



# SFI TRANSMISSION

## COMPLEXITY SCIENCE FOR COVID-19

**STRATEGIC INSIGHT:** We can use social media data to detect signatures of global crises, including early warning signs.

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*“The oldest and strongest emotion of mankind is fear, and the oldest and strongest kind of fear is fear of the unknown.”*  
—H.P. LOVECRAFT

Our global crisis has produced a variety of personal and larger social responses, from social unrest to widespread fear. My colleague Juan Pablo Cardenas (Net-Works, Chile) and I have been studying the spread of fear and social unrest by analyzing social media in crisis contexts, particularly around the COVID-19 pandemic.

Our research examines the correlation of crisis-related behaviors with geographic isolation, group size, and other factors. This should give us an idea of the characteristics, perhaps universal, that occur in these types of tumultuous events — whether massive shifts in employment from one sector to another or political protests in response to a government’s handling of a pandemic.

Few concepts have such diverse connotations as crisis. Current approaches that help to define the concept — from different fields such as epistemology and the social sciences— tend to deal with its negative connotations. Putting less emphasis on value and greater emphasis on quantification can contribute to a more general understanding of the phenomenon.

Our working hypothesis is that crises are manifestations of dynamics in all adaptive systems linked to the constant and spontaneous increase of the system’s complexity or internal information. We approach these concepts rigorously using large datasets and network science.

Based on the analysis of a large social dataset of communication events on Twitter, our analysis demonstrates that periods of greatest activity (a fully developed crisis) coincide with an increase in the number of nodes in a network of conversations as well as an increase in the number of components (maximal connected sub-graphs). Non-technically, this

means that there are significantly more conversations and that these become increasingly structured around a common set of themes.

A crisis is therefore characterized on the one hand by a combination of more intense and more concentrated activity. On the other hand, tweets (in the case of social media data) during a fully developed crisis tend to be addressed to specific users — whereas in periods of low crisis, tweets tend to involve messages of lower specificity and greater reach (i.e., opinions are less binding).

These are just a couple of ways in which we can explore quantitative network properties that reveal features of crisis behavior, and that in some cases could provide early warning signs of an impending crisis. In a couple of our studies — *Social Crises: Signatures of Complexity in a Fast-Growing Economy*<sup>1</sup> and *Social Crises: A Network Model Approach*<sup>2</sup> — we found early warning signs more than a year in advance of the deep social crisis in Chile that began in October 2019.

With respect to early warning signs, we have been very interested in the larger question of how an ongoing social crisis like the one in Chile relates to the crisis of COVID-19. Another set of deep questions relates to how history influences outcomes. In a dynamic system, this is called *hysteresis*; we are only now exploring how history modifies future behavior.

To pull together relevant research on these outstanding questions, I launched a Research Topic in the open-access journal *Frontiers*, dedicated to “Social Crisis.” All are welcome to take a look and see if it has any value to them.<sup>3</sup>

**The deadline for abstracts is August 12, 2020, with manuscripts due by December 12, 2020.** By sharing research and information, we can begin to answer the many questions that remain in relation to how fear and social unrest interact across social media, and how to find the signal in all the noise.

## REFERENCES

1 <https://doi.org/10.1155/2018/9343451>

2 <https://doi.org/10.1016/j.physa.2018.03.031>

3 <https://www.frontiersin.org/research-topics/12491/social-crisis>

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