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AN AGENT BASED MODEL OF SPREAD OF COMPETING RUMORS THROUGH ONLINE INTERACTIONS ON SOCIAL MEDIA

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ABSTRACT

The continued popularity of social media in the dissemination of ideas and the unique features of that channel create important research opportunities in the study of rumor contagion. Using an agent-based modeling framework, we study agent behavior in the spread of competing rumors through an endogenous costly exercise of measured networked interactions whereby agents update their position, opinion or belief with respect to a rumor, and attempt to influence peers through interactions, uniquely shaping group behavior in the spread of rumors. It should be pointed out that this research is still in its nascent stages and much needs to be further investigated. Our initial findings suggest that (i) rumors can survive under competition even with low adopting populations, (ii) latent positions in rumors seem to dominate extreme positions, and (iii) the timing of the effort expended by an agent affects the level of competition between rumors.

1 INTRODUCTION AND BACKGROUND

Online interactions, especially on social media, differ fundamentally from traditional offline human interactions and represent a new paradigm for the spread of information, ideas, and rumors. Even though there is a rich theoretical understanding of the spread of rumors, we are yet to fully understand the effects of modern communication channels (like social news media discussion sites), which are marked by unique agent behavior and online interaction dynamics, on the spread of rumors.

This research is motivated by Kaligotla and Galunic (2015), which examines the spread of rumors during the "Watertown Manhunt", the event involving the manhunt of the suspects of the Boston Marathon Bombings in April 2013. The event suggested that online social media can get things wrong for extended periods of time. That false rumors spread wildly, even in competition and are not easily stopped short of authoritative events, strongly motivates our work.

The term "social media" is commonly understood as virtual or electronic platforms which allow users (individual agents) to form online communities and interact by sharing information, ideas, personal messages, and other forms of communication. There is a marked difference between social news and information sites and social network sites, and between online and normal interactions.

Social news and information web sites like *Reddit*, involve interactions among distant anonymous individuals (with little or no historical contacts), whereas social networking forums, like *Facebook*, blend everyday, face-to-face friends or closed peer networks with online interactions. Online interactions are also fundamentally different from common face-to-face interactions in their sheer volume and pace. Also commonly observed is that rumors rarely exist singularly. Studies of rumor contagion, however, traditionally tend to involve a single rumor (much like disease contagion models of a single disease)

Most papers in rumor literature use stochastic models, which typically make simplifying assumptions (like homogeneous agents with random or directed mixing) to have tractable analytical results. We are however interested in studying the setting where agents are heterogeneous and their choices are behaviorally motivated. The use of Agent-Based Simulation (ABS) to study this kind of problem is practical as it allows us to relax some assumptions to build intuition (Macal and North 2010).

Our study extends existing theory by considering the following assumptions / constructs, with support from the literature: a) Rumors exist in competition, b) Rumors have depth and directionality, c) Rumors spread by agent influence through interactions, and d) Spreading of rumors evolve along network topologies. None of these constructs is new by itself; indeed different papers have looked at these points individually. We believe we are the first in putting these constructs together given our research goals.

The research questions we seek to address specifically are: [i.] How does competition between two rumor streams affect the diffusion of rumors?, [ii.] Does the initial distribution of agent population affect the evolution of rumors?, and [iii.] How does time-dependent effort affect the diffusion of rumors?

2 MODEL AND METHODOLOGY

We develop a conceptual model of competing rumor diffusion on social media networks, which we then implement through an ABS model on *NetLogo* (Wilensky 1999). Our model enables us to incorporate some of the key conditions observed in practice (e.g., heterogeneity of agents). We develop two distinct *NetLogo* simulation models, one for simulating rumor competition between two rumors, and another built on top of our rumor competition model to simulate the spread of rumors through influence, by the interplay of reputation, effort, and threshold values.

The primary inputs to the models are the initial population subclasses across both rumors, the mean and standard deviation of starting energy levels as well as the mean values for other agent characteristics. We model the network evolution using a preferential attachment model. Output measures from our simulation include the system states and population of subclasses in each time step, and for the second model, the number of interactions and the mean effort at time t.

3 RESULTS AND CONCLUSION

We implement a special case of an Agent Based Simulation model on *NetLogo* to confirm and validate the model, by replicating results from Schramm (2006). We then generalize our implementation for a boarder class of question and applications of interest and report our initial results.

Our initial findings suggest that (i) rumors can survive under competition even with low adopting populations, (ii) latent positions in rumors seem to dominate extreme positions, and (iii) timing of effort expended by an agent affects the level of competition between rumors (measured as the divergence of rumor populations).

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