News Dissemination: An Agent Based Model

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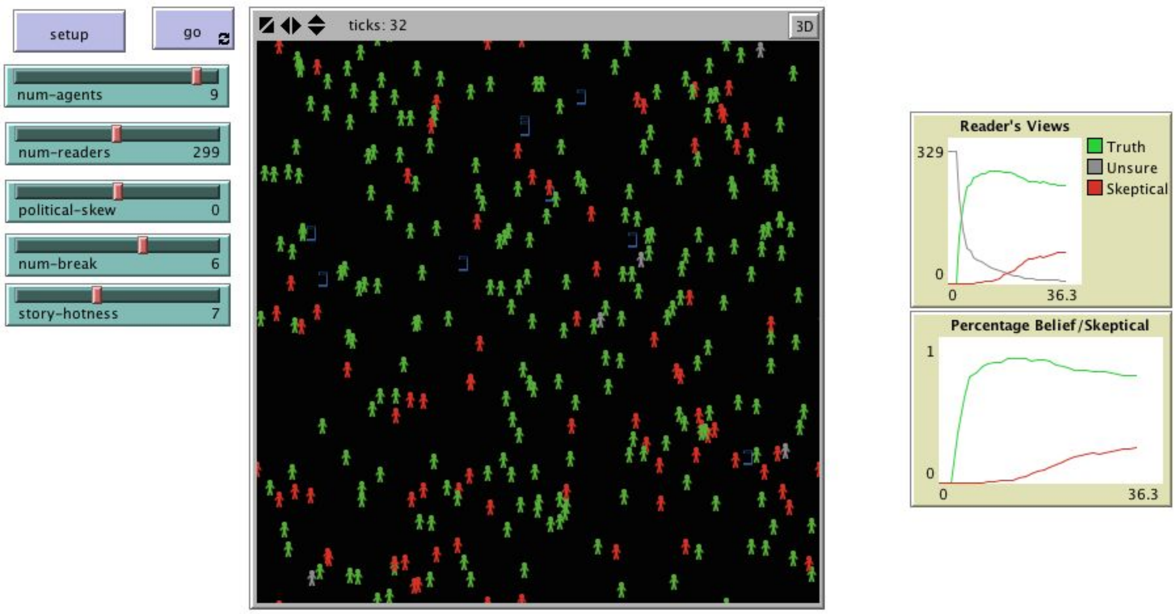


Introduction

This model looks to emulate the dissemination of political stories via new agencies that demonstrate a political bias or skew. With presidential elections swiftly approaching, several news agencies look to break stories about the candidates. These sources, however, may have favored certain parties historically, suggesting that their stories may either have a slant or perhaps contain unverified information. On the other side of the news market, readers themselves have political biases that affect how they perceive a story's content. This interaction, between readers and news agencies, often leads to a partition of the population- those who believe the story, those who are skeptical, and those who are unsure. This model explores how a number of variables affects these end states. In doing so, this model offers a new insight to how political news is transmitted in a society with differing political preferences.

Turtles

There are two types of turtles in this model- news agencies which we call *agents* and readers who we call *readers*. These breeds differ in structure which we will discuss here. We will begin with the agents. Agents have instance variables including *center-point*, *range*, and *break*. An agent's center-point represents the true political center of each news agency. These center point's are drawn from a uniform distribution between zero and 100 then divided by 100 to scale the center-point between zero and one. This allows for news agencies to be spread across the political spectrum. The credibility of an agent is sampled from a chi-squared distribution with one degree of freedom. The negative of this value is then then mapped via the inverse logit function to again scale the credibility of an agent between zero and one-half. In mapping the values from a chi-squared distribution it allows for most agencies to have large credibilities while still having agents with low credibility. The final instance variable is break. This boolean variable simply tells the agent to publish a story or not.

The other agents in this model are readers. Readers have four instance variables being *center-point*, *story*, *belief*, and *times-heard*. Center-point is defined similar to as above. The center-point is draw from a normal distribution and then mapped via the inverse logit function. This allows for a normal distribution of reader's political views but again confined to the zero to one scale. The story variable stores either a negative one, zero, or one. Negative one represents skepticism of the story, zero represents uncertainty, while one represents belief in the story. Belief is a continuous variable that is the deciding variable for story. Based on interactions discussed in the next section, the belief will either raise or fall and based on some threshold will change the value of story. Finally, times-heard represents the number of interactions with the story of the given reader. This will also act as an end condition to the system.

Implementation

There are three main interactions in this system- agent-to-agent, agent-to-reader, and reader-to-reader. Agent-to-agent is simple. Based on the story-hotness, a global variable, an agent that has published a story will tell other agencies this story and they will consequently also publish material on this story. The story-hotness dictates the patch radius in which the story is told from agent to agent. As the story-hotness increases, other news agencies are more likely to also publish material on this story.

The next interaction is reader-to-reader. Based on location of each reader, neighboring readers will 'discuss' the story if they have heard of the story. Based on the political beliefs of each reader, their respective belief metric is updated. Recall that center-point for readers was defined on a zero to one scale. We will call this range our *political spectrum*. The algorithm for change in belief is as follows- if the center-point of the two agents differ by less than .25 on the political spectrum, we consider them similar and reset the reader's belief to the sum of their original belief with the average of their belief with the other reader's belief. This will take the belief of the reader closer to the belief of the similar reader. If the difference is less than .5, we follow the same process but reset the belief to the .5 of the value highlighted above. If the difference is less than .75 or 1, we follow the same procedure as above except instead of moving towards the similar reader's belief, we move away from this reader's belief.

The final interaction is agent-reader. If an agent is within ten patches of a reader, the reader is asked to read the news. Before we describe the read news procedure we will define a few terms that will make the following discussion more clear. We will call an agent's *first range* the interval centered at its center-point with length defined by the range of the agent's range. Mathematically this range can be represented by [-.5*range + center-point, .5*range + center-point]. An agent's *second range* is the interval centered at its center-point with length defined by the two times of the agent's range. Mathematically this range can be represented by [-range + center-point, range + center-point]. In the read news procedure, if the reader's center point is located in the agent's first range, .75 is added to the reader's belief. This is to emulate that readers who read articles from sources they trust will believe the story. If the reader's center-point is located in the second range, only .25 is added to the reader's belief. This is to represent skeptical acceptance of a reader. Finally, if the reader's center-point is not in either of these ranges, their belief simply does not change.

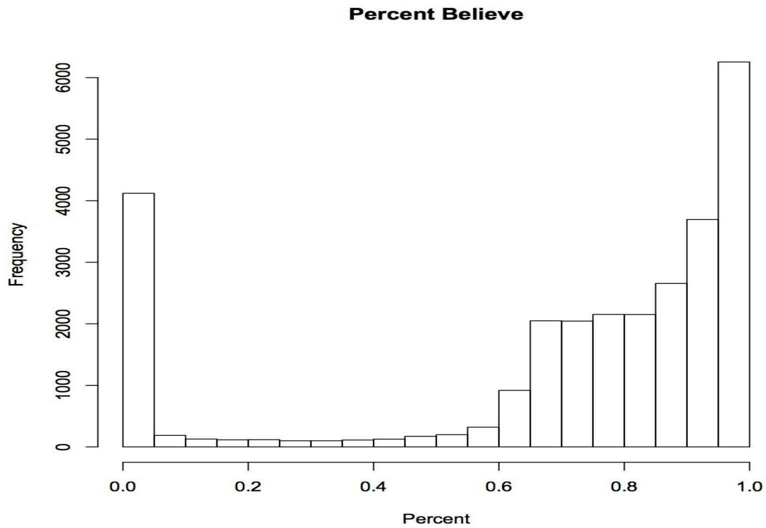
These interactions are based on the random interactions of each turtle. Thus each turtle is asked to move in a random fashion at each tick. After each tick, the readers update their beliefs. If they have a belief of less than -.5, they are skeptical of the story. If they have a belief of greater than .5, they believe the story. Otherwise, the readers are unsure on their standing regarding the story. The program ends when each reader has heard the story at least 25 times.

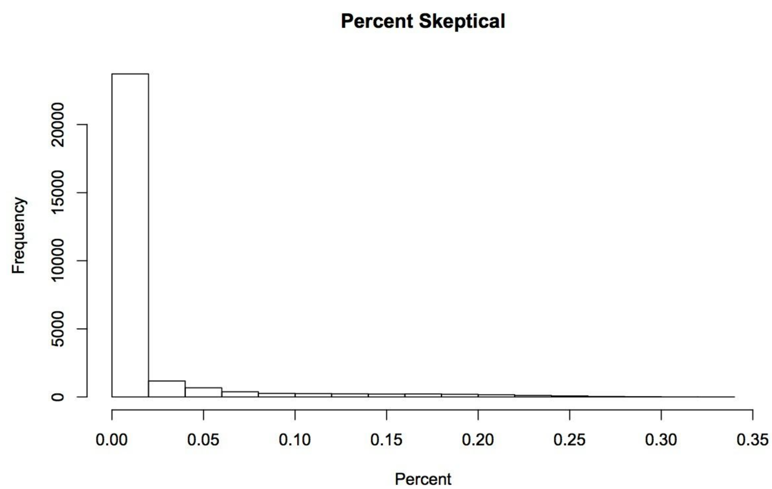
Model Creation

This model was built under the assumption that both agents and readers' political preferences can be modeled perfectly via continuous distributions. We also assume that every interaction contains some transmission of information given the story. While these assumptions may not be perfectly appropriate for a field model, building in a way to better represent the task at hand allows for quick and precise data collection. In doing so, however, suggests that these readers are perfectly in tune with their political surroundings. Furthermore, there is no time component built into this model. A reader's tenth time hearing this story should not affect their perception as much as hearing about the story their first time. In discounting this effect, we allow for a thorough, yet unrealistic diffusion of this story. The decisions here model sufficient conditions to produce an insightful understanding of the agent-reader environment. While these are not the only conditions possible for this interaction, these decisions have been documented and are available for scrutiny and adjustment in replication efforts.

Results

The experiment was designed to explore how a number of variables affected the probability of the readers who believed the story. The variables that were varied included number of agents, number of readers, story hotness and political skew of agents. A logistic regression model was used to model this interaction. First we present two histograms of the percentage of skepticism and the percentage of belief.





As shown by the histograms, there is a significant number of zero percentage of belief or skepticism in both the skeptical and belief end conditions. This can be accredited to the number of beginning agents being one. If, for example, a news agency has limited credibility, and is the only news source available, the story may never spread. Apart from this, we see a decreasing pattern in the skeptical data and an increasing pattern in the belief data. This can be accredited to the large number of agents and readers in a confined space. Having a diverse set of turtles allows for proper dissemination of a story.

Logistic regression was used to model the percentage of belief as predicted by the boundary variables. The model used here model the change in the log odds of each percentage. The model follow with the parameter confidence intervals.

$$\log \frac{\%belief}{1\text{-}\%belief} = \; 0.38- \; 0.000265*num.readers \; +0.0583*num.agents+0.00777*story.hotness$$

	2.5 %	97.5 %
(Intercept)	0.3667313663	0.3972704526
num.agents	0.0573589522	0.0591732443
num.readers	-0.0002835599	-0.0002472741
story.hotness	0.0062225801	0.0093210737

Using a Bonferroni correction, the above results prove statistically significant. We conclude that the number of agents and the story hotness increase the log odds of the percentage of belief. We also note that an increase in readers decreases the log odds of percentage believe at the end of the experiment. This may be due to misinformation and trustworthiness of each individual reader. These results show that the dissemination of a story is heavily dependent upon the number of readers and agents and less so on the story hotness and the political skew of the readers.

Conclusion

This model attempted to replicate how political news is shared in a reader-agent society. In doing so, this model offers insight to the ways in which news is disseminated and how political beliefs can mask the truth. A positive correlation between number of agents and percentage of belief show how an increased number of news sources better inform the population. A negative correlation between number of readers and the percentage belief suggest that in more politically active, densely populated space, interaction may lead to misinformation and therefore greater skepticism or disbelief in a population. As society continues to become more interdependent via social media, this phenomenon may become more prevalent, therefore validating this model.