A Funders' Tithe for Reproducibility Centers

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"Organized distrust produces trustworthy reports."
—Donald Campbell (1984)

Executive Summary

We propose a policy whereby large science funding bodies earmark a certain percentage of their allocated grants towards establishing and maintaining reproducibility centers. These specialized entities would employ dedicated teams of independent scientists to reproduce or replicate high-impact, high-leverage, or suspicious research. The existence of dedicated reproducibility centers with independent scientists conducting post-hoc, self-directed reproducibility, and replication studies will alter the incentives for active researchers throughout the scientific community, strengthening the body of scientific knowledge produced and increasing public trust in scientific findings.

Challenge and Opportunity

> *"In reality, mechanisms to correct bad science are slow, unreliably enforced, capricious, run with only the barest nod towards formal policy, confer almost no reward and sometimes punitive elements for a complainant who might use them."*
> *James Heathers (2019) in Vizare (2023)*

The reproducibility crisis in science is a pressing concern that threatens the foundation of scientific research. For example, a study by Camerer et al. (2018) attempted to replicate 21 social science results reported in high-profile journals, Science and Nature, and was able to reproduce 62% of the findings. Studies suggest that many published research findings may need to be revised, undermining the scientific endeavor's credibility and impeding progress. It is a challenge that necessitates immediate attention from all stakeholders, including funding bodies.

The responsibility for ensuring scientific reproducibility is primarily on individual researchers and academic institutions. However, reproducibility efforts are often inadequate due to limited resources, publication bias, time constraints, and the lack of incentives (Munafò et al. 2017). Furthermore, the burden of replication studies falls on individual scientists who may face challenges securing funding and encountering resistance to publishing non-confirmatory results (Vizare 2022). Junior scientists, who conduct most replication studies, are not rewarded for this activity on the job market and are currently strongly disincentivized from pursuing replication-focused careers (Vizare 2023).

Previous Efforts

Previous efforts to incentivize rigor and reproducibility in grant applications have primarily focused on pre-publication requirements, focus on transparency, disclosure, and open science principles rather than incentivizing or institutionalizing *actual replication*. For example, the NIH introduced a policy in 2018 that

requires grant applications to address issues of rigor and reproducibility explicitly. Other institutions like Stanford University also address these issues in their grant writing policies using a three-question framework.

A handful of existing centers are dedicated to open science and reproducibility, including the *Center for Reproducible Biomedical Modeling*, the *Center for Reproducible Neuroscience (Stanford)*, and *The Center for Open Science*. Still, none have institutionalized the practice of conducting independent, selective post-publication auditing of large bodies of scientific literature in the manner we propose.

Policy Proposal

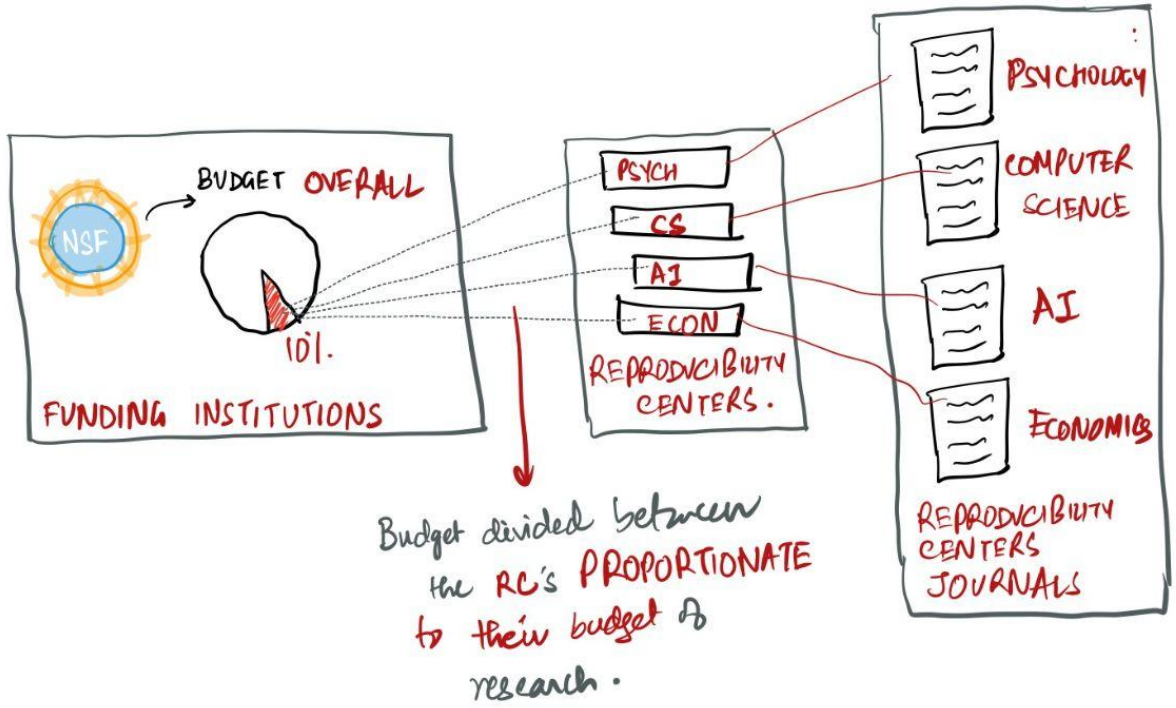

Figure 1: Example schematic of how a funder (NSF) might support the ecosystem of Reproducibility Centers. Image by Shambhobi Bhattacharya.

We recommend that major funders dedicate a 'tithe,' or approximately 10% of all outgoing science grants, to establishing and supporting field-level reproducibility centers. These independent, non-profit centers would be tasked with the critical job of verifying the accuracy of key scientific studies, enhancing the overall integrity of the scientific community, and fostering public confidence in scientific results.

The tithes from each funder would be directed to the field-level reproducibility center in proportion to the percentage of grantmaking activity they made in each field. In this manner, the funds available for reproducibility centers will align with the volume and expense of reproduction by field.

Each reproducibility center will operate independently and be given editorial discretion to select impactful or suspicious research for validation. The centers will employ highly skilled scientists across different domains who

can conduct rigorous reanalysis and replication of chosen studies. Field-level reproducibility centers will be empowered to self-organize internally, making cluster hires in areas of need and establishing centers of excellence in research methods that are particularly critical to verifying science within their fields. They will also be empowered to collaborate with centers in other fields to handle interdisciplinary research, and contract with private labs as necessary to meet specialty needs. Scholars employed at reproducibility centers will be held to the highest standards of ethical conduct and abide by strict conflict of interest protocols. This independence and autonomy will help ensure objectivity and limit the potential of biases and conflicts of interest from impacting the verification process.

Centers will conduct all replication and reproducibility studies in adherence to open science principles. All data, code, analysis, and results will be shared publicly in open-science repositories, and the results of all replication analyses and reproducibility studies will be published in an open-access journal maintained by each center. These open-access replication journals or other suitable online platforms will serve as a public record of each center's activity, circumventing existing journals' gatekeeping of corrections and retractions. While unsuccessful replications of existing work should increase the scientific community's skepticism of these findings, the center will also publish its successful replications, increasing the community's confidence in these results. We know that good science requires replication. This proposal incentivizes and institutionalizes it. In addition to facilitating the replication and reproduction of research findings, the proposed centers will establish a stable and rewarding career path for scientists interested in conducting replication studies.

Beneficiaries

This policy will yield widespread benefits for various stakeholders:

Scientific Community:

- Increased confidence in scientific findings: The centers can validate and replicate research findings, providing a higher level of confidence in the reliability of scientific knowledge.
- Identification of unreliable or questionable research: By independently examining and scrutinizing studies, reproducibility centers can identify and flag research that may be flawed or have uncertain results.
- Access to open science resources: Centers will adhere to available science principles and provide open access to data, code, analysis, and replication results, enabling scientists from different fields to access and use field specific and general resources for further research and verification.

Journals and Publishers:

- Improved credibility and quality control: Reproducibility centers can enhance the credibility of journals and publishers by validating and replicating the research in their publications, reducing the likelihood of published data being unreliable or irreproducible work.

Funding Agencies:

- Informed decision-making: Reproducibility centers can provide valuable insights to funding agencies by evaluating the reliability and reproducibility of proposed research projects, aiding in informed decision-making regarding allocating research funds.
- Accountability and transparency: Through these centers, the funding agencies will directly fund and support transparency and accountability research that undergoes rigorous replication and verification processes conducted by reproducibility centers.

Policy and Decision Makers:

- Evidence-based policy formulation: Reproducibility centers contribute to evidence-based policy formulation by verifying and replicating scientific findings that inform policy decisions.

General Public:

- Accurate and reliable scientific knowledge: Scientific knowledge disseminated to the general public is accurate and reliable, increasing public trust in scientific findings.
- A greater understanding of the scientific process: Through open-access repositories and publications, the public has insights into the scientific process and the importance of replication, fostering a better understanding of how science works.

Overall, reproducibility centers can benefit the scientific community, journals and publishers, funding agencies, policy and decision-makers, and the general public by promoting rigorous research practices, enhancing the credibility of scientific findings, and facilitating evidence-based decision-making.

Political Context

The proposal for reproducibility centers emerges within a political context marked by concerns over scientific integrity, evidence-based policymaking, resource allocation, and public trust. It responds to a growing reproducibility crisis and a desire to address issues of research misconduct and fraudulent studies, enhancing the credibility and transparency of scientific research. Politicians and policymakers seek to strengthen the evidence base for policy decisions, combat misinformation, optimize resource allocation, and rebuild public trust in science. The establishment of reproducibility centers aligns with these political goals by promoting accountability, transparency, and independent validation of research findings, ultimately aiming to improve the reliability and trustworthiness of scientific knowledge. Critically, this proposal institutionalized a key piece of the scientific ecosystem that will enable self-correction, and is currently and insufficiently handled to ad-hoc and unsustainable practices.

Anticipated Questions

Will this take away significant funding from original research? The proposed 10% tithe is a small fraction compared to the scale of potentially wasted funds misallocated because of non-reproducible research.

Furthermore, this initiative will increase the value and impact of the remaining 90% of funding by bolstering the robustness and trustworthiness of scientific research.

Is it feasible to replicate all research? While it is not practicable to replicate all studies due to resource constraints, the independent scholars working at these reproducibility centers will be empowered to select high-impact, high-leverage, or suspicious studies that most warrant reanalysis and replication. Furthermore, the known possibility of institutionalized, high-quality post-hoc evaluation of published all published research is intended to alter the incentives for all researchers, inducing greater compliance with sound research practices.

References

Camerer, C.F., Dreber, A., Holzmeister, F. et al. Evaluating the replicability of social science experiments in Nature and Science between 2010 and 2015. Nat Hum Behav 2, 637–644 (2018). https://doi.org/10.1038/s41562-018-0399-z

Munafò, Marcus R., Brian A. Nosek, Dorothy VM Bishop, Katherine S. Button, Christopher D. Chambers, Nathalie Percie du Sert, Uri Simonsohn, Eric-Jan Wagenmakers, Jennifer J. Ware, and John Ioannidis. "A manifesto for reproducible science." *Nature human behavior* 1, no. 1 (2017): 1-9.

Vazire, Simine, and Alex O. Holcombe. "Where are the self-correcting mechanisms in science?." *Review of General Psychology* 26, no. 2 (2022): 212-223.

Vazire, Simine, Where are the self correcting mechanisms in science? *International Conference on the Science of Science of Innovation.* Evanston, IL, 2023.

Note: this document was prepared with the assistance of OpenAI's ChatGPT tool running GPT-4.