from their "Repub" variable for each turtle in their radius and social network.

Performance

Once a turtles "Demo" or "Repub" variable exceeds a turtles specific "threshold" variable, the turtle is asked to change its color to the one that represents their affiliation.

If a turtles "threshold" is exceeded by both the "red" and "blue" count, then the turtle will compare the "red" count to the "blue" count and choose to change to the color of the higher count.

The above procedure means that turtles can flip flop between affiliations.

Each time a turtle chooses an affiliation or changes affiliation, the turtles threshold will increase by a random amount (between 1 and 10 percent).

Once a turtle reaches a threshold of 100, the turtle will no longer be able to change affiliations, and thus must remain with the affiliation (or color) they are when the threshold reaches 100.

End loop