

Open Research Case Study



Measuring Behaviour Better. My attempt to lead the Open Science journey in behavioural biology.

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As a behavioural biologist, my faith in my discipline has been severely shaken by the replication crisis. Earlier in my career, practices such as HARKing (hypothesising after results are known) and taking advantage of so-called 'researcher degrees of freedom' (flexibilities in data analysis) were widely accepted as part of doing good science. I used these practices myself to tell sexier stories about my data and ferret out the significant results necessary for high-impact publications. I now worry that some of my early success was based on results that might not replicate. I have spent the last few years on a personal journey, learning to do better science myself and, more importantly, training the next generation of behavioural biologists about the changes in practice, collectively known as Open Science, that are necessary to improve reproducibility.

Major reasons for replication failure are underpowered experiments and uncontrolled moderator variables. Behavioural studies on animals are plagued by both of these problems: sample sizes are small due to cost and the ethical imperative to reduce use of animals, and behavioural phenomena are particularly sensitive to small differences in how studies are conducted.

The usual approach to increasing reproducibility in animal research is to focus on standardizing procedures within a laboratory. However, the result of increased standardization is that different labs often produce different results—a phenomenon known as the standardization fallacy². This happens because something was different between the labs that nobody thought was important and hence was not standardized.

To address the above problems, I have been increasing the transparency and reproducibility of my animal experiments through innovative use of meta-analysis to combine and publish the results from multiple, small, exploratory experiments conducted in the course of refining my methods, that would previously have gone unpublished³. The experiments ask the same question, but differ in methodological details and thus together deliver the heterogenization necessary to address the standardization fallacy: if summary effects emerge from a meta-analysis of heterogeneous studies, then we can be more confident that these effects are robust to small differences in methodology and will be reproducible².

Publishing exploratory experiments also increases transparency over the true nature of the scientific process, something that is lacking in the highly selective, sanitised datasets that are the norm in high-impact journals. My novel approach also maximises the total available sample size for testing a hypothesis. An ethical benefit of my approach is that the knowledge obtained from more of the animals used in my research programme is made publicly available. I publish data and analysis scripts that accompany my papers on Zenodo.org.

In my teaching, my main contribution has been co-authoring a new edition of *Measuring Behaviour*¹, a classic textbook aimed at students in the behavioural sciences that now, for the first time, embeds Open Science practices as part of the standard research cycle (see Figure 1). Following the book's publication in 2021, I have been invited to run a workshop entitled *Measuring Behaviour Better* at The Association for the Study of Animal Behaviour's PhD student conference (Newcastle, April 2022) and the Universities' Federation for Animal Welfare international conference (Edinburgh, June 2022).

I have also used *Measuring Behaviour* to introduce my undergraduate psychology project students and my MRes students to the replication crisis and Open Science practices. In MMB8003 (The Biological Study of Behaviour), we get our MRes students to write a pre-registration for an experiment as one of their assignments and in PSY3097 (Empirical Project) all of the students I supervised pre-registered their projects on AsPredicted.org this academic year.

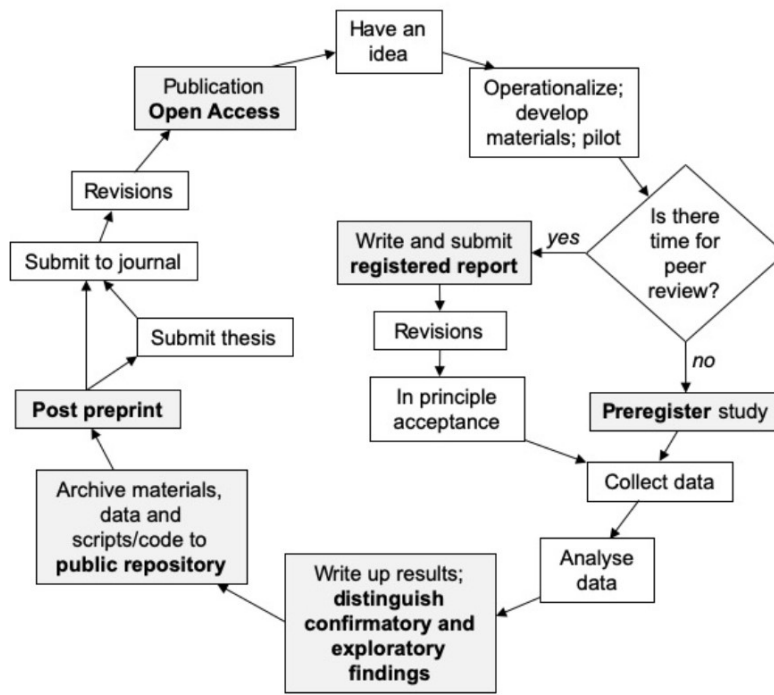


Figure 1. Steps in the research cycle showing where Open Science practices (shaded boxes) can be introduced to increase the openness and transparency of science and improve replicability (from Bateson M & Martin P. 2021. *Measuring Behaviour: An Introductory Guide*, 4th edition. Cambridge University Press.. The CC BY licence applied to this document does not apply to this image.

I have come to realise that the transition to Open Science is an ongoing journey, not a single step. Constraints of time mean that I cannot always implement all the practices that that I would like to in an ideal world. Moreover, constant innovation in Open Science means that the destination keeps getting further away. However, as long as I keep moving in the right direction, taking a growing group of students and colleagues with me, I believe that together we are improving the reproducibility of our science.

References

1. Bateson, M. & Martin, P. *Measuring Behaviour: An Introductory Guide*. 4th edition. (Cambridge University Press, 2021).
2. Voelkl, B., Würbel, H., Krzywinski, M. & Altman, N. The standardization fallacy. *Nat. Methods* 18, 5–7 (2021).
3. Bateson, M. et al. Food insecurity increases energetic efficiency not food consumption: an exploratory study in European starlings. *PeerJ* 9, e11541 (2021).