

LETTERS

Edited by Jennifer Sills

Editorial retraction

ON 7 MAY 2004, *Science* published the Report “RNA-mediated metal-metal bond formation in the synthesis of hexagonal palladium nanoparticles” by Lina A. Gugliotti, Daniel L. Feldheim, and Bruce E. Eaton (1). After an investigation by the U.S. National Science Foundation’s (NSF’s) Office of Inspector General, NSF did not find that the authors’ actions constituted misconduct. NSF nonetheless concluded that they “were a significant departure from research practices” and “a misrepresentation of data on which a conclusion was based” (2). In response to the NSF ruling, author Feldheim sent wording for a correction to *Science*. However, the Editors do not think a correction is appropriate given the concerns raised by the Inspector General’s report about what evidence was available to support the authors’ assertions at the time the paper was published. Hence, *Science* is issuing this Retraction instead. Author Gugliotti could not be reached for her concurrence in this matter. Authors Feldheim and Eaton do not agree to this Retraction.

Marcia McNutt

Editor-in-Chief

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Social cost of carbon: Domestic duty

THE NATIONAL ACADEMIES of Sciences have assembled a committee to review the economic aspects of climate change in order to better estimate the social cost of carbon (SCC) (1). The SCC is an estimate in dollars of the long-term damage caused by a one-ton increase in global carbon emissions in a given year. Although the SCC oversimplifies a dauntingly complex reality, agreement on an SCC is necessary for cost-effective emissions controls (2). A key question is whether the SCC should reflect social costs to the United States or the entire world.

In 2013, an interagency group established the current federal SCC values—\$43 per metric ton of CO₂ in 2020 assuming a 3% discount rate—based on the estimated



Cost-effective emissions controls depend on calculating the domestic and global social costs of carbon.

global SCC (3). Regulatory agencies use this global SCC as the sole summary measure of the value of reducing greenhouse gas emissions and compare it with estimates of domestic costs. This approach conflicts with long-standing federal regulatory policy directing agencies to issue regulations only upon a “reasoned determination” that the benefits “justify” the costs (4–6). A decision to issue a regulation with substantial domestic costs based on a finding that benefits to foreigners “justify” such costs would be irregular at best. Even with explicitly stated altruistic or strategic motivations (7), analyses that present only global benefits of regulations to reduce U.S. emissions would be misleading.

The federal government has a duty to inform Americans about the reductions in domestic climate damages that may result from federal regulation. The current approach of reporting only the global benefits neglects that duty. The National Academies of Sciences should refocus regulatory analysis of U.S. regulations on their domestic effects by recommending the use of a domestic SCC and supporting separate reporting of estimates of effects beyond the United States.

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False positives are statistically inevitable

IN HIS NEWS story “Reproducibility in psychology” (18 December 2015, p. 1459), J. Bohannon reports on the progress researchers in the field of psychology have made in implementing the practice of reproducing experimental results. He points out that preregistration—a procedure in which researchers first specify their hypotheses and methods and then publish the results of their analyses regardless of outcome—has helped achieve reproducibility goals. This type of methodology can help minimize poor statistical practices, such as doing multiple tests on data and only reporting those that are statistically significant. However, Bohannon’s conclusion that “[i]f everyone followed that protocol, false positives might all but disappear from journals” is a bit overstated.

In the absence of poor statistical practice and pressures to find and publish statistically significant results, the rate of false-positive results should correspond to the experimenter’s choice of test significance level, typically denoted as α . For a statistical test in which the conventional choice of $\alpha = 0.05$ is used, one would expect 5% of experiments to generate spurious “significant” results, and the probability of independently reproducing a false-positive experiment result at the same significance level is $0.05 \times 0.05 = 0.0025$. Under these conditions, this means we can expect that one-quarter of one percent of the experiments will have a false-positive result in the original experiment as well as a false positive in the reproduced experiment, thus seemingly confirming the original erroneous result.

Although this seems like a very small chance, leading to the suggestion that false positives “might all but disappear,”

the observed number of false positives is also a function of the number of scientific publications, which by one estimate in 2006 was 1.35 million articles (1). Others have estimated that the scientific output may double every 10 years (2). If correct, there could be 2.7 million or so scientific papers published in 2016.

So, imagine if half of all papers published in 2016 (about 1.35 million) contained the results of exactly one statistical test conducted at a significance level of $\alpha = 0.05$, and if every one of those tests was reproduced, then we would expect to observe around 3375 “confirmed” spurious results ($0.0025 \times 1,350,000 = 3375$). Of course, that is much better than the 67,500 false positives in the original papers ($0.05 \times 1,350,000$), but it is rather larger than “all but disappear.”

Reproducibility is clearly important, and we should support and encourage those who promote it—across all fields, not just psychology—as a crucial part of the scientific enterprise. In particular, moving away from publication standards based solely on the statistical significance of a single experiment or a single set of observed data to those based on evidence that observed

results can be reproduced is a critical change that we must make in the academic publishing culture. However, we must also recognize that, even within the most careful and rigorous experimental framework, erroneous conclusions are always possible. We should thus always maintain a healthy skepticism when assessing study results.

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Psychosocial factors key to healthy aging

I READ WITH great interest M. Kaeberlein *et al.*'s Review “Healthy aging: The ultimate preventative medicine” (4 December 2015, p. 1191). I agree that going beyond a disease-specific focus and “directly targeting aging” will be beneficial. However, Kaeberlein *et al.* focus on the biomedical aspects of this

challenge. The psychosocial components of aging should not be overlooked.

In a recent systematic review of qualitative studies examining what older adults considered to be “successful aging,” interviewees most commonly mentioned, and deemed most important, psychosocial components, such as social engagement, positive perspective, and personal growth (1). Just as it is important to go beyond a disease-specific focus to facilitate healthy aging, it is important to go beyond a strictly biomedical focus and to examine the ways in which psychosocial strengths can be fostered and quality of life improved. Augmenting models of translational geroscience to include psychosocial aspects of aging, such as social and emotional aging and resilience, will provide a more comprehensive perspective on aging. In addition to adding years to one's life, we must also work to add life to those years.

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