

Registered reports as an elegant means of improving research quality

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Sally French is a new health librarian, having joined the QUT Library Health Liaison team in 2020. While having no practical expertise in Registered Reports, she was inspired by the presentation delivered by Brian Nosek from the Center for Open Science to the 2019 AusHSI Research Quality Meeting.

Context

Issues in health research

For effective delivery of services, the public must trust the health care system. Public awareness of scandals in health and research creates outrage (Gille et al., 2021) because a reduction in trust can, among other things, harm the health of patients (Felix et al., 2015). Meanwhile, inside the research community, there is a crisis of reproducibility. Estimates of failure to reproduce results range from 60-90% of research (Baker et al., 2016). Additionally, approximately 85% of health research is avoidably wasted, with about half of funded research never published, and about half of published papers insufficiently written up to be useful (AusHSI, 2019).

The role of librarians

However, all stakeholders in research have some agency to improve the situation. For librarians, it is during our research and publishing consultations where we can advocate for improvements. Registered Reports provide an elegant solution to some of the problems raised above. Since 2018 there has been a jump in publications in this format (Fong et al., 2020), which indicates the research community is willing to engage in bettering the status quo.

Reward systems in research

Citations are the primary basis for rewarding research. Employment, career progression, funding, collaboration, and other opportunities use citation measurements as a proxy for regard, reputation or standing in the field (McKiernan et al., 2016). It is understandable that researchers will put effort into maximising their citation measures, as it is a necessary condition for continuing to research. However, several questionable research practices arise out of the pressure to maximise citation metrics.

Questionable research practices manifesting from incentivising publication and citation

Salami slicing

Salami slicing, or publishing small slices of research in different papers, inflates the author's publication count (Elsevier, 2019). When a study uses the same hypothesis, population, and method but the results are 'sliced' into smaller publishable units, the fragmenting of the research imposes extra costs on the research publishing system. Also, other researchers need to access more papers to get the comprehensive results from that research (Nature Materials, 2005).

Publication bias leading to scooping, p-hacking, and HARKing

Not all research is reported. People prefer stories that are new, have something significant happen, and that have a clear narrative (Scientific Reports, 2021). Publishers need to keep their business running, so are responsive to their markets. The resulting publication bias has led to an imbalance in research literature, where replication, null and statistically insignificant study results are not well represented, in turn affecting the information available to researchers to inform their own research work (Scheel, 2020).

Novelty, scooping and low statistical power

Being the first researcher to publish a discovery confers significant career advantages. These include eponymy (naming a discovery after the scientist who discovered it), financial prizes such as the Nobel Prize, publication in prestigious journals and promotions (Tiokhin et al., 2021). To speed up the research and publication process, researchers may resort to using smaller sample sizes, thereby scooping the rewards of publishing before their peers (Tiokhin et al., 2021). However, smaller sample sizes lower the statistical power of the results, a negative unintended consequence making research less reliable and harming reproducibility (Button et al., 2013).

Significance and p-hacking

P-hacking refers to the practices of changing the method of analysis or continuing to sample until results conform to a publishable outcome, one that appears significant. P-hacking appears to be widespread (Head et al., 2015). Deciding on sample sizes and analysis methods prior to data collection and analysis supports rigor.

Clarity and HARKing

HARKing is developing a Hypothesis After the Results are Known (Kerr, 1998). Because the results are known, a hypothesis can be developed that fits the data closely. This clarity promotes the likelihood of the report being published. It is legitimate to perform exploratory research to detect patterns. However, testing of the hypothesis is more legitimately performed on a different sample set (Kerr, 1998, p. 206).

How are Registered Reports different?

Traditionally, peer review occurs after the research has been performed, when the report is submitted to a journal for publication. If there are flaws in the method, it is too late to rectify them. The results are also considered by the editor in deciding acceptance, which drives publication bias. For Registered Reports, peer review happens in two stages, with in-principle acceptance for publication occurring prior to data collection.

Stage 1 review

The first stage is after the research question and method have been designed. The reviewers consider the validity of the research question and soundness of the method for investigating the question (Gray et al., 2021). If the protocol meets high scientific standards, it is in-principle accepted for the paper to be published. The reviewers can provide feedback, which allows the authors to improve their methods prior to collecting data (Reich et al., 2020). The relationship between reviewers and researchers becomes constructive and collaborative, improving the experience for both parties (Chambers, 2019). Researchers do not discover their efforts have been wasted after their research funding has been expended. Reviewers do not have to deliver the crushing news that a study has been conducted in vain.

Stage 2 review

The second stage of peer reviewing is when the research has been conducted and the report is submitted for publication. The same reviewers from Stage 1 return to assess the extent to which the researchers followed the protocol submitted at stage 1. The results of the research are not considered by the reviewers at all. Compliance with the protocol determines publication of the results: scientific integrity is rewarded. Despite the extra work a second stage of review entails, reviewers have responded enthusiastically to the Registered Report format, with a retention rate between the stages close to 100% (Chambers, 2013).

Conditions and Costs to using Registered Reports

Registered Reports suit hypothesis driven research. Purely exploratory research is not suited to this format (Chambers, 2019). Post-hoc hypothesis is permitted, but must be clearly delineated in the results section to differentiate it from HARKing (Chambers et al., 2014).

The Registered Reports model applies only to original research (Chambers et al., 2014) or for secondary analysis of existing datasets where the researchers have not had prior access to the data (Nature Communications, n.d.).

For unpredictable events where the researchers need to collect data as soon as possible Registered Reports are not suitable, as stage 1 review would hinder timely

data collection. Some examples would be events such as solar flares, black hole collisions, flash floods or mass violence (Chambers, 2019).

The additional rigor involved in committing to a methodology early in the research process takes extra time and effort. This extra start-up cost tends to increase the sample size (Tiokhin et al., 2021) which improves the statistical power of the results. One journal, the Journal of Psychiatric and Mental Health Nursing, has closed their Registered Reports section due to the lack of papers submitted and lack of good quality reports (Elliott, 2021). This highlights existing issues in research quality, rather than being a fault in the format.

To have true transparency, the in-principle accepted protocol needs to be published (Scheel, 2020), so the journal has extra content to accommodate.

Journals also have extra administration in managing two stages of review rather than a single review and maintaining the same reviewers for both stages. While peer reviewers should be well versed in good methodology, stage 1 review particularly highlights this requirement.

Positive outcomes to using Registered Reports

For researchers

The acceptance rate for Stage 1 reviews at Cortex journal is 90% - double that of conventional articles (Chambers, 2019). Registered reports are highly cited, on average exceeding the impact factor of the journal in which they are published (Chambers, 2019). These benefits provide incentives to researchers to be more rigorous in their methods. For early career researchers, in-principle acceptance at Stage 1 allows them to list a publication much sooner than they could for a conventional manuscript (Chambers, 2019).

For the research community

Publication bias appears to have been addressed, with Registered reports 3 times more likely to report null or negative findings (Warren, 2018). By granting in-principle acceptance, questionable research practices like p-hacking, HARKing or using small sample sizes are not incentivised (Reich et al., 2020). Registered Reports establish a new standard for evidence quality because they have a hypothesis that has been checked for flaws (Scheel, 2020). Registered reports also help with valuing research that tests predictive models, not just research that is generating new discoveries (Chambers et al., 2014).

In summary, by modifying the incentive structures for the researcher, researchers are supported in using more rigorous and transparent methods. This helps to address the crisis of reproducibility, which in turn contributes to the credibility of research

evidence with the public. Librarians' role in this can be to advise researchers about the benefits of using Registered Reports.

Resources that may be of particular use for librarians

One page flyer concisely explaining Registered Reports <https://osf.io/yp2um/>

Questionable research practices in the research cycle: Figure 1

<https://doi.org/10.3934/Neuroscience.2014.1.4>

Practical steps through a Registered Report: Figure 1

<https://doi.org/10.1016/j.tins.2019.07.003>

One page editorial summarising how Registered Reports can improve science

<https://doi.org/10.1038/s41598-020-79467-9>

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