

Pre-registration and Registered Reports in Ecology and Evolutionary Biology: An Evidence-Based Appraisal by SORTEE

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Reviewed by the 2024 SORTEE Diversity, Equity and Inclusion committee and 2024 SORTEE Board of Directors

Summary

1. A pre-registration is a time-stamped, read-only research plan that is written prior to data collection and analysis. This practice aims to increase transparency and reduce questionable research practices (QRPs) such as p-hacking and HARKing. Registered Reports are an article format with two stage peer review, that integrates Pre-registration and peer review and aims to additionally reduce research waste and publication bias.
2. Cross-disciplinary evidence for the benefits of Pre-registration in terms of reducing QRPs is mixed; deviations from pre-registered plans often happen and are not disclosed, reducing their value in reducing QRPs.
3. There is much clearer evidence for Registered Reports reducing QRPs and publication bias, as well as increasing the quality of published articles.
4. There is no specific research on Pre-registration and Registered Reports in ecology and evolution, and uptake of the practices is currently very low.

What are Pre-registration and Registered Reports, and why are they important

There is considerable pressure on scientists to rapidly produce both innovative and significant results. Traditional publication practices favour statistically significant results (typically assessed using statistical measures, such as p-values). This is known as publication bias and leads to multiple unwanted effects. First, researchers may not try as hard to publish non-significant or null results, exacerbating the problem (also known as the file drawer effect; sensu [Rosenthal, 1979](#)). Second, in addition to distorting the evidence in the published literature, journal preference for significant results incentivises Questionable Research Practices (QRPs), and in particular, the selection of data and/or analyses that lead to significant p-values (p-hacking; [Simonsohn et al., 2014](#)) or the formulation of hypotheses after data analysis (Hypothesising After Results Known, or HARKing; [Kern, 1998](#)). These QRPs inflate effect sizes and increase false positive rates ([Ioannidis, 2005](#); [Forstmeier et al., 2017](#)). Finally, the combination of publication bias and the fact that a lot of published research is underpowered leads to an inflation of effect sizes ([Sterne et al., 2000](#)). This occurs because, at low power, only effect sizes larger than the true effect pass the significance threshold ([Button et al., 2013](#)), and these are more likely to be published ([Fanelli, 2012](#)). The scientific community has taken steps towards prevent-

ing these problematic practices while ensuring research quality. Two main approaches have been implemented: Pre-registration and Registered Reports. Both approaches aim to increase the transparency and robustness of scientific results, and reduce QRPs and misconduct.

A Pre-registration is a time-stamped, read-only research plan that is written (and either made public or embargoed) prior to data collection and analysis ([Wagenmakers et al., 2012](#)), for example, using the [Open Science Framework \(OSF\)](#). When researchers specify their hypotheses and produce a detailed analysis plan in advance, the opportunity to HARK and p-hack (whether consciously or not) is greatly reduced (assuming the pre-registered plan is followed), and deviations from the plan become more transparent. Although researchers can create a Pre-registration after conducting an analysis (intentional misconduct), this creates a higher bar for intentionally conducting QRPs, and so should reduce their incidence. In theory, the Pre-registration provides a means for the reviewers/readers to see the process of the conceptualization and implementation of the project. Deviations from the originally specified hypotheses, methods or analyses should be documented and justified in the subsequent manuscript ([Lakens, 2024](#); [Willroth & Atherton, 2024](#)).

Registered Reports effectively combine the concept of Pre-registration with the peer review process ([Chambers & Tzavella, 2022](#)). A Registered Report is a type of research article with two stages of peer review (Figure 1). In the first stage of review (Stage 1), the Introduction and the Methods sections of a manuscript are submitted to a scientific journal for peer review prior to data collection/analysis. After this first stage, articles are either given an in-principle acceptance (IPA) or rejected. The IPA guarantees that the article is published regardless of what results are found, as long as the authors conduct the research as laid out in Stage 1. By conducting peer review before the work is conducted, registered reports allow for any experimental design problems to be detected and corrected before the study is conducted. The IPA is designed to ensure that studies are published based on their scientific quality, irrespective of their results. Therefore, in addition to addressing the issues of p-hacking and HARKing, registered reports also reduce research waste and publication bias. After the study is completed, the whole manuscript is then submitted for Stage 2 review. At this stage, the editor and reviewers are able to check whether the study was conducted as planned, or if any deviations are described and justified. As both stages are reviewed, registered reports should also enforce adherence to the proposed analysis design, thereby reducing p-hacking and HARKing.

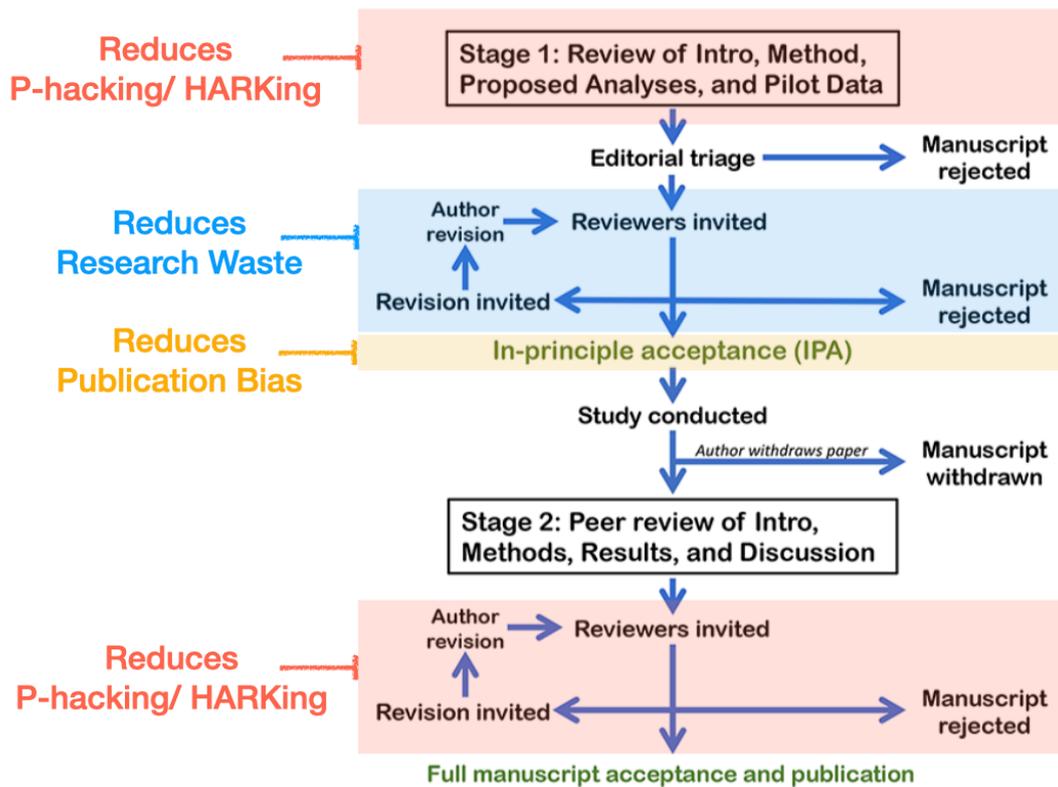


Figure 1: Registered Reports workflow, highlighting the stages at which different issues are addressed. Edited from the original version at <https://cos.io/rr/>

General research on the costs and benefits of Pre-registration and Registered Reports

A recent study provides evidence (predominantly in medical fields) that the increased adoption of Registration (including the practices of Pre-registration and Registered Reports) would make primary research more cost-effective by reducing research waste (Purgar *et al.*, 2024). Here, we separate out the costs and benefits of Pre-registration and Registered Reports specifically (note that study registration in medicine and economics is typically subtly different from Pre-registration and Registered Reports outlined above, with more emphasis on making sure there are records of all studies conducted, over pre-analysis planning and reduction of QRPs).

Costs and benefits of Pre-registration

Pre-registrations help researchers map hypotheses to a strategy of study design and data analysis, reducing the scope for p-hacking and HARKing. Studies have assessed these effects by comparing the effect sizes in Pre-registrations and standard articles

(which would be expected to be smaller in the absence of p-hacking, as p-hacking acts to inflate effect sizes; [Schäfer & Schwarz, 2019](#); [van den Akker et al., 2024](#)), as well as the proportion of positive results (which would be expected to be lower in the absence of p-hacking and HARKing; [Toth et al., 2021](#); [van den Akker et al., 2024](#)). The resulting evidence of the efficacy of Pre-registration is mixed. Importantly, the studies showing an effect of Pre-registration on these practices do not differentiate between Pre-registration and Registered Reports ([Schäfer & Schwarz, 2019](#); [Toth et al., 2021](#)), whereas the only study that considered Pre-registrations alone found no evidence that Pre-registration reduced these practices ([van den Akker et al. 2024](#); null results: 69% versus 68% (pre-registered versus not), effect size: 0.29 versus 0.36). The lack of evidence for effects may be explained by the lack of adherence of studies to their Pre-registration. Several studies have shown that Pre-registrations often lack specificity ([Heirene et al., 2024](#); [Brodeur et al., 2024](#)), which allows undisclosed flexibility at the analysis stage. Further research has shown low adherence to the Pre-registered plan, evidenced by changes in hypotheses ([van den Akker et al., 2023a](#)) and undisclosed deviations from an analysis plan ([Heirene et al., 2024](#); [Claesen et al., 2021](#); [van den Akker et al., 2023b](#)), suggesting the potential for p-hacking and HARKing. Interestingly, one study directly assessed p-hacking in pre-registered studies and showed that p-hacking was only avoided when a specific analysis plan (and in particular, a power analysis) was presented ([Brodeur et al., 2024](#)). There are likely other benefits to Pre-registration other than the reduction of QRPs. For example, [Sarafoglou et al. \(2022\)](#) showed that both researchers who have done Pre-registrations and those who have not, believe that Pre-registration results in (among other things) a strong increase in the quality of analysis plans, research hypotheses, and experimental design, with the disadvantages of a small increase in project duration and work-related stress. Pre-registration is also associated with an increase in sample size across studies ([Schäfer & Schwarz, 2019](#); [van den Akker et al., 2024](#)).

Costs and benefits of Registered Reports

In contrast to the mixed evidence for realising the potential benefits of Pre-registration, the positive impact of Registered Reports has been consistently documented. As noted above, studies jointly analysing Pre-registrations and Registered Reports have shown they present lower effect sizes ([Schäfer & Schwarz 2019](#); median of 0.16 in registered articles versus 0.36 in standard articles) and a lower proportion of significant results ([Toth et al. 2021](#); 48% in registered articles versus 66% in standard articles) compared with standard articles, consistent with a reduction in p-hacking and HARKing. When considering Registered Reports alone, comparisons of Registered Reports and standard arti-

cles have also shown a large reduction in the proportion of positive results ([Scheel *et al.*, 2021](#); 44% versus 96% and [Allen & Mehler 2019](#); 49.5% versus 80-95%). Furthermore, Registered Reports were rated as higher quality and more rigorous across all aspects of an article, when compared with standard articles by researchers ([Soderberg *et al.*, 2021](#)). Interestingly, whether a study is a Registered Report or not appears not to affect the credibility of the research to the public ([Costa *et al.*, 2022](#)).

General research on Pre-registration and Registered Reports in Ecology and Evolutionary Biology

There are no specific studies on the impact of Pre-registration or Registered Reports on studies published in Ecology and Evolutionary Biology (EcoEvo) journals, likely due to the current low uptake of the two practices (see below). However, EcoEvo are no exception when it comes to the prevalence of the aforementioned issues of widespread publication bias ([Fanelli, 2012](#); [Cassey *et al.*, 2004](#); [Yang *et al.*, 2023](#); [Kimmel *et al.*, 2023](#)), low power ([Fidler *et al.*, 2017](#); [Yang *et al.*, 2023](#)) and QRPs ([Fraser *et al.*, 2018](#); [Kimmel *et al.*, 2023](#)). This has led to a massive inflation of effect sizes in published literature ([Yang *et al.*, 2023](#); [Kimmel *et al.*, 2023](#)). Furthermore, it has been estimated that 45% of research in ecology is unpublished, and a further 67% of published literature is wasted due to poor study design ([Purgar *et al.*, 2022](#)).

Prevalence of Pre-registration and Registered Reports within Ecology and Evolutionary Biology

Despite efforts to increase their popularity over the past decade (e.g. [Parker *et al.*, 2016](#)), the uptake of Pre-registration and Registered Reports in EcoEvo has been slow. According to an informal survey, less than 1% of EcoEvo studies in 2023 included a pre-registration (J.L. Pick and E. Macartney, Unpublished), despite the calls for action. In social sciences, the uptake of Pre-registration and Registered Reports was also initially slow (0-3% in 2014-2017; [Hardwicke *et al.*, 2020, 2022](#)), but the practice is now becoming relatively common across many journals (0-25% in organisational behaviour journals in 2020, [Tenney *et al.*, 2021](#); 16% in political science in 2021, [Scoggins & Robertson 2024](#); 7-16% in psychology in 2022, [Hardwicke *et al.*, 2024](#)). Little is known in EcoEvo about the attitude of researchers towards Pre-registration and Registered Reports.

Diversity, Equity, and Inclusion Concerns with Pre-registration and Registered Reports

For Pre-registration to be effective, it has to be shared during peer review. As with other Open Science practices, without appropriate blinding, this could reveal the identity of the authors to the reviewers during double-blind review, giving an unfair advantage to authors working in higher-income countries (Fox *et al.*, 2023). Platforms such as the [Open Science Framework \(OSF\)](#) allow blinding of author identity and affiliation. Such concerns should not be an issue with Registered Reports, however, as the stage 1 review (on which IPA is based) can be fully blinded in the same way as a traditional manuscript submission, as it is all done via the same publishing platform.

Acknowledgments

We thank Alexa Fredston, Kaija Gahm, Friederike [freddy] Hillemann, Malika Ihle, Malgorzata [Losia] Lagisz, Rose O’Dea, Matthieu Paquet, Patrice Pottier, Easton White, and Coralie Williams for constructive feedback.

Conflict of Interest Statement

We believe there are no conflicts of interest. All authors are members of SORTEE. EIC was on the board of directors and was the 2025 President. SORTEE is sponsored by Peer Community In (PCI) and the Center of Open Science (COS); however, these organisations did not have a role in the creation of this appraisal. PCI runs a Registered Reports reviewing service (PCI-RR). However, this service is run for free by PCI, and so there is no financial gain, and we do not explicitly recommend (nor disapprove of) PCI-RR in this statement. COS hosts Pre-registrations on the Open Science Framework (OSF). Again, there is no financial gain for COS from Pre-registration submissions.

Funding Statement

This work received no funding.

CRediT statement

Conceptualization: JLP, ET. Writing - Original Draft: JLP, ET. Writing - Review & Editing: JLP, ET, KBN, EIC, DM, SN, JS. Project administration: JLP.

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