Research integrity requires to be aware of good and questionable research practices

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Publications are at the epicenter of the academic system, be it for hiring, career advancement, or funding. The probability of getting a manuscript published in a scientific journal often depends on whether the results are significant, novel, or even "glamorous". Yet, this favoritism is difficult to justify from a scientific viewpoint. The purpose of science is to incrementally build knowledge. Knowing that a variable influences another variable is as important as knowing that this effect does not exist or is unclear. Moreover, the overemphasis on the findings of an article creates an incentive to submit results that are more likely to be accepted for publication, even if those results do not accurately reflect reality. Therefore, the nature of the results should not be considered when deciding whether a manuscript should be accepted or rejected. Such decisions would contribute to making questionable research practices (QRPs) irrelevant.

Questionable Research Practices

QRPs are the byproduct of the incentive to publish significant, new, and glamorous results. The term represents the grey area between outright fraud (e.g., creating false data) and being honestly unaware of committing research misconduct. Most scientists unknowingly commit QRPs because they are unaware why these practices are problematic. The use of QRPs harms science because they result in the publication of incorrect results rather than in the accurate confirmation of a phenomenon that reflects reality. In other words, QRPs provide misleading evidence that distorts our perception of the truth.

QRPs can take a variety of forms [1], such as insufficient blinding of participants, underpowered research ($1 - \beta < 90\%$), incorrect or inappropriate statistics, post-hoc hypothesizing, i.e., stating the hypotheses after the results are known (i.e., HARKing), collecting more data after seeing whether results were significant without reducing the alpha level, stopping data collection after achieving the desired result, failing to correct for multiple comparisons, manipulating data to meet a significance level (i.e., p-hacking), failing to report all tested dependent measures, failing to report all tested conditions, switching primary and secondary outcomes, selectively discarding nonsignificant results or results that are not consistent with the narrative of the article (i.e., cherry-picking), excluding data after looking at the impact of doing so, only publishing statistically significant findings or studies that "worked" (i.e., publication bias, file drawer problem), claiming to have predicted a finding that was in fact unexpected, or misleadingly reporting, interpreting, or extrapolating study findings to "beautify" them (i.e., spin).

In a study including 2,000 scientists, 63% of them admitted to having committed at least one QRP [1]. Another study including 6,813 academics showed that being a male PhD candidate or early-career researcher conducting empirical research increased the odds of frequently engaging in QRPs [2]. Although the prevalence of QRPs has not yet been established within rehabilitation research, there is no reason to believe that our field is immune to the issues faced by other fields. The outcome of this high rate of QRPs is a literature with an unreasonably high rate of positive results that misrepresent the true reality [3, 4], undermining the robustness of cumulative knowledge and delaying the improvement of clinical practice.

The pressure to publish, well-illustrated by the idiom "publish or perish", has been shown to drive the engagement in QRPs [2]. Conversely, lower engagement in QRPs is associated with the subscription to scientific norms, such as the desire for knowledge and discovery, not the possibility of personal gain, or the desire to put research materials (e.g., data, code) into the public domain so that they can be read and used freely by other researchers and the general public [2].

Reproducibility Over Novelty

What is important in science is reproducibility. For a study to be reproducible, it should provide enough details about the procedures and material used so that they can be repeated exactly (methods reproducibility) [5]. Results reproducibility (also called replicability [5]) is validated when the same procedures are followed in two different studies and the results are consistent. Reproducibility is essential to science because it provides information about the robustness of the findings and determines whether those findings can be safely used in clinical practice. Unfortunately, studies have shown that the prevalence of irreproducible preclinical research ranges from 51% to 89% [6]. By transforming the true nature of an experiment's findings, QRPs contribute to this irreproducibility in science.

Exploratory vs. Confirmatory Research

Empirical research can be exploratory or confirmatory, which is important to consider in order to reduce QRPs and improve the current publication system. The objective of exploratory research is to identify trends that could lead to the development of hypotheses, whereas confirmatory research addresses a specific theory-based research question using predefined hypotheses. Therefore, confirmatory research should ideally be registered [7] or published as protocol articles prior to data collection.

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This approach prevents changes to the original hypotheses and statistical plans after researchers have observed the data. This pre-registration can be done by filing hypotheses and analysis plans on independent registries such as clinicaltrials.gov or aspredicted.org that can be made public immediately or when the article is published. Another option to register a study is "Registered Reports" [8], an article format where a study proposal (introduction, methods, and pilot data) is reviewed and "in principal acceptance" (IPA) can be decided for the final article before data collection has begun, independently of results. Preregistered studies and Registered Reports do not diminish the importance of exploratory research, they enable to clarify what is exploratory and what is confirmatory in two different sections of the final manuscript. Importantly, the methods and analyses of Registered Reports are perceived as more rigorous by reviewers and of higher overall quality than standard articles with no detriment to the importance and creativity of the research [9]. Moreover, the effect of registration on QRPs is illustrated in a study on 55 randomized clinical trials published before or after the year 2000 [10], when prospective registration in clinicaltrials.gov became required in medicine. Results showed a significant benefit of intervention in 57% of the trials published prior to 2000 and only 8% of those published after 2000.

Transparency & Openness

Transparency is an important factor of good science that can be achieved by sharing material (e.g., data, code, software) on open access repositories (e.g., zenodo.org, osf.io) and by publishing open peer-reviews. These open research practices facilitate error detection and correction, minimize academic misconduct, eliminate duplicative efforts by others to recreate materials, and speed the progress of science. The idea of making data findable, available, interoperable, and reusable (FAIR principles) has recently received considerable support from journals and funding agencies (e.g., United States' National Institutes of Health [NIH], Canadian Tri-agency [NSERC, CIHR, SSHR], European Research Council [ERC]). However, the impact of this support is not yet evident in the literature. Moreover, data sharing statements such as "data available upon request" have proven ineffective in ensuring data sharing. Results from a study including 1,792 articles with data sharing statements showed that 93% of the authors did not respond or refused to share their data [11].

Another way to accelerate the progress of science is to upload the final version of a manuscript to a public "preprint" server (e.g., sportRxiv.org, medRxiv.org), prior to submission to a journal. These preprints allow for immediate dissemination of research findings, with authors retaining copyright on their work, and are free for authors and readers. Although some researchers consider the absence of peer-review and the multiplication of published versions of the same manuscript to be problematic, many national and international funding agencies consider preprints as a research output and an important vehicle for the dissemination of research results [12].

Redefining the Path to Prestige

The prestige of the journals in which scientists publish their research is a crucial factor for success. It is therefore important to realize that this prestige is determined by the scientists themselves, not by the publishers. If journals that implicitly support QRPs are considered prestigious, it is the scientists' responsibility. To correct this aberration, scientists should value reproducibility and transparency over novelty, and promote journals that uphold these values.

To empower scientists to make this cultural change and reshape academic incentives, funding agencies and academic institutions should develop policies that promote an accurate and wise evaluation of scientific outputs. In line with the San Francisco Declaration on Research Assessment (DORA) [13], these policies should banish the use of journal-based metrics (e.g., journal impact factors) and instead assess the impact and merit of individual articles, consider all research outputs (e.g., datasets, code, science communication), not only research publications, and use a broad range of indicators. These indicators may include reproducibility, transparency, contribution to community (e.g., peer reviews), social engagement (e.g., blogs, Twitter, podcasts), and influence on policy and practice.

Competing interests

Nil.

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Provenance

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