

Attention, please -- how innovations and Nobel Prize winners make it

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"The rich-get-richer effect," is famous not only in sociology. It applies to the success of innovators as well. But if attention is paid only to people who are already at the top, how are scientific revolutions possible? A new publication investigating careers of Nobel Prize winners gives insight into this stunning phenomenon.

"Attention is a scarce resource in today's society," says Dirk Helbing, professor at ETH Zurich, and Bernardo Huberman, Director of the Social Computing Lab at HP, immediately adds: "We live in a world where [information overload](#) is normal. Attention is precious. The money goes where the attention is. And often people are willing to trade money for the attention of others." Hence, understanding the laws of attention economics is a prerequisite of success.

As a new study of publications of Nobel Prize laureates shows, the same is true for scientific achievements. Success in science is measured in [citations](#). That is, the more citations by others a researcher collects in important journals, the more acclaimed he is. In a sense, citations are for scientists what bonuses are for bankers, or, likewise, what applause means for artists.

Boosting Nobel Prizes

Information overload is known in science as well. The amount of publications exceeds by far the amount of what a researcher can read in

his whole life. Additionally, scientific fields of research are usually dominated by a few outstanding scientists that attract most of the attention. In this almost hostile environment, how can unknown researchers bring about a [paradigm shift](#)? How are groundbreaking discoveries feasible at all?

A recent publication by the teams of Dirk Helbing of ETH Zurich and Santo Fortunato of the Institute for Scientific Interchange (ISI) in Turin throws light on this matter. In their paper, the researchers investigate several million citations in the scientific area, references to Nobel Prize laureates in particular.

"Remarkably, innovations are able to overcome the rich-gets-richer dynamics," Helbing says. The explanation of this phenomenon is based on a new key parameter, the so-called boost factor. "Sometimes, a paper gets cited overwhelmingly often and thus overcomes the rich-gets-richer effect. We then see citation cascades," Helbing says. These papers are called landmark papers. The boost factor represents a powerful instrument in accurately describing the careers of researchers. Its peaks precisely indicate the landmark papers.

New Talents

Citations have become a widespread method to measure scientific excellence. For example, they are frequently used in academic recruitment procedures. Furthermore, they play an important role in university rankings and for the distribution of funds among scholars and scientific institutions. However, the boost factor proposed by the teams of Helbing and Fortunato goes beyond the indices that are commonly used in its sensitivity to identifying landmark events: The sharp peaks allow one to identify scientific breakthroughs and talents much earlier than through classical citation analysis. The authors propose that the boost factor could be used together with other measures to evaluate the

performance of scientists.

Interestingly, the boost factor also shows that, when a groundbreaking paper receives abundant attention, the scientist's body of work overall enjoys a greater impact. A specific paper thus influences even the success of publications in the past. The benefitting pieces of work do not even have to be from the same area of research.

"Similar feedback effects are likely to affect the influence of a politician, or the price of a product," suggests Helbing. "Otherwise brands would not be so important."

A Self-organized Critical System?

Interestingly, the statistical distribution of the peaks of the boost factor looks like a power law. This suggests that the boosts may reach any possible size. "In fact, we observe everything, from small cascades that reflect quasi-continuous scientific progress all the way up to scientific revolutions, which change our perception of the world fundamentally," says Helbing. Nobel Prize winners, for instance, usually have a significantly larger boost compared to other scientists.

This power law behavior indicates that science undergoes phase transitions, where sudden systemic shifts occur. For example, new scientific concepts such as Quantum Mechanics or Einstein's Theory of Relativity may be understood as paradigm shifts. Furthermore, the scientific system seems to drive itself toward the tipping point, where citation avalanches occur on all scales. "It's only for this reason that innovations sometimes have a chance to overcome established paradigms," concludes Helbing.

More information: Mazloumian A, Eom Y-H, Helbing D, Lozano S, Fortunato S (2011) How Citation Boosts Promote Scientific Paradigm

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