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Learning from our mistakes

David Tempest
Elsevier

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The value of bibliometric measures



Learning from our mistakes

DAVID TEMPEST

Human discovery, scientific and otherwise, has always been moved forwards in response to the positive and negative outcomes of our experiences. The experimental nature of scientific research, based on the testing of hypotheses, implies a distinct possibility of negative results to our experiments. The very essence of science is based on using both positive and negative results as steps along the continuum.

Medical and scientific theories are developed over time as new research challenges and builds upon received wisdom. For instance, medical research has overturned the assumption that conditions like scurvy and beriberi are caused by infection, finding that they are actually a symptom of vitamin or hormonal deficiency due to malnutrition.

However, there is a growing feeling in the research community that publishing negative results, despite their scientific value, can be damaging, and many are choosing not to submit such findings to journals.

Publishing negative results

Much research does result in negative findings, and these are rarely published. However, prior knowledge that a particular hypothesis or experiment leads to a negative result could help other researchers modify their experiments or save time in reproducing this event. In an article in *Nature*, Jonathan Knight has asked whether scientific progress is being hampered in some areas by this practice (1).

William F. Balistreri, MD, Editor-in-Chief of *The Journal of Pediatrics*, says: "We agree with the International Committee of Medical Journal Editors (ICMJE). They have made a **clear statement** regarding the obligation to publish negative studies: 'Editors should consider seriously for publication any carefully done study of an important question, relevant to their readers, whether the results for the primary or any additional outcome are statistically significant. Failure to submit or publish findings because of lack of statistical significance is an important cause of publication bias.'

"*The Journal of Pediatrics* serves as a practical guide for the continuing education of physicians who diagnose and treat disorders in infants, children and adolescents. We seek original work, which undergoes peer-reviewed scrutiny overseen by the Editorial Board, and have accepted articles that clearly documented a lack of efficacy of therapeutic agents or procedures. We believe that evidence-based medicine must be based on the best evidence."

Spectacular blunder

Polywater was initially described in 1962 as a new form of water generated from regular water inside glass capillaries. Polywater was believed to have different properties to normal water, including a significantly higher boiling point (three times that of water) and a higher level of viscosity. This led to considerable research for several years until it was eventually confirmed that Polywater was actually normal water containing impurities that were so concentrated that they significantly affected the properties of their solvent – i.e. water. Polywater is rather a large negative result and *World Records in Chemistry* has described it as a "spectacular blunder" (5).

In an attempt to encourage researchers to publish negative results, BMC launched the *Journal of Negative Results in BioMedicine* in 2002. This journal publishes research that covers: "aspects of unexpected, controversial, provocative and/or negative results/conclusions in the context of current tenets, providing scientists and physicians with responsible and balanced information to support informed experimental and clinical decisions."

The polywater effect

The effects of negative results and wide-scale research failures have also caught the attention of the scientometric community. The polywater (see box) research front has been analyzed both bibliometrically and econometrically to assess its impacts on citation activity and economics.

In two papers published in *Scientometrics*, Eric Ackermann followed the progression of polywater research, demonstrating that seminal papers published in 1962 led to an "information epidemic" that proliferated through the literature and peaked in 1970 with over 100 articles (2, 3). Ackermann found 445 papers on polywater between 1962 and 1974. The research penetrated numerous disciplines, with 85% of papers appearing in five subject fields: nuclear science and technology, physics, multidisciplinary science, electro-chemistry and analytical chemistry.

Ackermann's findings show how rapidly a new research front can spread and how readily researchers alter their own direction in the light of seminal papers, regardless of whether the research carried out turns out to be true or not.

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The impact of negative findings

More recently, Arthur Diamond has analyzed the career consequences for researchers who worked in polywater research (4). In an article in the *American Journal of Economics & Sociology*, he benchmarks key data on researchers who published on polywater against those who did not. Diamond concludes that “choosing a mistaken research project results in fewer future citations”, and he suggests that these researchers may have suffered a loss in financial income due to these apparently lower citation counts of around \$15,000.

While Diamond adds that it is difficult to generalize to other cases, those involved in the polywater research were clearly affected. Commenting on this research, Diamond says: “Non-publication of negative results biases us toward positive results in economics, as in medicine, and elsewhere. This slows the advance of knowledge and reduces the soundness of policy advice.”

In addition, as Robin Hanson has pointed out in a Blog on the [OvercomingBias](#) website: “Once polywater was considered a failure, not only were those who had written in its favor punished, but those who had written against it were punished just as strongly.”

Clearly, if researchers believe that their career could suffer for following the “wrong” research question or for discovering that a particular line of enquiry leads to a negative result, they will choose to only publish their positive results. However, the impact of this trend on the progression of science could be extremely damaging. Negative results are an important part of the journal literature, showing us not only where we are going right, but also where we are going wrong. We need to be able to learn from our mistakes as well as our successes.

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