Researchers use science to predict success

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Distinguished professor Albert László Barabási is director the Center for Complex Network Research, where his team is using network theory to answer a variety of research questions. Credit: Mary Knox Merrill

We all want to know the secret to success and physicists are no different. Like the rest of the academic community, physicists rely on various quantitative factors to determine whether a researcher will enjoy long-term success. These factors help determine everything from grant approvals to hiring decisions. The only problem with this method, according to Distinguished University Professor of Physics Albert-

László Barabási, is a known lack of predictive power.

Impact factor, for example, is a measure of a scholarly journal's impact on the field over time while the Hirsch index quantifies an individual researcher's success. While these models do a good job of representing past accomplishments, they are not able to predict the future for young researchers and new papers.

In a paper released Thursday in the journal *Science*, Barabási—a world-renowned network scientist who has joint appointments in the College of Science and the College of Computer and Information Science—and his team at Northeastern's Center for Complex Network Research offer a new mathematical model for quantifying impact that goes a step further in its ability to forecast long-term success.

"Novelty and importance depend on so many intangible and subjective dimensions that it is impossible to objectively quantify them all," write the study's authors. "Here, we bypass the need to evaluate a paper's intrinsic value."

The team examined the citation histories of thousands of scholarly physics articles published between 1893 and 2010, hoping to find some patterns. "At first what we saw was true chaos," explained Barabási. Some articles met with plenty of attention in the first year after publication but interest quickly fell thereafter, others took four or five years before nose-diving, while still others never experienced a spike.

To sort through this apparent disorder, the team identified three mechanisms that seemed fundamental to the way a paper generates citations: its originality, its age, and the number of citations it has already accrued.

The team translated each of these concepts into a mathematical equation and then combined the results to create a new model for representing citation patterns over the course of a paper's lifetime. The new model successfully matched the citation history of every one of the 463,348 papers they examined.

Unlike any of the existing impact measures out there, Barabási's new model has the added functionality of being able to predict long-term citation histories based on just the first few years of data. The findings—which the team validated in fields beyond physics, including biology, chemistry, and the social sciences—provide a new, arguably more effective, tool for quantifying academicians' success.

The research continues Northeastern's groundbreaking work in network science. For instance, Barabási is also working to build the human diseasome—a network of cellular and genetic interactions that will help scientists better understand the causes of all kinds of illnesses and ailments. Researchers are also using network science to study politics, social media, and the spread of epidemic contagions. And this summer, Northeastern launched the nation's first doctoral program in network science.

More information: www.sciencemag.org/content/342/6154/127.short

Provided by Northeastern University

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