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The registered reports revolution: Lessons in cultural reform

The rise of the “registered report” – a type of research article that is reviewed and accepted before results are known – offers lessons for the current debate surrounding p-values and significance. By Chris Chambers

On 12 November 2012, as my train sped towards London, I received one of the most important emails of my life. The message cordially informed me that the publisher of Cortex, a scientific journal that I had recently joined as an editor, had approved our request to launch a new type of article called a registered report.

The registered report format was unlike anything most journals had seen before. A month earlier I had written an open letter to my fellow editors arguing that to prevent publication bias and various forms of reporting bias, we should accept research articles before authors do their research. If the theory, proposed methods and analysis plans were judged sound then the journal would accept the paper in advance, putting an end to the suppression of negative results (or indeed any kind of result), and instead making editorial decisions based on the quality and rigour of the science (see Box 1).

The response from the board was mixed, but the chief editor saw the potential in the idea. “Imagine a sci[entific] article where [the] editorial decision is based on rationale, meth[od] & analysis plan BEFORE data is even collected”, I tweeted rather excitedly from the train (bit.ly/2RfOEby).

“Well it is happening, at the journal Cortex where I am an associate editor” (bit.ly/2R78g1g).

When I arrived at my destination, I had the chance to explain the concept over coffee to a professor who served on the editorial board of a prestigious psychology journal. I hoped, perhaps naively, that my pitch would light a spark and maybe we would have our second adopter of registered reports by lunchtime. After all, here was a format of article that would eliminate the pressure on authors to produce beautiful results while also maintaining the highest standards of quality, rigour and transparency. Authors would benefit from expert appraisal, at a point in time when it can be used to improve study design. Crucially, this could also include statistical review, promoting the statistician from Ronald Fisher’s famous analogy of a post-mortem examiner to the role of surgeon and fitness coach. Then, armed with pre-study acceptance from the journal, the scientist would be able to

pursue their research free from the anxiety that their results – the one part of the scientific endeavour that scientists are supposed to keep at arm’s length – would determine whether their article is eventually accepted for publication. Finally, once published, the community would benefit from a corpus of reliable, bias-free research. The concept seemed like a clear win for everyone. Indeed, it struck me as scientific publishing as it was originally intended, before concerns about reproducibility emerged.

The professor frowned. “Well, that would never work at my journal,” he intoned. “Why not?” I asked. “Because we would always need to see the results,” he shrugged. “Otherwise we would risk lowering our impact factor. Nobody wants to read papers with null or boring results. The impact factor matters to top journals.” I should not have been shocked, and in truth I was not, but the professor dragged me back from my utopian fantasy to the cold light of day. On the very day that registered reports came into existence, I had a preview of the opposition to come.

The inflationary phase

Having just one journal offer registered reports was never going to be enough, and so, in the months that followed, we lobbied hard for others to follow suit. In June 2013, we brought together over 80 journal editors and wrote a joint article in *The Guardian* (bit.ly/2Ra5k48). “[A]s a group of scientists with positions on more than 100 journal editorial boards,” we wrote, “we are calling for all empirical journals in the life sciences – including those journals that we serve – to offer pre-registered articles at the earliest opportunity.”

The pushback that followed was ferocious. Registered reports denigrated exploratory research, the critics cried. Pre- registration would “put science in chains” (bit.ly/2R9nSS9). We were accused of behaving like “high priests”, “Stasi”, of being “self-righteous”, “fascists”, “crusaders on a witch hunt”, and worse in private channels. In one widely circulated email, a British professor dismissed the signatories of our *Guardian* letter as having “low scientific weight”, adding that, “In response I would like to front load our big guns as signatories”.

Regardless of the storm it created (or perhaps because of it), the letter appeared to work as intended. Beyond the heat of the debate – and the numerous misconceptions voiced by opponents – other scientists were quietly deciding that registered reports made sense. The idea had turned a corner and the number of adopting journals steadily grew. By the end of 2013 we had three adopting journals. A year later we had seven. Through 2015, 2016, 2017 and 2018, the number of adopters rose to 21,

41, 88 and 154. The first published articles started appearing. Today, registered reports are offered by 202 journals and rising, and across a wide range of sciences.

Nearly 200 completed articles have been published, with hundreds more in the pipeline. Despite ongoing resistance from some journal editors, pioneering outlets such as Nature Human Behaviour and Royal Society Open Science have led the way in showing that registered reports are suitable even for journals with prestigious reputations or a multidisciplinary remit. The concept has also been taken further than we envisaged.

Journals and funders are now partnering in the support of registered reports research grants, in which proposals are reviewed simultaneously (or near simultaneously) by the journal and the funder, with the grant awarded and article accepted simultaneously or in tight succession.¹ Variants of registered reports have also begun to emerge, such as the accountable replications policy at the Royal Society (bit.ly/2R7Nrms) and registered reports for clinical trials (bit.ly/2RdIkKH). Entire initiatives that centre on registered reports have sprung up, including the Psychological Science Accelerator – a distributed laboratory network of more than 400 teams over 50 countries (bit.ly/2RctTgB) – and research institutes such as the Leibniz Institute for Psychology Information in Germany (bit.ly/2RbeKMy).

Alongside this expansion we are seeing the first evidence of impacts, and the signs are promising: registered reports are more likely to reveal evidence that is inconsistent with the authors' pre-specified hypotheses (a possible indicator of reduced confirmation bias);² they also have more reproducible code and data than regular articles (psyarxiv.com/fk8vh); and they are cited, on average, at or above the impact factors of the journals in which they are published (tinyurl.com/RR-citations).

Six years post-launch, the registered reports revolution is well under way. So what have we learned from this journey about how to change the academic and publishing system? I think there are five central lessons.

Lesson 1: “How” and “why” arguments transcend “should” arguments

Meta-scientist and historian Fiona Fidler has shown that this is not the first time concerns about reproducibility have prompted discussions about reform (bit.ly/2RdU46W).

Until now, though, little had changed. Reforming science is a hideously difficult task – perhaps one of the most complex collective dilemmas in existence. The academic system is an antiquated and labyrinthine set of rules and incentives, some placed by design, others incumbent as accidents of history. To survive in this competitive game, the intrepid academic player channels Irvine Welsh from *Trainspotting*: Choose haste. Choose beautiful, clear results. Choose grants. Choose high impact factors. Choose productivity. Choose promotion. Choose to publish, or choose to perish. Choose trainees who are like you. Choose to reinforce the status quo.

If someone then comes along and says, “Whoa, there! You should archive your data in a public repository. You should preregister your protocols to control bias. You should replicate that study before submitting it to *Nature*”, the response of the player isn’t even “No”. The response is silence. The working scientist sweeps past in a blur of desperation, racing towards the next publication, or tenure, or the next grant or fellowship with a tiny success rate. Every so often, the weary explorer looks up and catches a fragment of the reform argument. “You’re telling me I should do X, Y, Z. But why would I? Unless someone is going to make everyone else do it too, I’m just going to become less competitive. I’m a scientist, not a sacrificial lamb.” They vanish over the horizon.

“Should” arguments fail because they offer only judgement, not solutions. If should arguments were sufficient to change behaviour then behaviour would have changed decades ago.

Breaking this impasse requires aligning incentives so that any reform works for the community and the individual.³ Registered reports achieve this by turning the pursuit of high- quality science into a virtuous transaction: submit your protocol to our journal, receive a positive assessment (most likely after performing some revision based on expert reviews), and we will guarantee to publish your paper regardless of whether or not your results support your hypothesis. Work hard at designing rigorous, careful, important science and we will de-stress your life by making the results a dead currency in quality evaluation.

For a “how/why” argument to be persuasive, it must also address the potential downsides of the proposed reform. With registered reports, one concern can be the time taken for submissions to pass through Stage 1 (pre-study) review – a period typically in the range of 3 months, not including the amount of time authors take to make revisions and resubmit. Since data collection cannot commence until Stage 1 in-principle acceptance, this downtime can present a logistical challenge for authors. The solution to the problem emerges from a parallel benefit of the initiative: the low rejection rate. Once a Stage 1 submission enters the peer review process, it typically has a much

higher chance of being accepted than a regular article. At Cortex, for example, the acceptance rate for Stage 1 registered reports following in-depth review is around 90% whereas for regular articles it sits at around 10%. This high rate for registered reports is not due to any lowering of the bar in quality assessment – quite the opposite – but because the review process provides the unique opportunity for flaws to be corrected and reviewers satisfied before it is too late.

In addition, at Stage 2 after the results are in, the acceptance rate is currently 100% because submissions cannot be rejected on the basis of the results. This high acceptance rate means that authors are much more likely to have their article accepted and published at their first target journal, rather than shopping their regular article to a list of journals and getting rejected over and over. So, for the price of investing a few months at the start of their research, the careful scientist saves time overall while reducing waste in science, converting a “should” argument into a “here’s why it works for you” argument.

The key lesson of registered reports here is clear: do not tell scientists what they *should* do. Instead, tell them why what you are proposing is better than the status quo and why the new practice is both in their career interests as well as in the interests of the scientific community. Give them no reason to say, “This will harm my career” or “My peers will disapprove”. Give them every reason to say, “This works for me and helps me leave a lasting positive legacy on my field”.

Lesson 2: Don’t make the perfect the enemy of the good

At one of the first talks I ever gave on registered reports, someone stood up at the end and accused me of conspiring with “the enemy”. The journal Cortex, where we first launched the initiative, is published by Elsevier, and big academic publishers like Elsevier are frequently criticised for the way they control access to scientific output; in particular, for the “paywalls” they erect around published papers. This critic of mine was therefore annoyed that I had given the idea for registered reports to a big academic publisher, and that it had now become part of a publishing system he objected to.

I sympathise with his view. Does science need corporate publishers? No. Does science need registered reports? Yes. So wouldn’t a better solution be to create registered reports in some way beyond the grip of publishers? In principle this would certainly be attractive. The problem is that it violates Lesson 1: it is calling for registered reports to exist separately from the regular journals that are baked into the academic incentive structure, but without showing how they could exist, and

without explaining to authors why they should use them if they did. Launching a new article format within a popular and highly utilised infrastructure is far more likely to change everyday practice than launching it in the wilderness.

The broader lesson here is that to make changes in a complex, conservative entity like academia, it is important to work with parts that exist and are considered malleable, even if we might prefer a purer solution in the long term. This inevitably requires moral compromise. Achieving incremental reforms in academia is hard enough. Making the perfect the enemy of the good is guaranteed to achieve little.

Lesson 3: Amplify the message outside conventional channels

Scientists can be reluctant to engage with the media, but there is no question that it can be a powerful tool for driving reform. Our open letter in *The Guardian* widened the issue of registered reports to a broad forum of scientists, journalists, publishers, medical doctors, policy-makers (including politicians), and other professionals. The public – as the principal supporters of academic research – also have a right to be part of these discussions. The letter prompted steady interest in registered reports from across the media spectrum, and they are now well known to science journalists. I have no doubt that the rise of registered reports can in significant part be attributed to this coverage.

Working in the media can be expected to prompt criticism from academics. As one professor wrote in 2013: “Another worrying element here is how this issue [registered reports] is raised in the media first, rather than being adequately debated within the scientific community before media pronouncements are made.” Such sentiments are understandable, but should not deter us from broadening the scope of the discussion, not only in the interests of amplifying the message but also for democratising the process of reform.

Social media is an equally important tool. Unlike journals or the mainstream media, the hierarchical landscape of social media is relatively flat and sometimes even inverted – on a platform like Twitter, a PhD student can easily amass a much larger following than a tenured professor. Social media has proven crucial for expanding the reach of registered reports beyond the confines of newspapers and journals, into the minds of early-career scientists who are more comfortable with newer modes of communication.

Where a public campaign is successful, the benefits will extend to the all-important private discussions that lead to policy reforms by key stakeholders, including journals, funders and universities. Having a clear public message will help ensure that you are in the room when important decisions are made.

Lesson 4: You cannot change “culture” without changing everything else first

Sometimes people disagree with an initiative like registered reports on the grounds that because it does not solve all problems or apply to every kind of science, it is therefore naive and unfit for purpose. Many such critics go on to suggest that we should focus on changing the culture of academia rather than proposing simplistic fixes.

Appeals to “cultural reform” are a common refrain among critics of registered reports, but in my view ring hollow. If there is one key lesson I have learned on this journey, it is that there is no such thing as culture, at least not in the sense that we can touch or shape directly. In academia, culture is the shadow created by the machine of rules, norms, mandates and incentives that drive everyday decisions. If we want to fix the machine, it makes no sense to direct our efforts at the shadow. We must instead replace the parts, one by one, and eventually – if necessary – the entire machine. If we succeed, the culture will have changed, but only because we changed everything else. The pragmatic reformer is at heart a reductionist.

Lesson 5: The revolution never ends

A reform initiative like registered reports is never finished. As the reach of registered reports expands, we are finding that it must evolve to improve its own levels of transparency, standardisation,^{4,5} and internal reproducibility (psyarxiv.com/fk8vh). It must also be subject to constant recalibration to fit with specific needs, for instance in qualitative research.

The acceptance of perpetual imperfection brings us back to Lesson 2 and should not overly concern the reformer. The job of the reformer is not to implement a single permanent change, or to place their personal stamp on history, but to turn vision into a programme of action, to disrupt the status quo, to remain self-critical, and to inspire the next generation of scientists to carry the torch forward.

Informing neighbouring debates

What can the lessons of registered reports teach us about how to approach reform discussions in other domains? One related and seemingly endless debate concerns the application of statistical significance testing, and p-values in particular. For decades, the use (and abuse) of p-values has prompted heated argument among statisticians, with the issue peaking again following a response from the American Statistical Association to concerns about reproducibility.⁶

Questions about what constitutes best statistical practice are now the subject of a steady stream of articles and petitions. Should the classic significance threshold of $p < 0.05$ be sharpened to $p < 0.005$ to lower the rate of false discoveries?⁷ Should researchers instead justify their significance threshold?⁸ Should significance testing be abandoned, either outright⁹ or in favour of confidence intervals?¹⁰ Should frequentism itself be abandoned in favour of Bayesian statistical methods?^{11,12}

In my view, one of the reasons this debate continues to rage – aside from its complexity – is that proponents on all sides fail Lessons 1 and 2. Read the paragraph above again and count the number of “should” arguments. While statisticians slug it out over what researchers should do, what is there in this discussion to inspire the busy scientist to change anything about their behaviour? What will convince the scientist to look up from the daily sprint and pay attention, to decide that somewhere in this noisy dialogue is a solution that benefits science and their career prospects? What middle ground might there be that could achieve broad consensus among statisticians, even if regarded as imperfect? If we have learned anything from registered reports, it is that answering these questions is fundamental to turning any vision of scientific reform into reality.

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Box 1. Registered reports in a nutshell In contrast to regular empirical articles, registered reports are subjected to peer review before the results of the research are known, and usually before data are collected. Based on pre-study review of the theory, methods and analysis plans, the journal issues an in principle acceptance that commits the editors to publishing the final paper, provided the authors adhere to their approved plans and the conclusions are based on the evidence. Once the research is completed, the authors then resubmit the manuscript, including the results of the pre-registered analyses as well as any additional post hoc analyses. At this second stage, editors and reviewers assess whether the authors followed the protocol and whether the conclusions are sound. Crucially, the question and methods are not relitigated, nor do the results themselves influence the final editorial decision. This combination of measures aims to prevent publication bias by journals and various forms of selective reporting by researchers.

