Open Science and Reproducibility: Understanding Good and Bad Science

Victor Ogada Otieno

Open Science has become an important movement in modern research. It encourages the sharing of data methods and results so that other researchers can review, verify, and build upon existing work (Bertram et al., 2023). At its core, open science is closely connected to reproducibility, which, in essence, is the idea that scientific findings should be repeatable by others using the same methods and materials. This essay explores the role of open science and reproducibility in distinguishing good science from bad science.

Good science is often characterized by transparency, honesty, and rigorous methodology. Robert Merton, a renowned sociologist of science, identified openness as a central value in the scientific process. He called this principle (communalism), meaning that scientific knowledge should be shared openly rather than kept secret for personal gain (Robert K. Merton., 1942). When scientists make their data and methods available to others, it helps build trust in research, increases accountability, and invites meaningful review.

On the other hand, bad science often results from secrecy, selective reporting, or poor methodology. Some researchers may publish results without providing access to their raw data or code. In such cases, others cannot verify whether the findings are accurate, biased, or even manipulated. (John Ioannidis, 2005), famously argued that “most published research findings are false” because of factors such as selective reporting, low statistical power, and confirmation bias. His work sparked global concern about reproducibility and encouraged reforms in scientific practice.

Open science directly addresses these concerns by requiring that publications include not just conclusions, but also the underlying processes that produced them. For example, open-access journals allow anyone to read research articles, and open-data repositories make supporting datasets publicly available. By allowing independent researchers to re-run analyses, test assumptions, and replicate experiments, open science stands as a quality check against bad science.

Reproducibility is often regarded as a fundamental test of scientific reliability (Mathur & Fox, 2023). As philosopher Karl Popper explained, scientific claims must be falsifiable, meaning that they can be tested and potentially disproven (Popper & Popper, 2005). If research findings cannot be reproduced by others, they fail this test and fall short of scientific standards. Good science accepts criticism and replication; bad science avoids scrutiny. A practical example comes from psychology research. In 2015, a large study led by the Open Science Collaboration attempted to replicate 100 published psychology experiments. They found that only about 36% of the studies produced similar results when repeated (Open Science Collaboration, 2015). This raised awareness that even fields with strong research traditions can suffer from reproducibility problems.

Open science also encourages collaboration across countries, disciplines, and institutions. When data and tools are openly shared, scientists from developing regions, who may lack funding or journal

access, gain equal opportunities to participate in global research. This democratization of knowledge strengthens science as a collective human effort rather than a closed club of elites (Mwelwa et al., 2020)

However, open science is not without challenges, just like any other venture that contributes to global knowledge sharing (Kohrs et al., 2023). Some researchers worry that sharing data may lead to their work being reused without proper credit. Others fear criticism or misinterpretation of their datasets. In some fields, such as medicine, the sharing of sensitive personal information complicates the process of data sharing. Yet, these challenges can be managed with ethical guidelines, data anonymization, and recognition practices (Diaba-Nuhoho & Amponsah-Offeh, 2021). Ultimately, good science is transparent, testable, and collaborative. Bad science conceals information, resists verification, and lacks transparency and accountability. Open science practices encourage the former and discourage the latter. They help restore public trust in research, support better policy making, and foster innovation through shared knowledge.

In conclusion, open science and reproducibility form the foundation of reliable and trustworthy research. By embracing openness, scientists strengthen the integrity of their work and contribute to a scientific culture that values honesty over prestige. The shift toward open science represents a positive move away from guarded, individualistic research and towards a cooperative model where knowledge benefits all.

References

Bertram, M. G., Sundin, J., Roche, D. G., Sánchez-Tójar, A., Thoré, E. S. J., & Brodin, T. (2023). Open science. *Current Biology*, *33*(15), R792–R797. https://doi.org/10.1016/j.cub.2023.05.036

Diaba-Nuhoho, P., & Amponsah-Offeh, M. (2021). Reproducibility and research integrity: The role of scientists and institutions. *BMC Research Notes*, *14*(1), 451. https://doi.org/10.1186/s13104-021-05875-3

Ioannidis, J. P. A. (2005). Why Most Published Research Findings Are False. *PLOS Medicine*, *2*(8), e124. https://doi.org/10.1371/journal.pmed.0020124

Kohrs, F. E., Auer, S., Bannach-Brown, A., Fiedler, S., Haven, T. L., Heise, V., Holman, C., Azevedo, F., Bernard, R., Bleier, A., Bössel, N., Cahill, B. P., Castro, L. J., Ehrenhofer, A., Eichel, K., Frank, M., Frick, C., Friese, M., Gärtner, A., … Weissgerber, T. L. (2023). Eleven strategies for making reproducible research and open science training the norm at research institutions. *eLife*, *12*, e89736. https://doi.org/10.7554/eLife.89736

Mathur, M. B., & Fox, M. P. (2023). Toward Open and Reproducible Epidemiology. *American Journal of Epidemiology*, *192*(4), 658–664. https://doi.org/10.1093/aje/kwad007

Mwelwa, J., Boulton, G., Wafula, J. M., & Loucoubar, C. (2020). Developing Open Science in Africa: Barriers, Solutions and Opportunities. *Data Science Journal*, *19*, 31–31. https://doi.org/10.5334/dsj-2020-031

Open Science Collaboration. (2015). Estimating the reproducibility of psychological science. *Science*, *349*(6251), aac4716. https://doi.org/10.1126/science.aac4716

Popper, K., & Popper, K. (2005). *The Logic of Scientific Discovery* (2nd ed.). Routledge. https://doi.org/10.4324/9780203994627

Robert K. Merton. (1942). *The Normative Structure of Science*. Retrieved November 27, 2025, from https://www.panarchy.org/merton/science.html?utm_source=chatgpt.com