Whether tweets live or die depends more on network, competition for attention than message or user influence

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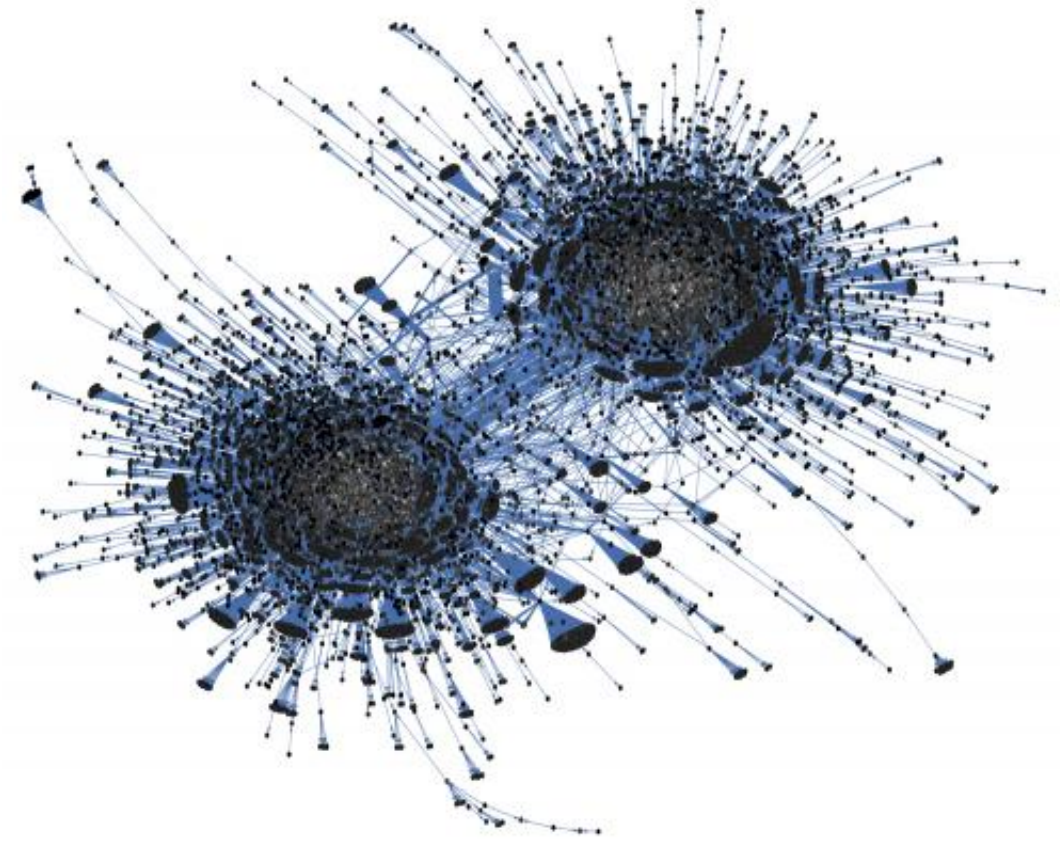


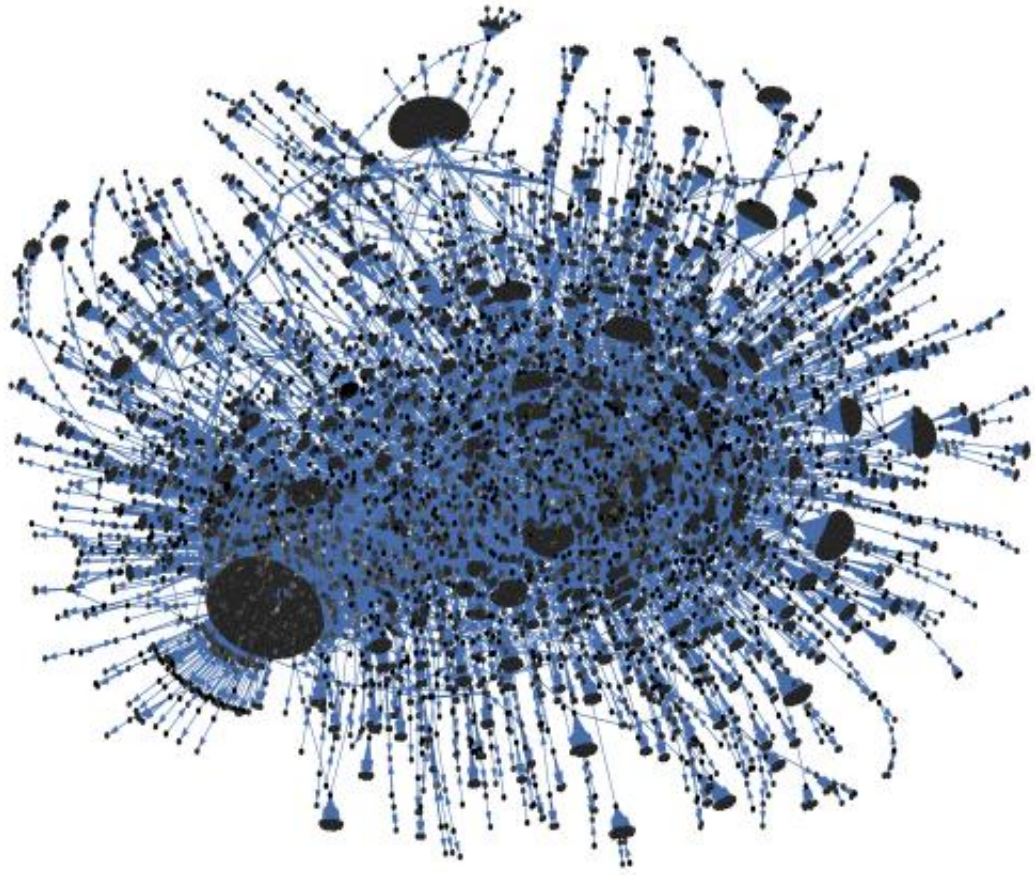
A visualization of meme distribution originating from the #GOP Twitter hashtag about the U.S. Republican Party displays strong polarization between people with opposing views. Credit: Indiana University

On the global social media stage, it's not so much the message but rather network structure and competition for attention that determine whether a meme becomes popular and shows staying power or whether it falls by the wayside, research led by Indiana University has determined.

After analyzing 120 million retweets connected to 12.5 million users and 1.3 million hashtags, the team from IU Bloomington's School of Informatics and Computing was able to model the mechanisms of meme competition in the Twitter social network and show how information spread is shaped. The findings show it's not as much the message as it is the medium, and even memory, that determines whether an Internet meme goes viral or dies without a trace.

The research, published March 29 in *Scientific Reports* and conducted at the school's Center for Complex Networks and Systems Research, is the first to attempt addressing social media as a series of new, unrestrained epidemics continuously input into a system. IU Bloomington informatics associate professor Alessandro Flammini, one of the paper's authors, said the model is similar to a natural ecosystem.

"In an ecosystem you have individuals, which here would be posts, that belong to different species (the memes) that produce offspring in an environment -- in this case our collective attention -- that can sustain only a limited number of individuals," he said. "When individuals belonging to a new species enter, as many individuals die as needed to maintain the sustainability threshold."



Visualization of meme diffusion related to the Arab Spring and the 2011 uprisings from the #Egypt hashtag, which shows strong connectivity and many users linked to one another to form a dense cluster. Credit: Indiana University

It's not that the scientists found the message played no role in the selection process, but it was the mechanisms of competition and the economization of attention that were sufficient for them to generate a complex information landscape in which a number of different meme spreading patterns could be defined. And excluding either social network structure or user finite attention as key ingredients in the information diffusion model led to results that were inconsistent with the empirical data they had.

"At a statistical level, we found that it is not necessary to include external explanations like intrinsic appeal, user influence or external events to observe the global dynamics of memes," said another co-author, IU professor of informatics and computer science Filippo Menczer. "This provides a real stop-and-pause moment for us as it makes information epidemics quite different from the basic modeling and conceptual framework of biological epidemics."

Informaticists have traditionally used the epidemic process as inspiration for representations of information spread, with "infection" spreading along the edges of the social network. But until now they always focused on a single infection (meme) at a time, said IU Ph.D. candidate and lead author Lilian Weng.

"The research calls out for new and different frameworks of analysis of competition among ideas and for new strategies for the optimization or suppression of their spread," she said. "We now know there is no need to assume different intrinsic values among ideas in explaining the massive diversity in the popularity and persistence of memes. At a statistical level, it is competition for limited attention and the social network that can provide the answers."

To identify the extreme diversity of behavior that allows some memes to become popular and persistent while the vast majority die off quickly, the team developed a meme diffusion model with agents (users) that maintained time-ordered posts, each about a specific meme. Neighbors received new memes, a memory mechanism allowed agents to develop interests and focus, and limited attention was included by allowing posts to survive on agents' lists for a finite time period. A retweet model was also employed, and then simulations were conducted taking into account the novelty and number of retweets along with the diversity of user interests, all of which came from the Twitter data.

By scaling down the social network to correspond with a subset of the overall user group (12.5 million users/1.3 million hashtags) and simulating stronger or weaker competition for limited attention by modulating the time that posts were allowed to be retained by agents, the team was able to develop a model focused solely on competition mechanisms that allowed for the evaluation of making attention more scarce or abundant.

More information: Co-author with Weng, Menczer and Flammini on "Competition among memes in a world with limited attention" was Alessandro Vespignani, Sternberg Distinguished Professor of Physics, Computer Science and Health Sciences at Northeastern University.

Provided by Indiana University