Understanding the spread of behavior: How long-tie connections accelerate the speed of social contagion

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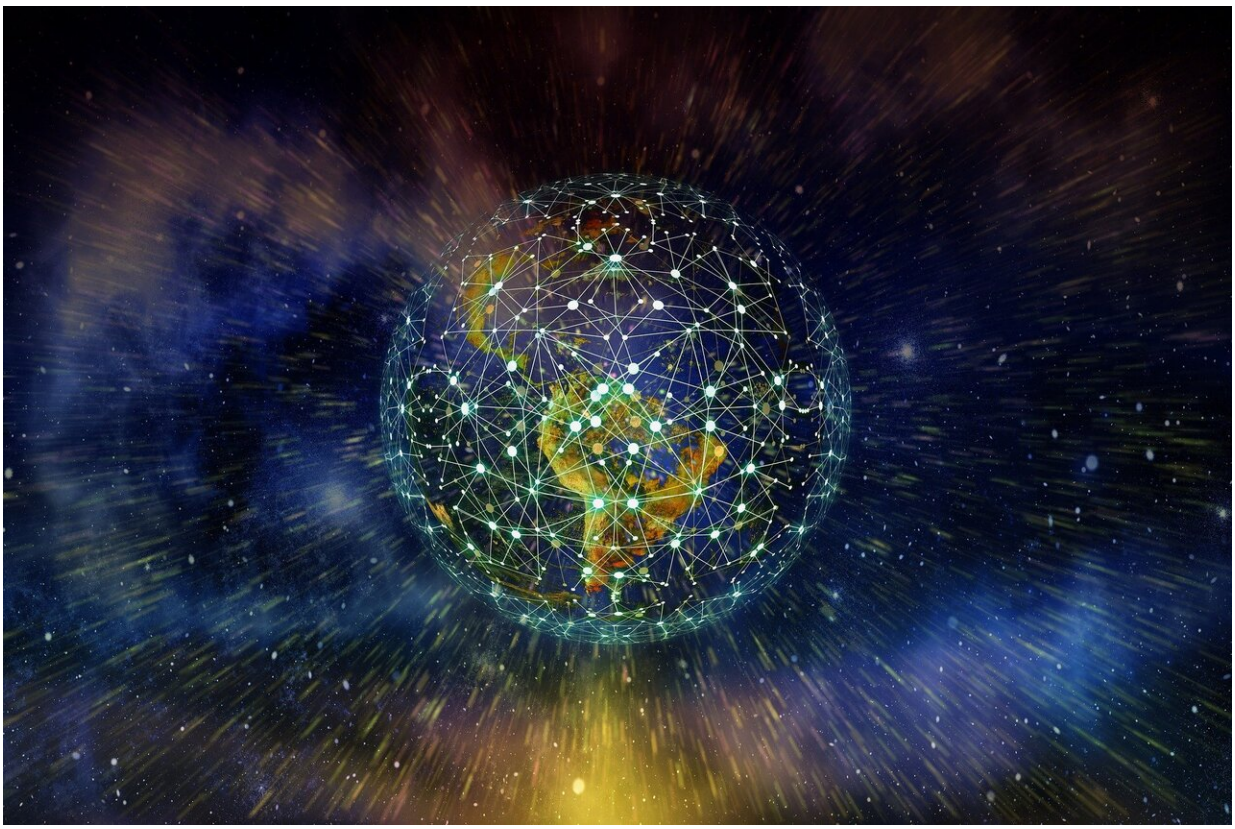

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Human beings are likely to adopt the thoughts, beliefs, and behaviors of those around them. Simple decisions like what local store is best to shop

at to more complex ones like vaccinating a child are influenced by these behavior patterns and social discourse.

"We choose to be in networks, both offline and online, that are compatible with our own thinking," explained Amin Rahimian, assistant professor of industrial engineering at the University of Pittsburgh Swanson School of Engineering. "The social contagion of behavior through networks can help us understand how and why new norms, products, and ideas are adopted."

Initially, researchers thought highly clustered ties that are close together in networks created the perfect environment for the spread of complex behaviors that require significant social reinforcement. However, Rahimian, alongside a team of researchers from Massachusetts Institute of Technology (MIT) and Harvard University, counter these ideas.

Long ties, which are created through randomly rewired edges that make them "longer," accelerate the spread of social contagions. For example, in the age of social media, long ties can facilitate broader reach across different demographics and heterogeneous populations. Rather than just communicating with one's neighbor, one may also be connecting with someone in another state—even another country.

By using mathematical and statistical methods, the researchers were able to analyze the rate of spread over circular lattices with long ties and show that having a small probability of adoption below the contagion threshold is enough to ensure that random rewiring accelerates the spread of these contagions.

"Mechanisms that we identify for spread on circular lattices remain valid in higher dimensions," explained Rahimian.

Similar network dynamics arise in the study of neural activity in the

brain.

"We are interested in the implications of these results for a better understanding of network structures that facilitate the spread of bursting activity in various brain regions," explained Jonathan Rubin, professor in Pitt's Department of Mathematics.

This research suggests those wanting to achieve fast, total spread would benefit from implementing intervention points across network neighborhoods with long-tie connections to other network regions, explained Dean Eckles, associate professor of marketing at MIT.

"Further work could study such strategies for seeding complex behaviors," Eckles continued.

The paper, "Long ties accelerate noisy threshold-based contagions," was recently published in *Nature Human Behavior*.

Other researchers on the project include Elchanan Mossel, Professor of Mathematics at MIT, and Subhabrata Sen, Assistant Professor of Statistics at Harvard University.

More information: Dean Eckles et al, Long ties accelerate noisy threshold-based contagions, *Nature Human Behaviour* (2024). DOI: 10.1038/s41562-024-01865-0

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