Cultural Dissemination Model with Stubbornness Extension

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Abstract

The cultural dissemination model, created by Robert Axelrod, focuses on how the social influence between two people could lead to an adaptation of culture. As more people adopt the culture of those they interact with, the total amount of cultures begins to lessen. In our extension of the model, we consider how a person's willingness to change cultures can affect if they adopt the culture of those they interact with. If the user has the stubbornness switch turned on, then each agent has a random probability of "willingness to change" assigned to them when the model is set up. As the model continues to run, the agent's willingness to change continues to differentiate based on the other agent that they interact with. In this model, the velocity of the agents is the probability that the agent will move and interact with the other agents. During the analysis, we examine the number of cultures based on the velocity and stubbornness of the individual agent.

Introduction

Culture is "the beliefs, customs, arts, etc., of a particular society, group, place, or time," (Merriam-Webster, n.d.). Culture is always changing. Culture evolves as society evolves. As politics, economics, and technology grows, so does culture (Naumann, n.d.). Oftentimes, people want to share their culture with those around them. This gives people the opportunity to appreciate and embrace a culture that is different from their own. Robert Axelrod created the Cultural Dissemination model to show how people can adapt to other people's cultures just through social interaction. This model starts off with agents who have around 100-120 different types of cultures. These cultures are assigned randomly. The agents interact with those with whom they have commonalities. Once they interact, one agent adopts a feature of the other agent's culture. In this model, we see how the number of cultures reduces until there are only a few cultures that still exist. The model is extended by a feature of stubbornness. The stubbornness is controlled by a switch that turns on and off. If the stubbornness switch is off, the model runs the way Axelrod originally designed it. If the stubbornness switch is turned on, the agents are assigned a random probability of stubbornness. This means that the agent will be X% willing to change their culture based on the social interaction that they had with another agent. Ultimately, this will have an effect on the number of agents that conform to the culture of the other agent. At the end of the model run, this will affect the final number of cultures that remain.

The main questions that this extended model addresses include the following: "If people tend to have their beliefs, attitudes, and behavior become more alike when they interact, why do not all such differences disappear over time?" (Axelrod 1997), "How does stubbornness levels in a society affect the way culture is disseminated?", and "How long does it take for the system to settle down if it ever does?" Axelrod is trying to show that we are more likely to interact with people who share some of the same characteristics as us. There might be a sense of trust and understanding of an agent since they already have a few similarities. Therefore, the agent will begin to adopt more cultures and characteristics from that other agent that they trust. In this interaction, the agents become more similar. The purpose of this model is to show how cultures can disappear over time through social interaction. However, it is important to see the trend of how other cultures disseminate.

This model can be used to show how cultures can change in a society and how some people have more strongly held beliefs than others.

Background

While social interaction could lead to adopting one's culture, there are many instances where individuals prefer to not conform to another person's culture. This is where we introduce the stubbornness extension to the model. If the stubbornness switch is turned on, the agents are assigned a random probability of stubbornness. This probability translates to the percentage that the particular agent will be willing to change their culture and adopt a new culture. It is more realistic that people will be more resistant to taking on culture, rather than taking on another person's culture just because they had one social interaction and a few similar characteristics. It is important to note that this value changes with each interaction that the agent has with another agent. This consistent change of stubbornness is an example of opinion dynamics.

Opinion dynamics is the process of the change of others' opinions. Opinion dynamics models are now being researched in a variety of fields. The benefit of opinion dynamics is that people are always going to be able to listen to others' opinions. Just because somebody is very strong-willed about a topic and not willing to have a change of mind in one moment, doesn't mean that they will never be able to have a change of mind(Zha et al., 2020). Since people's opinions are always changing, we determined that it was important to include opinion dynamics in the cultural dissemination model extension.

There are many reasons why people tend to be stubborn when it comes to changing and adapting to another culture. Some of the reasons for stubbornness are explained by Axelrod as follows; social differentiation, fads and fashions, preference for extreme views, drift, geographic isolation, specialization, and changing environment or technology. Social differentiation occurs when there is a group of people from various different cultures. The people are able to recognize that they all have different cultures, but they don't want to start inheriting the cultures of other people. Instead, everyone wants to embrace their differences.

Social differentiation leads to a society that appreciates all cultures (Olzak, 1983). Social division considers economic, political, and normative relationships in society. Social fragmentation is rooted in inequalities in power, status, wealth, and prestige. The four most common aspects of social differentiation include gender, age, race/ethnicity, and locality (Juteau, 2014). Fads and fashions are trends that come and go very quickly. As soon as everyone hears about the "next big thing," they want to be a part of it. Normally, we tend to think of all the followers of fads and fashions. It is important to remember that fads and fashions have to have a starting point. There has to be a person who starts the trend for everyone else to follow. It doesn't take long for the new trend to die down and quickly become irrelevant to society. There is always a race to be the person to start the next trend. This results in a constant change of culture. Another reason that people tend to not want to switch cultures is the preference for extreme views. Extremism refers to having an extreme viewpoint on a particular subject. This term is not describing the people who tend to stay neutral on an issue. People who stay neutral are likely to be able to be swayed in their viewpoint. People who are extremists are either completely for or completely against an issue. Sometimes, people like to criticize extremists and their viewpoints in order to discredit unpopular viewpoints (Case, 2020). People with a preference for extreme views

are less likely to change culture just based on social interaction. They will have a certain level of being unwilling to change. Extremists might have a chance to change their viewpoint in the future; however, it takes a little more convincing and more than one interaction. Drift describes the evolution of the culture. Individual traits inside of the culture can lead to separation and distinguishing inside of the culture. Language is an example of a drift in one's culture. Language is constantly developing. For generations, we have been able to witness new words being acquired as old words die away. Not only does the language gain and lose actual words, but dialects add a new element of change to the culture as well. Dialect is the form of language that is specific to a certain area or region; therefore, a singular language can consist of many different dialects. This is how subgroups are formed in that culture (Encyclopædia Britannica, n.d.). In the present day, language change is tricky. This causes a slight gap or disconnect between the older generation and the new generation. As individuals notice language change, they normally respond negatively. Older people, who aren't comfortable with technology, might refer to the change as a disappointment or something that isn't productive to the growth of the culture. As these languages and cultures change, other people might not be willing to adopt a culture because it may be perceived as something that isn't consistent in itself. Geographic isolation is another reason why people won't be as eager to change cultures as the original cultural dissemination model shows. People live near others who are similar to them which can result in no one changing. Most people will move around until they are surrounded by people who they are comfortable around. Oftentimes, people are most comfortable around people that have the same values that they do.

Thomas Schelling's segregation model is a good representation of what patterns can occur in society based on the decisions that one makes about where they want to live and the type of people that they want around them. The segregation model consists of two different types of agents, orange and blue. Every individual agent wants to find a place to live, but they also want to be happy in the place where they reside. The only way that the agents will be happy is if they are around people who look like them. There is a slider to adjust the percent of similar agents that they want around them. If the slider is on the lower end, the agents don't care as much about being around other agents that look like them. If the slider has a higher percentage, then agents will only stay in a place where they feel comfortable by having more agents around that look like them.

The thing to note about this model is that the agents aren't gathering together to make a plan and decide to all life together or all live separately. Each agent makes an individual decision about where it feels comfortable living. However, when the agents have a preference for a higher percentage of agents around them that look like them, we see clusters begin to form. It looks as if all the orange agents planned to live with each other and all the blue agents decided to live together. This is an example of how several individuals' discriminatory decisions can create segregation in a larger collective. A changing environment, specifical technology, is another reason that people will not be willing to change their culture or viewpoints. Technology has made the world grow in ways that we have never thought were possible. On the other hand, technological advancements make society progress very quickly. This is why it is important to remember that just because the world and cultures are changing doesn't always mean that people are changing with it. Technology has given great contributions to the disability community. To be specific, people with intellectual disabilities such as autism have benefited greatly from

electronic habit trackers and planners. People with autism benefit from a solid schedule for daily living. A helpful schedule can help an individual remember to do important things that are essential to daily living. When no routine is given, individuals create their schedules as they go throughout the day which can be very overwhelming for people in this community. Some people don't fully understand how to use electronics; therefore, they don't see the significance of how new technology, like the electronic schedule or habit tracker, can help someone with autism gradually become independent with basic daily living skills. The culture of working with people with intellectual disabilities has become heavily reliant on technology. The technology gap between generations can cause confusion of a culture, which would not intrigue someone to join that culture.

Methodology

The cultural dissemination model shows how cultures can lessen through the special interaction of agents. The user is able to input the world size in the model by using a slider that ranges from 2 to 50. The world size determines the number of people that are in the grid. Then, the user is able to input a value for F, Q, and radius. In the model, the value for F controls how many features each agent will have. The value for Q controls the maximum trait value for those features each agent has. The value for the radius will determine the amount of space between each agent during an interaction. The user is also able to turn the "saving?" switch on and off. If the saving switch is turned on, that model run will save the q values, number of agents in the cultural domain, and save the number of agents in the bigger cultural domain. The user is able to input a value for the velocity using a slider from 0 to 1. The velocity is the probability that the agent will move. Once the agent decides whether to move or not, they are able to decide where to go using the step length and the angle slides. The step length slider goes from 0.1 to 1. The angle slider goes from 30 to 359. The final input that the user can use is the "setup-agent-stubbornness?" switch that goes on and off. If the stubbornness switch is turned on, the agents are assigned a random probability of stubbornness. This means that the agent will be X% willing to change their culture based on the social interaction that they had with another agent. Each moving agent follows the steps listed below:

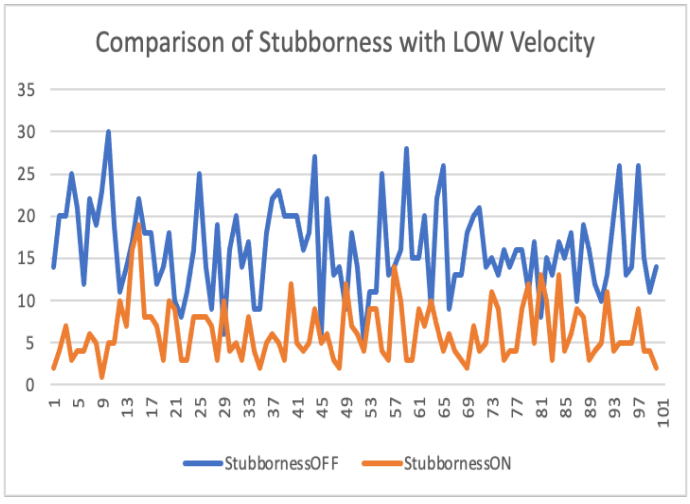
"(i) agent decides to move according to the probability veloc. If moving:
(a) select a direction according to the angle value
(b) select a step distance according to steplength
(c) agent moves

(ii) checks if it is active and, in this case,
(a) selects a neighbor for cultural interaction (without any constraint)
(b) interact with the selected neighbor with probability proportional to the amount of features they have with the same trait values, the amount of shared features
(c) if interacting, the active agent modifies one of its cultural features he does not
share with selected neighbors copying the neighbor cultural trait value if he has a stubbornness value less than his neighbors. Note that if there are no common traits value, the interaction is not possible, and the respective agents refuse to influence each other.

(d) agent i modifies its color according to its new cultural values" (Rodriguez, 2011).

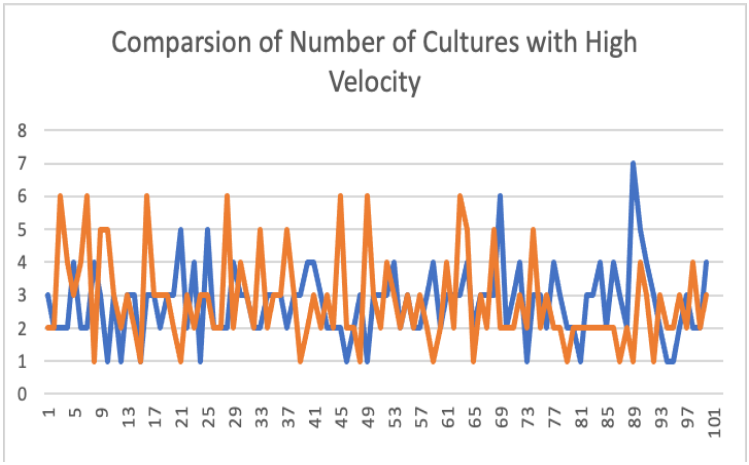
Results & Discussion

In order to focus on the research question, "How does stubbornness levels in a society affect the way culture is disseminated?", it is important to focus our analysis on the change in velocity and the stubbornness switch. As a reminder, velocity is the probability that the agent will move. Whereas, the stubbornness switch will determine the proportion that increases or decreases the agent's choice to change to another culture. In order to truly determine how the stubbornness levels affect the dissemination of culture, we need to take the final number of cultures at the end of the model run. This will help us examine the total loss of cultures during a model run. On the other hand, it is always important to take multiple runs of the model. The more times the model is run, helps eliminate any possible bias that might come from only a few model runs. To begin, we analyzed the change in cultures when there is low velocity. We used the least amount of velocity possible which was 0.1. In the model, this translates to, the agents have a 10% chance that they will move around and interact with other agents. When the stubbornness was turned off, the maximum number of cultures in a model run was 30 and the minimum number of cultures in a model run was 5. The average when the stubbornness was turned off was 16.13. When the stubbornness was turned on, the maximum number of cultures in a model run was 19 and the minimum number of cultures in a model run was 1. The average when the stubbornness was turned off was 6.25. We plotted the final amount of cultures when the agents had a velocity of 0.1 (see below). The orange line shows the number of cultures when the stubbornness was on and the blue line shows the number of cultures when the stubbornness was off. When there is a low velocity, there are a greater amount of cultures that occur when the stubbornness is off.

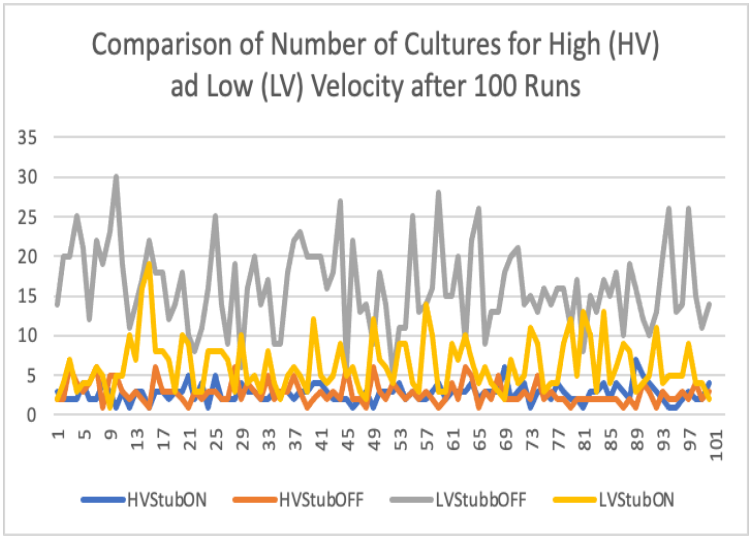


Next, we analyzed the change in cultures when there is high velocity. We used a velocity of 0.8. In other words, the agents have an 80% chance that they will move around and interact with other agents. When the stubbornness was turned off, the maximum number of cultures in a model run was 7 and the minimum number of cultures in a model

run was 1. The average when the stubbornness was turned off was 2.78. When the stubbornness was turned on, the maximum number of cultures in a model run was 6 and the minimum number of cultures in a model run was 1. The average when the stubbornness was turned off was 2.76. We plotted the final amount of cultures when the agents had a velocity of 0.8 (see below). Again, the orange line shows the number of cultures when the stubbornness was on and the blue line shows the number of cultures when the stubbornness was off. When there is a high velocity, the number of cultures tends to be around the same amount. While the stubbornness of the line plot did have a maximum of 7 cultures, it stayed relatively low for most of the other runs. It is also important to note that the stubbornness of the line plot tends to reach higher values more often than the stubbornness of the plot. Therefore, these two lines plots are too close to determine which one produces the most amount of cultures.



The four plots have been put together in a singular plot to better understand the difference in trend for each set of lines for the low velocity and high velocity (see below).



Velocity played a key role in the change in the number of cultures at the end of each round. When the agents have a lower probability to move, no matter what the stubbornness is, they have more cultures. We believe that since they aren't meeting a lot of random people and aren't being influenced, they are going to keep their same cultures. The more agents that they interact with, the more people they find similarities with. Once the agent finds that similarity, they are more likely to adopt their cultures from each other. The more you interact with others, the more the total amount of cultures dwindles. Therefore, it doesn't matter if the stubbornness is on or off, the low-velocity plots always show more stubbornness. We see the highest amount of cultures present when there is low velocity and stubbornness is turned off.

Further Development

There are a few ways to further develop this model. In the future, we could use opinion-based groups to help create the values for the "willingness-to-change" variables in the models. We can create these groups by using survey data where each participant will answer a survey question that will help us generate a more realistic value for stubbornness/willingness to change. Another way to further develop this model would be to add different proportions of "willingness to change" for different cultures. When setup-agent-stubbornness is switched on, the agents have a random proportion of stubbornness assigned to them. Even though the agents have different cultures, the same amount of stubbornness is given to each of the cultures. This doesn't reflect real life. Most people have multiple cultures that combine to create them as a unique human being. It is normal for someone to feel more passionately about one culture over another. There are certain cultures that we are not as willing to change our viewpoint on, than other cultures. A good example of this is religion. Religion is a part of many people's culture. Religion can be something that many people guide their life by. A person who is watching their life closely by a religious doctrine will stand firmer in their belief and will not be willing to change this part of their culture. Whereas, this same person could have a culture of wearing clothes from the 90's. If someone has an interaction with that person and tries to convince them to change their clothes, then they might be more willing to change since they are not guiding their life by the clothes that they wear. There should be a differentiation between levels of stubbornness for different cultures.

Reflections

This group project was a great opportunity to be able to learn and improve in coding in Netlogo. My group decided to extend a model that was already created. The Axelrod model had plenty of resources that were easily accessible to learn about the background behind why the Axelrod model was created. Since this model is very well known, there are a lot of people who have been trying to extend the model. It was helpful to read through these papers and look at these models to try to help us get an idea about how to extend the model. The professor was very helpful with fixing the Netlogo code. I believe that our group worked together very well. We set up a plan for when to have our part of the project done and made sure we had follow up meetings with that plan to be sure that everything was

getting accomplished in a timely manner. We both contributed to the part of the project where we would most benefit the group. Francesca specialized in the coding and mathematics part of the project, while Jada was more comfortable with completing the powerpoints and finding background knowledge to contribute to the significance of the code. Since both of us are in CSS 600, the TRACE and Research Paper combination wasn't something that we were unprepared to do. This project helped expand both of our knowledge with coding in Netlogo and creating research documents to complement the code.

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