

What social media data could tell us about the future

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Can a flow of information across Twitter signal when a momentous event is about to occur? Northeastern's Alessandro Vespignani and an interdisciplinary group of scientists developed a method to find out. Their findings represent an initial step in constructing models to detect trouble before it's too late. Credit: YoungHee Jang/Northeastern University

Northeastern's Alessandro Vespignani, Sternberg Family Distinguished University Professor of physics, computer science, and health sciences, has teamed up with an interdisciplinary group of scientists to develop an innovative method to map how tweets about large-scale social events spread. Using massive twitter datasets and sophisticated quantitative measures, it tracks how information about political protests, large business acquisitions, and other "collective phenomena" gather momentum, peak, and fall over time, from city to city, and where the impetus comes from for that trajectory.

The findings, published Friday in the journal *Science Advances*, is only a first step, notes coauthor Nicola Perra, a former research associate at Northeastern's Network Science Institute. But knowing the characteristics of that buildup could, in

the future, enable us to prepare ahead of time for undesirable repercussions from such events, with implications for crises from earthquakes to power-grid failures.

"A lot of people have analyzed social media in terms of the volume of tweets regarding particular phenomena such as the Arab Spring," says Vespignani, who is also the director of the Network Science Institute. "What we are trying to understand is the presence of precursors: Can we find a signal in the flow of information that will tell us something big is about to happen? That's the multimillion-dollar question."

Borrowing from neuroscience

In an interdisciplinary leap, the researchers turned to network modeling in neuroscience to conduct the study. "For the brain we map based on physiology, and for social aggregates, like those in this paper, we map on geography," says Vespignani.

In neuroscience network modeling, the "nodes," or centers of activity, are functional brain areas—say, the motor cortex, which is responsible for movement—and the "links" connecting the nodes are neural circuits. For example, the circuits connecting the [motor cortex](#) to the auditory cortex, which is responsible for hearing, trace a neural pathway, or "link," that enables us to tap our foot to a beat and even dance.

In this new, social-events study, the nodes are cities—for example, Madrid and Barcelona in the researchers' analysis of twitter transmission during the 2011 Spanish anti-austerity movement—and the links are the pathways the tweets take over time.

Consider the Spanish protest, which later sparked the Occupy Wall St. movement in the U.S. The tweets gained in volume and intensity until, says Vespignani, they reached a "social tipping point of collective phenomenon" on May 20, 2011. "You

create a system that starts from a few nodes that then drive others, and so on, until everybody is talking to everybody else in a full coordination of the information," he explains.

The quantitative identification of those drivers sets this new method apart from other approaches to tracking [social media](#), says Perra, who is now a senior lecturer at London's University of Greenwich. "It enables us to understand which city is driving the conversation when and to characterize the dynamics of the spread."

"Before you can develop a method to predict future events," he adds, "you need a quantitative understanding of the communication patterns that shaped past events."

Looking to the future

Laying the groundwork for predictive studies is what Vespignani and his colleagues are attempting to do with this analysis of five major social events: the 2011 protest in Spain; the 2013 protest in Brazil, known as the "Brazilian Autumn"; the release of a Hollywood blockbuster in 2012; and Google's acquisition of Motorola in 2014.

"Everyone wants to predict when the next big event is going to be, what will trend in the future," says Perra. "We are, as a research community, in the early stages of understanding this type of phenomena. There is very little understanding of even past events, so we are very far from prediction. But in the future our findings may lead us to that."

More information: J. Borge-Holthoefer et al. The dynamics of information-driven coordination phenomena: A transfer entropy analysis, *Science Advances* (2016). [DOI: 10.1126/sciadv.1501158](https://doi.org/10.1126/sciadv.1501158)

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