John Measey

How to publish in Biological Sciences: A guide for the uninitiated

To my son,

without whom I should have finished this book two years earlier

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Welcome

Welcome to my guide on how to publish in the biological sciences. This guide is not here to tell you what to write, but to demystify what goes on in the world of scientific publishing, and more broadly in the academic context. My intention is to demystify publication in the biological sciences, so that readers become aware of what is happening once they have submitted a manuscript, and how to better interpret the decisions made by colleagues who are reviewing and editing your work.

Publishing has become vital for all academics, such that it is recognised that we inhabit a 'publish or perish' academic landscape. Yet for some, the process appears to require little or no stress, while others are left in the cold. This book is meant to be a guide to those uninitiated members of the academic community, postgraduate students and early career researchers, to bring them up to speed with all the background information on publishing.

Why read this book

Publishing a paper in an academic journal should simply consist of submitting a publication worthy manuscript. But having a working knowledge of publishing will enable you to make better decisions about what, where and how to submit manuscripts. In this book, I explain the many choices that exist for those wishing to submit a manuscript for publication in the Biological Sciences. I describe publication bias, and how this is evidenced by reviewers and editors. Impact Factors and how the desire to track the performance of academics has led to unethical practices and exploitation of science and scientists. This guide provides an "everything you wanted to know about publishing but were afraid to ask" approach for anyone who still feels that there is more they need to know about publishing that might get them onto an even footing.

Structure of the book

This book is written in four parts.

Part 1 - Getting your manuscript ready for submission

Part 2 - Submission, reviews and reviewing, revising and resubmitting

Part 3 - Once your paper is published

Part 4 - Further challenges in academia

Why 'A guide for the uninitiated'?

I think that most people with doctorates would agree that a PhD is not awarded to people because they are particularly bright or smart. If you had to be a genius then I wouldn't have a PhD. Indeed, I don't consider myself to be particularly clever, but I worked very hard to get my PhD. I was hampered by the fact that I didn't know anything about the goals and aims of the academic process of working towards a PhD, so it took a lot more work, wasted time, and (let's not mince our words) real pain. The end product was a fraction of the potential that I could have achieved, if I had understood more about the process. If I had only had a guide to tell me what it was all about, I could have saved myself so much time and energy. In short, I feel that I was uninitiated, and this is the guide I wish that I had had.

So, this guide is my practical attempt to help you to get you up to speed in the world of academic publishing, specifically for the biological sciences. Too often, however, it's a nightmare journey of cul-de-sacs, and groping in the dark.

Acknowledgments

There are a great many people that I need to thank. First and foremost are my students, past and present, who have inspired me to put together first the blog posts and then the book. It is because you wanted more that I put this together. I have also been a student, and have been inspired by colleagues

around the world who have been exemplary advisors. This book contains lots of links to blogs and articles written and posted freely on the internet by others who also aim to demystify and help. I thank this greater academic community (especially #academicTwitter) for sharing and inspiring. Thanks go to the many reviewers and editors who have taken their time to improve my writing. I am still learning. Lots of the text in this book has been improved by feedback from my students and postdocs. A special mention must go to my brother, Richard, who has hosted my lab website for more than a decade, and especially for saving blog posts from hacking attacks. Thanks also to my wife, Thalassa, who proofread many of the blog posts after I had published them late at night, so that I could correct them over breakfast in the morning. James Baxter-Gilbert, Jack Dougherty, Anthony Herrel, Allan Ellis, Lisa and Mark O'Connell, James Vonesh, Carla Wagener all read or commented on different aspects of the book. Thanks are also due to my colleagues at the Centre for Invasion Biology, the Department of Botany and Zoology, and Stellenbosch University. A special thanks to the librarians who have supported many of my more extreme rantings about publishers.

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Cape Town

About the Author

John Measey is Associate Professor of Biological Sciences at Stellenbosch University. He has authored or co-authored more than 200 peer reviewed scientific papers and book chapters, and five books. He has been the Editor-in-Chief of an ISI journal for 9 years, and currently serves as Associate Editor for 4 other journals. He has graduated more than 20 postgraduate students, and his blog on writing and publishing in biological sciences is read by thousands globally. British born and educated, he lives and works in the beautiful Western Cape, South Africa.

Do you have something to contribute?

This book is written in bookdown (Xie, 2016) specifically to make it a 'live project' that will be open to anyone who wants to contribute, improve, or use as the basis for your own book. The easiest way for readers to contribute content directly is through a GitHub pull requests[1]. At the repository for this book, you will find Rmd files for each chapter, and as a GitHub user, you can simply edit the Rmd file and submit the changes. If I am happy with the changes proposed, I will merge your content with that of the book and add your name to the Acknowledgements.

One of the amazing potentials for bookdown books[2] is that all the files for this book are hosted in a repository on Github[3]. You have the opportunity to fork this repository and write your own version for a different discipline, a different language or for a different region of the world. It is also my hope that this guide can grow to become a community of practice for those conducting PhDs in Biological Sciences. It will not be possible to cover every aspect of writing a PhD in Biological Sciences, but it may be that I have missed out ones that are very important to you. Equally, parts of what is currently written will become obsolete as new initiatives begin, and old problems are resolved. For this reason, this guide needs to be a 'living document', and anyone who wants

[1] https://help.github.com/articles/about-pull-requests/
[2] https://bookdown.org/
[3] https://github.com/johnmeasey/How-to-publish-in-Biological-Sciences/tree/main

TABLE 0.1: We must have the iris data and some R code, otherwise it would not seem right

Sepal.Length	Sepal.Width	Petal.Length	Petal.Width	Species
5.1	3.5	1.4	0.2	setosa
4.9	3.0	1.4	0.2	setosa
4.7	3.2	1.3	0.2	setosa
4.6	3.1	1.5	0.2	setosa
5.0	3.6	1.4	0.2	setosa
5.4	3.9	1.7	0.4	setosa

to provide feedback or contribute new sections is more than welcome. Please feel free to open an issue, or make a Pull Request if you spot a typo.

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```
knitr::kable(
  head(iris), caption = 'We must have the iris data and some R code, otherwise it would not seem r
  booktabs = TRUE
)
```

Part I

Part 1: Getting ready for submission

The reasons for publishing your work…

I assume that you will all want to publish the work from your thesis, but it's worth going through the points here about why publication is so important.

- If your work is unpublished, then it will not be used. Without use, all the work that you put into it falls away.
- Your published work will become the foundation for future students and academics who are active in your field. This might well be in another country or on another continent.
- Your work was most likely paid for by tax-payers in the country where you studied. Publishing this work is a way of handing back the value of what you found. If it is published Open Access, the public can also read it for themselves.
- Other funders of your thesis work may have made publication a prerequisite of the funding criteria.
- It is hoped that by publishing your work it will become more accessible to the scientific community.
- By publishing your work you will find that both you, and your work, become known by an international community that may well invite you to participate in the academic process further (Marks et al., 2013).
- Both inside and outside of science as a career, peer reviewed published papers are seen as an important accomplishment in addition to the production of your thesis.
- The work that you have already put into your thesis (especially if you have followed the advice in this book!), will mean that you are close to having chapters that can be submitted as publications.
- Your advisor and lab colleagues who helped with your thesis work may depend on your publications.
- There is a lot of satisfaction to be had by seeing your work published. It has been argued that this depends on who you are and where you come from (Husemann et al., 2017).
- The satisfaction of having someone say how enjoyable or inspiring your work is to read will certainly not be as frequent as if you managed to publish a novel or newspaper column. But when it does happen, it will bring a smile to your face.

This is by no means an exhaustive list, but I hope it will give you some insight into the importance of publishing your results. To counter this assertion, please be aware that there is also research that suggests that publication driven science is not healthy, and that we need a new way to motivate science (e.g. Stergiou and Lessenich, 2014). Indeed, it has been suggested that the 'publish or perish' mentality of academia has resulted in the retention (and even deterioration) of poor experimental design, and hence higher false positives in the behavioural sciences (Smaldino and McElreath, 2016). We will

come back to this later in part 4. However, before you can join the debate about the future, I'd argue that you need to provide your credentials for the present.

Given that you are reading this book, I will assume that you plan to publish your work. However, there are still some basics that I think it is worth considering in this first part of the book:

- What is a journal for?
- What is it possible to publish?
- What is the journal Impact Factor?
- Why are citations important?

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What is a scientific journal for?

I think it's worth reflecting on why we have scientific journals, and what they are for. Primarily journals are a means of communication for the academic community.

1. They pass on the findings of individuals and teams of academics from all over the world.
2. By having a date when they are published, together with the names of the authors, they record primacy (see taxonomic names[4]); that is who came up with the finding or idea first.
3. They attempt to register legitimacy by collating and integrating comments and concerns through peer review[5].
4. Lastly, they archive these findings so that in future people can build on the work.

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1. There are so many scientists in the world publishing so many papers that it's not possible for all scientists to read everything. Today annual growth in scientific papers of 5.1%, equivalent to a doubling time of 13.8 years (Bornmann et al., 2020). Contrast this with the early days when there were only two journals and they published all of the studies that were being undertaken at the time. Over time there has developed a natural hierarchical system of what scientists will read. This is reflected in citations, and the simplest measure of journals is something called the Impact Factor[6] which is discussed in a chapter below.
2. It has been said that 'authorship' is a relatively modern concept, emerging from the empiricism of England's middle-ages (see Cronin, 2001). In our recent history, it is considered to be important for individuals to record who thought of what and when. From these authors, we give societal 'author-ity.' This gives credit where it's due. In the big scheme of things of course it's not important who

[4] taxonomy.html
[5] peerreview.html
[6] impactfactor.html

did it. We know from historical examples like Darwin's theory of natural selection and Wallace's very similar thoughts will merely be a product of many people who were thinking about these ideas at the time. Although certain authors may be 'ahead of their time', the majority of thoughts and ideas that come around today are a product of their time. However, for individuals and their institutions it can be important to claim credit as this may translate into some monetary value (e.g. with patents) or a prestige value. The regulated system of a taxonomy puts a lot of importance on the priority of who described what and when (you can read more about that in the chapter on taxonomic nomenclature[7].

3. The system of editors and peer reviewers determining whether or not a manuscript possesses sufficient merit to be published is still regarded as the gold standard in science (Mayden, 2012). As you will discover, it is often a very high bar to achieve. Of course both editors and peer reviewers are human and so the system is not perfect. We'll talk more about peer review in a chapter below[8].
4. Archiving the findings of scientists is perhaps one of the most important roles of publishers that we should be most concerned about. In my career I have seen the changes from strictly paper dissemination of scientific findings as it was for the past 350 years, to primarily electronic findings many of which and never printed by the majority of readers. We should be concerned about how long these records will last. If you have never thought about the longevity of data storage, then this is something that you should give some thought to. We all need to change our perspectives on long-term thinking as this impacts almost every societal function (see the Long Now Foundation[9]).

[7] taxonomy.html
[8] peerreview.html
[9] https://longnow.org/

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What is the Impact Factor of a journal, and why is it so important?

The impact factor of a journal relates to the number of times each publication from the journal gets cited in the two years preceding the date of the Impact Factor (IF) (Equation (I)). Thus, if you are thinking of publishing in a journal that has an IF of 1 you might expect that In the two years following the publication of your article you may get one citation. But this is not necessarily true for your paper. As discussed elsewhere you might be very good at publicising your work and have it extensively cited. One or two extensively cited papers might even change the impact factor of the journal without too many publications per year. As IFs are calculated on average for all papers published in that journal. If on the other hand you are thinking of publishing your article in a journal that has an IF of 5, you might expect that your article will be cited 5 times more than if you published in the first journal.

It's a relatively simple calculation as seen in equation (I):

$$\frac{Sigma citations in journal X for year Y}{(Number of publications in journal X for year Y - 1) + (Number of publications in journal X for year Y - 2)} \left($$

Because all citations for year Y are needed before the IF can be calculated for each journal, IF for the preceding two years is typically not released until June of Y+1.

Impact Factor is calculated by Thomson Reuters based on their Science Citation Index now called the Web of Science[10]. This means that if your journal is not even listed in the Web of Science then it will not have any Impact Factor. The Web of Science[11] is continually policing the quality of the journals but it includes and this means from time to time channels are excluded. This tends to happen at the lower end of the Impact Factor scale. But recently it happened to some very well known journals and there was a big stink. You can read more about this here[12].

Note that there is a large conflict of interest here. A publisher, Thomson

[10] https://www.webofknowledge.com/

[11] https://www.webofknowledge.com/

[12] https://retractionwatch.com/2020/07/13/stunned-very-confused-two-more-journals-push-back-against-impact-factor-suppression/

Reuters, owns the Web of Science[13] and that's the means to decide whether or not a publication can get an Impact Factor. Is it more likely that journals published by Thomson Reuters will be included in the Web of Science? Previously the Science Citation Index was a not-for-profit organisation. Now the organisation that is used by many of our employers in their means of evaluating our effectiveness is owned by a private company. This is certainly cause for concern. There is a group of people who are trying to replace Impact Factor with a group of other metrics, so perhaps by the time you read this Impact Factor will no longer be relevant. If you're interested read more here[14].

Do remember that there are a number of other citation indices including Scopus and Google Scholar. Google Scholar doesn't currently calculate the Impact Factor for all journals, only the top 100.

0.1 From a simple score to a way of life

When IF was originally devised, it wasn't supposed to govern the lives of academics. It was a calculation for librarians to help them decide which journals to keep and which to ditch under ever constrained budgets (caused by publishers' ever increasing prices). But along the way, this very simple index is now considered by many people to be a measure of quality, prestige and even academic success (Garfield, 1999). Many people have highlighted how wrong these beliefs are (see here and here), but the growing trouble is that not only have many academics been misled, but so have administrators responsible for hiring and promotions.

In a paper by McKiernan et al (2019), they found that this metric features in the guidelines of many university panels responsible for the fate of academics jobs and therefore lives. Worryingly, many of these institutions don't actually talk about what IF measures. Instead they equate it with values and qualities that it certainly does not represent. Thus you may find that your career is influenced by a simple metric that almost all who use it don't actually understand what it means. The undue influence on lives of scientists that IF has led directly to the San Francisco Declaration on Research Assessment (known as DORA) in which many institutions and publishers signed up to. You should read this very simple declaration and find out whether your institution is a signatory.

[13] https://www.webofknowledge.com/
[14] https://www.nature.com/articles/d41586-019-01643-3

0.2 What can you do if you publish a journal with high IF?

Very high ranking journals for Impact Factor are publications like Cell, Nature, Science and PNAS. This is because these publications are read by a very great number of people, and so are widely cited. Articles that get published in them receive a lot of attention from the press and media. This results in the prestige that a hiring institution might be looking for. If your academics publish in this journal, your institution may well receive lots of positive publicity. In some countries, notably China, there may be a cash incentive towards publishing in a journal with a high IF (Quan et al., 2017).

One frightening trend that we are seeing in biological sciences is that the higher the Impact Factor the more the journal will charge you to publish in it. At the time of writing in November 2020 nature has just announced that they will charge $9500 to publish in the highly-ranked journal (see part 5[15]. This is more money than it cost to publish in any other journal at the moment.

0.3 Why is it so important?

Academics are measured by their productivity but also about the quality of their output. Because there are so many different academic disciplines the bean pushers who administer us need some way of ranking academics against each other. This is why they use the Impact Factor of the journals that the academic publishing in order to determine the quality of their output. Even though there are other metrics of the actual quality of an academic, most administrators continue to cling to IF and their beliefs of what it stands for (see blog post here).

Some countries reward their academics if they publish in high ranking journals. This can result in a salary bonus. It may also help with promotion, getting tenure or even just getting an interview for a job. If you're going to publish and you want a career in academia then you need to be aware of Impact Factors and what they mean to different stakeholders.

Many people will complain that their particular sub-discipline has a range of very low ranking journals with low impact factors. Others complain that journals with high impact factors tend to be edited by an old boys club that facilitates the members. In some cases like PNAS this is certainly true.

[15] openaccess.html

0.4 Editors try to increase IF

It's important to remember that editors care about Impact Factor (see Ioannidis and Thombs, 2019). This means that if they think your paper will not garner the same or more citations in two years as the current Impact Factor they are likely to reject it often without even sending it out to review. Editors also have been known to manipulate impact factors and there are a number of established ways of doing this (see Metze, 2010; Martin, 2016):

1. Ask authors to cite publications from your journal published within the last 2 years.
2. Ask reviewers to suggest publications from your journal published within the last two years to authors on which their review is conducted.
3. Encourage submission papers from laboratories with high output and citation rates
4. Reject papers that are likely to have no citations. This effectively reduces the size of the denominator in the above equation
5. Publishing issues in January means they have a maximum period of the year to get cited. This is now being inflated to having issues published online well ahead of the January date all the time gathering citations.
6. Encourage review articles
7. Editorials that cite every paper in the journal. This tactic is frequently used in special issues.

Just like any metric, Impact Factor is liable for abuse. You need to be aware of how IF is used and abused by many people in the academic community.

0.5 Push back against IF

One very simple way that you can push back is to calculate IF scores for your papers and show how they relate to the IF of the journal that you publish in. In this way you are simply comparing your actual citations in the 2 years after your paper is published with the mean for the journal. There is a good chance that you generally get more citations than the mean for the journal, and with some statistics you can convincingly show that your citations are

significantly higher than the IF. For this to be true, you might need to help your work get cited. That's the subject of another chapter[16].

[16] citations.html

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Citations and how to get them

Citations matter as they reflect the number of people who found your research useful. Getting your research cited is not always straightforward. We have already mentioned here about publishing your research in journals with higher Impact Factors. This will likely help you get your research read. But there are lots of other tactics and here I have produced a list although I imagine it is not exhaustive.

0.6 Media release

Some journals will want you to write a media release that they may use to promote your paper. You can also proactively write a press release[17] and send it to your Media office at your institution. Writing a release for the media is very different from most of the writing that we've talked about so far and you can find a guide in a chapter below.

0.7 Social media

Social media is another way of getting your article to the attention of more people. Twitter has been adopted by many scientists and tweeting out an article that gets retweeted by the right people can get you tens or even hundreds of thousands of views. This is likely to be far in excess of anything your article will get by passively sitting on the journal website.

[17] pressrelease.html

0.8 Popular articles

Writing popular articles[18] is a good way to ensure that your paper gets some media attention. There are outlets like The Conversation[19] that specialise in publishing popular articles written by academics. But you might also find that academic societies that you belong to have newsletters that you can contribute a popular article to about your paper. As long as the circulation of these newsletters is big it should enhance the numbers of people that eventually read about your work.

0.9 Self-citations

Self citation is when you cite a paper that you or one of your co-authors have written or co-authored. This is probably one of the oldest and most widely practised ways of increasing citations to your articles. It is generally frowned upon to have gratuitous self citations. However, it is also true that you are more than likely to cite your own work because you have probably published in the same area previously. By the end of your PhD you will already be citing publications that you produced at the beginning. There is evidence to suggest that the proportion of self citations will change in different disciplines, and that they will increase with increasing numbers of collaborative co-authors (Davarpanah and Amel, 2009).

How do you make sure that their citations are not gratuitous? Simply by only citing a work when you need to. Note that many citation indices will provide your citation scores both with and without self citations. There are some metrics that suggest within what bounds self-citations are reasonable. A study of Norwegian scientific papers found that the mean rate of self citations was 36% (Aksnes, 2003), which seems very high.

[18] popular article.html
[19] https://theconversation.com/

0.10 Organising symposia and having special issues

Having your research published in a special issue is a great way of getting citations. This is because special issues have research on a theme and so many people will be drawn to the issue and are then more likely to see your work. This includes other people who participate in the special issue and are de facto already interested in this line of research.

Special issues are often edited by people who have an interest in pulling together this kind of research. They may encourage other authors to cross cite articles in the special issue, and may write an editorial that includes citations to yours and other papers. Of course the best position to be in is when you are one of the organising members. Your name will be associated with the special issue as well as your contribution.

Probably the easiest way of pulling together a special issue is to organise a symposium at a conference and ask those participating to contribute to the special issue. If this is done long enough in advance and you are good at organising then it can work very well. Talk to your adviser about the possibility of their help in organising a symposium.

0.11 Traditional Media

To get your work cited you need to get people reading it. As scientists read the traditional media[20] it can be a way of bringing your work to their attention, and result in additional citations. There are other benefits of having your work highlighted by the traditional media then you should always make sure that you get a plug in for your institution and any prominent funders. There are now additional metrics (e.g. Altmetrics[21]) that track traditional and social media and in the future you might be able to use these to your advantage in getting a job, a promotion or tenure.

[20] pressrelease.html
[21] altmetrics.html

0.12 Not so legitimate ways of increasing citations

As well as the legitimate ways of increasing citations and visibility of your work that I've listed above there are other illegitimate ways that I have heard about. I have heard of certain laboratories that have quid-pro-quo arrangements where they agree to cite each other's publications.

Another way of increasing citations might be to have a co-author that is very well known. Certainly having a co-author that is very well known is likely to increase your citations but only if they actually do something to contribute to the work. See comments about ghost authorship above[22].

Journals have also been known to manipulate citations in order to increase their Impact Factors and therefore their perceived level of standing. A group of physics journals from Romania were found to have clearly manipulated self-citations to increase their own impact factors (see Heneberg, 2016). There can also be a level of coercive pressure from journal editors to cite papers from their journals published within the 2 year citation window (Chorus and Waltman, 2016). Such practices are now systematically analysed by the larger literature databases, and clear levels of Impact Factor manipulation result in losing the journal listing in the database (see part 2[23]).

0.13 Well cited articles are likely to be cited more

Articles that already have a lot of citations are more likely to pick up extra citations than the ones that have very few. This phenomenon is exaggerated by search engines like Google Scholar that order the results of searches by the number of times an article is cited. Like people looking for a website, academics looking for a paper are more likely to choose one on the first page of Google Scholar than to keep searching through Google Scholar until they find your study.

As you read through papers in your specialist area you will notice but there are some papers that seem to get cited over and over again as standard examples of a particular phenomenon. These are often some of the first examples published and also being published in high-ranking journals. If you are the 20th person to have shown a particular phenomenon then it is unlikely that your paper is going to end up being cited the most.

[22] authors.html
[23] databases.html

Part II

Part 2: Publishing your work

Part 2 of this book is all about submitting your manuscript to the journal of your choice. It will then take you through what happens to the manuscript and give you insight about where you might want to publish, how to choose the journal.

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Formatting your submission

Let's face it, after spending so much time writing your manuscript.

0.14 Must do check-list before submitting your manuscript:

The following points are based on what may irritate or annoy your examiner (and you really don't want to do that!):

- Spell check - yes, it sounds obvious but doing a final spell check is a good idea. Not only this, but take the time to have your word processor ignore or add all of the special words (e.g. species or site names) that it doesn't otherwise recognise. This will ensure their consistency throughout (within and between chapters).
- Make sure that your language settings are set to 'UK English' (or the English setting for where you are based.
- Look out especially for words that have different accepted spellings like those ending in -ise or -ize. Decide which you want and be consistent. Consistency is king!
- Capitalisation of common names[24], place names and not adjectives. For example, 'South Africa' has two capitals, but 'southern Africa' only has one.
- Grammar check - always good to take a final look, especially for chapters that you wrote some time ago.
- Use the word processor automated options to help you.
- Have your computer or another device read the text so that you can hear anything obviously wrong.
- Pay attention if you have used "we" or "I" and make sure they are consistent in your thesis. As a rule I encourage "I" in a thesis, unless the chapter is also a manuscript, in which case "we" is usually correct.

[24] taxonomy.html

- Page layout. Really important to get this right in your template. Make sure that your template has:
  - Correct paper size (A4 and not US letter - or visa versa!)
  - Margins
  - Line spacing
  - Page numbers
  - Line numbers (really helps your examiners)
- Headers and Footers. If you can manage a chapter specific header, it's useful to show your name and a short chapter title.
- Sections and subheadings. I've encouraged you to use subheadings throughout your thesis. Here you have a chance to number them sequentially. This is very useful for your examiners and may be a requirement for the university. Using the word processor's[25] built in functions will make this task consistent and easy.
- I dislike writing within a formatted document (as word processors can start getting weird), so my preference is to cut and paste written text into a template at the end.
- Remember to give them a check through before handing it in. If you've done the sections correctly, then the contents page will come out right.
- Title page[26] - prescribed very strictly by the university. The librarians place the SU watermark after final submission to the library. It may be tempting to change your title now that you know what's in the thesis, but many universities have strict policies about this. If you want to change the title, make sure that you are able to do so.
- Content page - word processors can do this automatically if your thesis is formatted correctly throughout (see sections and subheadings above).
  - You can check this to make sure that you've done all of your sections and subheadings correctly.
- Acknowledgements[27] - this is your time to say thank you to all the special people that have helped during your study. There are probably more than you realise, but in addition to your friends and family (who most people don't forget), think about the people who administered the work, lab mates (past and present) who were always there to help, and people who gave permission at study sites.
- References[28] - probably one of the most dreaded sections of any thesis preparation, but they do have to be done. If you're one of these people that has everything in a database[29], then you'll be laughing or cursing your database throughout. While it might be tempting to only look through the data within

[25] software.html
[26] title:html
[27] acknowledgements.html
[28] references.html
[29] database.html

the database, spend some time to see how it's displayed in the thesis. A mistake in the reference database will be multiplied many times in the thesis. Remember that examiners love to take a random look through the reference section to make sure that it's all good. After years of painfully entering references themselves, they know just what to look for.

0.15 Mistakes people make:

Other than the obvious things, all mentioned above, here are some of the mistakes I've seen.

- Submitting the wrong version (yes this does happen!). Probably worse if having a mixture of right and wrong versions for different chapters (worse because it takes longer to sort out)
- Last minute additions to text with incorrect spelling and or grammar
- Two correctly spelled synonyms sitting next to each other when only one is desired (probably came about when editing)
- Forgetting to check for plagiarism (see here)
- Comments and or edited text (especially when it's marked as being by someone other than the student).
- Page numbers that start again and again at different sections
- Lots of blank pages or spaces (avoid blank pages if you can, and try to limit the amount of blank space (never >half a page).
- Leaving important people out of the acknowledgements (e.g. advisor, administrators, funders, etc.)

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Choosing the right journal

In this chapter I give you a list of steps to go from a potentially very long list of journals where you might publish, to choosing the one where you will submit your manuscript first. As you work through the list keep notes on why you exclude journals at each step. You may want to revisit these criteria later, or explain to your advisor why a particular journal was not considered.

0.16 Step 1: Indexing

You want other people to be able to find the work that you publish, and so selecting a journal that is already indexed in one of the major literature databases (Web of Science or Scopus) is important.

0.17 Step 2: The Subject Area

No matter what your paper is about it will fall within an existing subject area. A good way of determining your subject area is to look at a literature database[30] like Web of Science or Scopus. These databases have subject areas which contain groups of journals. You can look through the journals that you cite in your references, then check with Web of science or Scopus to see which subject area the majority of them are grouped into.

Journals have different hierarchies of scope. Some journals attempt to take on the full gambit of science (e.g. Science and Nature) while others are only interested in a particular taxonomic group. In general, the impact factor of the journal is likely to be linked to the diversity of the scope. This is not always the case. There are some taxonomically specific journals with high

[30] database.html

impact factors, and there are some general journals with low impact factors. See chapter below for the importance of the Impact Factor.

Once you have determined your subject area make a list of the journals within this area. Based on your reading of literature pertinent to your manuscript, try to decide whether your manuscript is likely to be accepted by a journal with a high ranking Impact Factor, a medium ranking journal, or a low-ranking journal. Sort the list of journals within the subject area by impact factor and then select the ones that are either high (>10), medium (>4), or low (<4).

0.18 Step 3: The Journal Scope

Every journal has a scope that is stated on their website. Your manuscript must fit into the scope of the journal that you select. In order to get your candidate list of journals you now need to visit their websites to look at their scope in detail.

If your list is long, I suggest that you start with the journals whose articles you have already cited in your manuscript. Your manuscript should clearly fit within the scope. If you are not sure then it probably doesn't fit, but try asking your advisor.

0.19 Step 4: Current Contents

Now that you have a shorter list, it's time for you to look at the current contents of the journals that are on their website. The contents for the last 2 years should reflect the policy of the current editor for accepting manuscripts. You should be looking for papers that look similar to your manuscript in their scope.

If you see papers that look directly comparable to your own then make a note of what they are. Your list of journals should now be less than 10.

0.20 Step 5: Society journals

Academic publishing started with society journals, and I think that they are still worth supporting if you can. Your advisor or co-authors may be members of particular academic societies, and may have a preference therefore to publish in their own society's journal. See below for other potential advantages in publishing in a society journal.

0.21 Step 6: Transparency credibility

As we have already seen (part 2), transparency in science is very important and should be part and parcel of your own work. When publishing your work where you have made a real effort to be transparent, you should look for journals that do the same. There is a badge system used for transparency in science (see or Kidwell et al., 2016, or see Marshall and Strine (2021) for an example of how this can be applied). You can find a list of journals that have been approached to join the transparency movement here. It's interesting to see how many have rejected the idea of transparency, and why!

0.22 Step 7: Knowing the journal from the inside

Your advisor or co-authors could be an Editor or Associate Editor (past or present) of one of your target journals. Or there may be someone in your department or institute that you could consult. I am not suggesting that you use their influence to help you get published, this is strictly prohibited by most journals. Instead, these people can help you decide whether or not your submission will be welcomed or rejected without review.

Reject without review is typical for manuscripts whose authors have not followed steps 2 to 4. It can still happen, even if you have. Reject without review is such a waste of everybody's time that you should avoid it if at all possible.

0.23 Step 8: Financial considerations to publishing

In an ideal world, there wouldn't be any more barriers to you publishing your contribution to the collective of scientific knowledge. Not only is it not an ideal world, but I would argue that there has never been a less ideal time for publishing science. Greedy publishers have taken publicly funded science and made the public pay for it time and again. Read more on this in chapters below. The way they scam taxpayers is called "Open Access":

0.23.1 Open access

Some journals are exclusively Open Access (OA)[31] meaning that you will need to pay in order to publish your accepted manuscript (author pays). Different types of OA are covered in the next chapter.

Your university may have a deal with some OA publishers so it's well worth making a note of this. If in doubt, talk to your librarian. However, watch out for manipulative publisher deals that make you more likely to publish OA when your institution has a "read-and-publish" deal. Remember to ask yourself your motivation for why you are choosing your journal. Choice by publishing company should never be high up on anyone's list.

0.23.2 Page charges

Note that some journals that remain behind paywalls still demand page charges. These can be quite substantial if you come from a lab with no money for publishing costs. In my experience American society journals regularly have page charges.

0.23.3 Fee Waiver

Note that with all of the above you may be eligible for a waiver to page charges or Open Access fees. See the chapter below about who gets a waiver.

[31] openaccess1.html

0.24 Step 9: Type of peer review

Another factor that may influence your choice of where to publish is the type of reviewing done by each journal.

0.24.1 Single blind review

This is the traditional method of reviewing papers where the reviewers are anonymous but the authors are known to the reviewers. Many studies have suggested that the style of reviewing allows the prejudices of the reviewers to influence whether or not they recommend a paper be accepted. Although this is the most common type of review format it is the least recommended. If you or your advisor feel that there may be potential reviewers who bear a grudge to your laboratory, your institution or your work then it may be better to avoid this kind of review system.

0.24.2 Double blind review

In journals that practice double blind review, the author names and acknowledgements are removed from the manuscript before it is seen by the reviewers. This way the reviewers don't know who the authors are. Similarly the names of the reviewers are withheld from the authors. Only the editors and associate editors of the journal know who the different actors are.

This is a good system as it potentially removes prejudices that are known to exist in the mainstream of STEM reviewers (i.e. middle aged, white males). Prejudices that have been noted are against scientists who are not middle aged (or more specifically tenured professors advanced in their careers), white or male. This comprises most of the world's scientists so you may want to opt for a journal with double-blind review if you have the choice.

0.24.3 Triple blind review

Essentially the same as double blind review, except for the fact that the editors also do not know who the authors or reviewers are.

0.24.4 Open review: named authors and named reviewers

This could be considered the gold standard for any journal. It has also been called Open Evaluation (OE) by Kriegeskorte et al (2012). The reviewers

know who the authors are, and the authors know who the reviewers are. Moreover, the reviews of the reviewers are a matter of public record that are open access (carrying a DOI[32]) along with the published paper. PeerJ and ELife are among a very small handful of journals that have tried to instigate this model. Nevertheless it can be very difficult to find reviewers who are prepared to reveal their names to the authors.

0.25 Impact factor

The impact factor of the journal may be an important motivation in your choice, or that of your advisor. I've left it off my list of stepwise criteria as I hope that it's not going to influence you according to the San Francisco Declaration on Research Assessment (known as DORA). If Impact Factor[33] is important to you, include it in the list that you produce and make a note of the most recent impact factor for each journal. There's more about the impact factor in a chapter below[34].

0.26 Shortlist

Once you have your shortlist of journals to consider, take it to your advisor. Together with your advisor rework your list into something that you both agree with and then propose it to your co-authors. Rank your list by journals that you want to try first and those that are your last options at the end.

Keep the list so that if you are rejected by the first journal on your list you know where you're going to next.

[32] doi.html
[33] impactfactor.html
[34] impactfactor.html

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Open Access or Paywall for your manuscript?

There are many well established benefits to publishing an Open Access (OA) paper where there is no pay wall to any readers. These include, increased citations, increased exposure and coverage by the media, not to mention increased interactions with the public and the moral and ethical duty to be able to share research as widely as possible. Many studies are now suggesting that the advantages go even deeper (see a collection of studies by Tennant, 2017). However the current reality is that most publishers will then require you to pay in order to produce your publication open access. There are chapters later on in this book that discuss the importance of open access. In this chapter, I review the different OA models offered by different publishers. At this period in time, the names are somewhat fluid, and you may not find the specific term mentioned here on the publishers' website.

0.27 Closed Access: i.e. The Paywall

This refers to the need for your institution or you personally to be subscribed to the journal in order to access the content. This is the traditional model in academic publishing. If you are a member of an academic society then you may get access to their society journals through your membership. This is still effectively a paywall that is maintained by the publisher and the society together (Figure 1).

It is sometimes hard to know if there is a paywall if your university subscribes to the publisher or the journal that you are interested in. There has been a lot of headway made in having seamless integration and access to articles behind paywalls from within university IP addresses.

If you try working from home then you will quickly find out which journals exist behind paywalls. See later chapter for ideas on how to get around the paywall if you need to.

Although publishing an article behind a payroll is often frowned upon these days it usually means that there'll be no cost for you as the author, and so

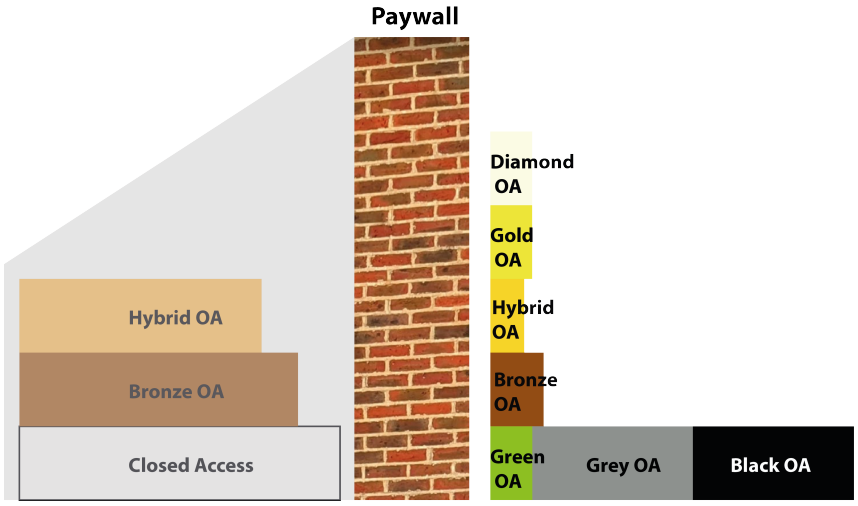

FIGURE 1: The world of Open Access (OA) is built on shaky foundations. Much more of journal content is still behind a paywall, even for journals that practice Hybrid and Bronze OA. When you are inside your institution, you may not notice the paywall due to seamless integration with many literature databases. You will be far better acquainted with the paywall if you are from a smaller institution or trying to access literature from outside your institution. Once you are the wrong side of the paywall, your options for most content will be Grey and Black OA. There are regular assaults on these two initiatives by publishers.

for many academics is still the only real option in terms of publishing their scholarly work in an academic journal.

There follows a brief description of each of the OA models. See Piwowar et al (2018) for a historical review of these different models:

0.28 Gratis or Libre OA

Some definitions of OA extend beyond simply being allowed to read the text (Gratis OA) to it bearing a "CC-BY" Creative Commons license (see here). This Libre OA means that in addition to being able to share, redistribute or copy the content, the CC-BY (4.0) licence allows others to "remix, transform, and build upon the material for any purpose, even commercially".

A good example of this would be my ability to publish the following figure

(Figure 2) from Piwowar et al (2018) as the content of PeerJ is published under CC-BY licence.

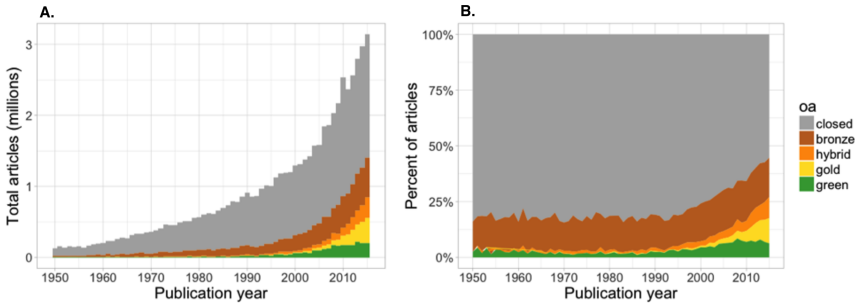

FIGURE 2: Figure 2 from Piwowar et al (2018) shows the increasing number (A) and proportion (B) of a random sample of 100 000 papers published with a CrossRef DOI shows an increasing trend in gold and hybrid OA publications since 2005.

0.29 Green OA

This is an option no matter what journal you publish in (including the paywall). You take the accepted manuscript before it has been typeset, and you deposit it in your institutional repository; usually your library hosts this. This is sometimes referred to as a postprint (manuscript with changes made following peer review) - the same version that has been accepted by the journal. Once your paper is published by the journal anyone can access the manuscript that was accepted because it is free from your institutional repository. However the typeset paper will remain behind the publishers' paywall.

0.30 Bronze OA

Bronze Open Access is an option at the discretion of the publishers. Only some publishers do this for some of their content. For example, they may decide that a certain thematic issue should be open access, an editorial, or review article. There is some debate about whether this bronze model is truly OA as it often still carries copyright restrictions.

0.31 Delayed OA

Some journals choose to have their archived content available for all readers without a paywall. Like Bronze OA, there is some debate about whether delayed OA is truly open as it often still carries the publishers' copyright restrictions.

0.32 Gold OA

In a journal with gold open access it is compulsory for you to pay the open access fee in order to publish your paper. These fees can be very large, so if your choice of journal is gold open access then make sure that your advisor knows.

Examples of gold open access journals are PLoS one[35] and PeerJ[36]. The advantage to these journals is that as soon as you publish your work in them, everyone will have access to it without any paywall. The disadvantage is that you may not be able to afford to publish there. The disadvantages of these journals are now becoming very prominent in the Biological Sciences, such that you may be excluded from increasing numbers of journals in your field. Alarmingly, journals with higher impact factors are also charging ever increasing sums to publish Gold OA (Gray, 2020). Gray (2020) makes the important point that prestige (often confused with Impact Factor[37]) is being allocated a higher price in Gold OA, that is likely to disadvantage and disenfranchise scientists from less wealthy institutions and countries. This is likely to reinforce an increasing dichotomy between rich and poor researchers. We will take another look at who pays for OA in part 5[38].

Watch out for predatory journals amongst journals with Gold OA. (See chapter on predatory publishing in part 5[39]).

[35] https://journals.plos.org/plosone/
[36] www.peerj.com
[37] impactfactor.html
[38] openaccess.html
[39] predatory.html

0.33 Hybrid OA

Hybrid OA journals are increasingly the norm. You can decide upon acceptance of your manuscript whether or not you want to pay the fee to make your article open access. Again note that your institution may have a deal with the publisher that means that anything you publish there is open access. It is well worth knowing these things in advance before you submit. If you can't afford to pay the open access fee then your manuscript will remain behind a paywall and be only available to subscribers.

A slight variation on hybrid OA is when you are a member of an academic society that allows its members to publish open access without extra payment. As a student you are likely to get very discounted membership to an academic society Which might make it very cheap for you to publish open access with them.

0.34 Platinum or Diamond OA

These journals are very rare but they do exist. In a platinum or diamond open access journal you do not have to pay any money but everything that is published is open access. In order to do this these journals are often subsidised by governmental or philanthropic agencies. Some university presses are also in the habit of publishing platinum or diamond OA when it meets with their stated mission.

0.35 Black OA

This refers to the placement of published material onto a pirate website such as Sci-Hub[40]. Sci-Hub is considered by most governments to be illegal and may be blocked by your institution or country. However they do a great job in making scientific applications open access and need to be supported for that. Many scientists all over the world depend on Sci-Hub in order to access literature and therefore conduct research. In addition, there are a number of

[40] https://sci-hub.se/

other Black OA sites: Unpaywall.org[41], Open Access Button[42], freefullpdf[43]. See part 2[44].

0.36 Grey OA

You can find grey OA repositories of published material on Academic Social Network sites in which you need membership to access such as ResearchGate[45] and Academia.edu[46]. The legality of such sites is regularly questioned (see Piwowar et al., 2018, for more details). There has been legal action with thousands of members being issues with take-down notices.

0.37 Supplementary Information and Data

Whichever route you decide to go for your manuscript, please do not place your data with the publisher. There are some examples where publishers choose to place both data and supplementary information deposited with them behind a paywall, even if the article is available Open Access. We also need to ask whether the publisher has the long term vision to curate data, especially when the expense associated with this will rise over time as datasets accumulate behind their paywall. See part 3[47] for some suggestions about what to do with your data to make it available for all.

0.38 Unsure what you can legally do with published paper?

If you don't know what level of copyright exists on something that you have published, then you can find an aggregated set of publisher policies at Sherpa

[41] https://unpaywall.org/
[42] https://openaccessbutton.org/
[43] http://www.freefullpdf.com/
[44] paywall.html
[45] https://www.researchgate.net/
[46] https://www.academia.edu/
[47] transparency.html

Romeo[48]. This is a really nice database which provides a very simple summary by journal. You can also use this to check out a journal that you are thinking of publishing with.

[48] https://v2.sherpa.ac.uk/romeo/

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Should you submit your manuscript as a preprint?

Later on in the book (part 5[49]) there is a chapter that deals with preprints, explaining what they are and how they function - essentially a place for manuscripts prior to peer review. However, the question of whether or not you should submit your paper as a preprint is relevant now. Essentially, there is no right or wrong answer, and it's entirely up to you, your advisor and your team of authors.

Here are some reasons for and against submitting your manuscript as a preprint:

0.39 For:

- Your manuscript needs to be cited by another that you are submitting and you are worried that the peer review process will take too long
- You are aware that another lab is working on a similar project and are worried that submitting to peer review will scoop your findings.
- Your work has immediacy that it might not have after (potentially) 3 months of peer review. It may be that by releasing your preprint you can contribute to an ongoing debate that otherwise you'll potentially miss.
- You are concerned that you've missed something important or perhaps analysed something in a novel way that others might be able to help with. You want this chance at feedback before submitting to peer review.
- Your manuscript crashed out of peer review with comments that you felt were unfair or unsubstantiated. You are looking for more balanced comments.
- In the above case, you might be able to use your preprint as leverage to persuade an editor that your contribution should be fast tracked into their journal.
- If you can generate enough buzz and positive feedback, you might be able

[49] preprints2.html

to get leverage on an editor for submission to a journal with a higher impact factor.
- You have a working group that you actively want to share your publication with, even before it is published

0.40 Against:

- Any of your co-authors don't want the manuscript submitted as a preprint before peer review
- There is a real chance that others can use the access to your work and publish it before you

I can't really come up with a lot of reasons against submitting a preprint. This is possibly because I'm broadly in favour of preprints and see that there is value there. However, I've done it with only a fraction of papers submitted in the last 5 years. Why?

My experience of preprints is disappointing. Although these get widely shared on social media, and garner a large number of downloads, they don't generate comments from colleagues. Even when we have sent links of preprints to colleagues asking directly for feedback, we've received nothing. Looking through a random selection of preprints on PeerJ, I found no comments, suggesting no feedback for any of them.

At this point, I should say that I have not (yet) made any public comments on a preprint. When I have looked at preprints, I (generally) have downloaded them in order to look at some of the details (often the methods or analyses), when there's a dearth of peer reviewed (published) material. There are a few references to preprints in this book. I'll replace them if I find that they have been published. But what should I do if the published version doesn't contain the point that I'm citing on? In this case, I'll delete the citation and no longer make the claim because there is the chance that the result did not stand up to the rigours of peer review.

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Submitting a paper to a journal for peer review

This chapter deals with the process of submitting a manuscript to a journal (Figure 3), and what to expect once this is done.

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knitr::include_graphics("figures/Editorial-work-flow.png")
```

1. Targeting journals for submission: there are a lot of journals out there, and you need to make sure that you are submitting your paper to a journal in the right subject area (see part 4 for a detailed chapter on this subject). Remember to keep your ordered list of journals that you prepare so that you can refer back to this in the case of rejection.
2. Prepare your manuscript (ms) according to the journal guidelines: this may require a lot of work especially if the journal requires full formatting on first submission. Some journals require additional items such as graphical abstracts, so make sure that you know what is needed.

- Very important to note are any word limits (including for the abstract), and potential caps on number of citations.
- After approval from your advisor, circulate this final version among your co-authors. This is a good time to gather the needed meta-data for submission.
- You'll (usually) need a letter to the editor, key-words, recommended (or opposed) reviewers, and addresses (with ORCID) for all authors. These should all meet the approval of your co-authors.

1. For the purposes of this chapter, I am assuming that you are the corresponding author. This is something that you should learn to do, but check with your advisor about whether or not they think it is a good idea for this submission.

- Being the corresponding author carries some extra duties as they are responsible for making sure that all the other authors are in agreement about the

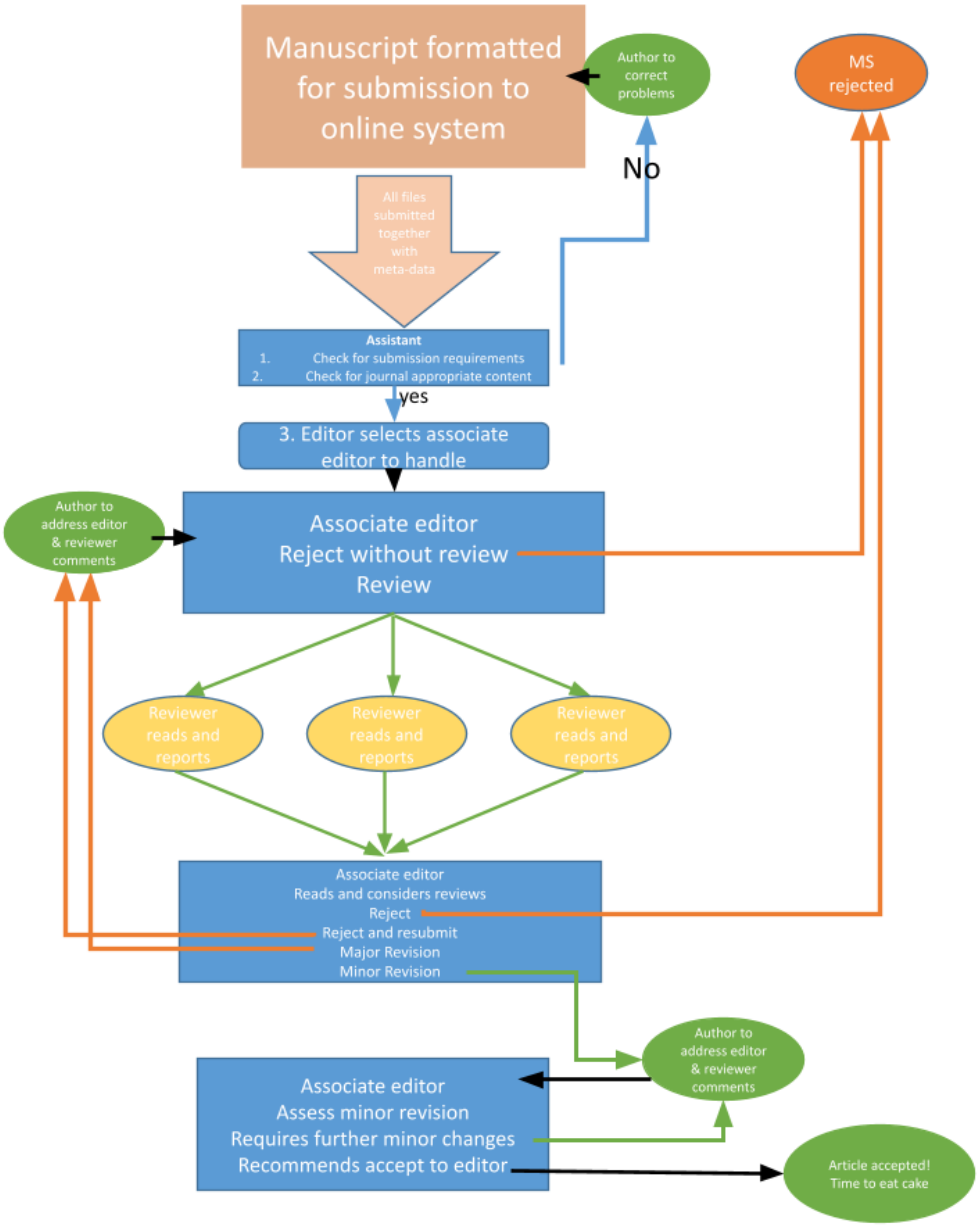

FIGURE 3: This schematic demonstrates the editorial work-flow of a 'typical' journal. Be aware that although it does take a lot of effort to get a manuscript ready for submission, once it is submitted, there is a lot more work taken on by a large group of people who are (usually) not paid, and who are undertaking the work associated with your manuscript in addition to their 'day jobs'.

contents of the paper before submission. They are responsible for gathering all of the necessary information about each of the authors on the title page.
- Most of the following principally concerns the corresponding author. If that's not you, then you get an idea here of what is going on.

    1. Uploading your ms to the editorial management software requires time and preparation. Give yourself a good couple of hours for this process, as it can be frustrating.

- Friday afternoon might not be the best time. You may well need to refer back to your advisor and any other authors if you don't have their relevant information (see 2c).

    1. Once submitted to the system, your manuscript is usually checked before being passed to the editor. You may get it sent back if the meta-data is wrong.

- As corresponding author, it is courteous at this point to send a copy of the submitted version (usually the journal provides a pdf of the submission) to all of the other authors for their records.

    1. Inside the management systems, there are various workflows, and here I'll describe something typical, although others do exist. Once the editor (often Editor-in-Chief) has your ms, they will decide which Associate Editor (AE) will handle it.

- The AE should read the ms and may reject it if they feel that it won't make it through review. An AE rejection isn't great as they don't always have the best experience in knowing what will and what won't make it through. The editor usually has more experience. Hopefully, this won't have taken long (1-2 weeks) and so won't be very painful. This rejection may be fair or unfair, but it's done and there's nothing much you can do except return to step 2 (above).
- Normally, your ms will be sent out to review and you can expect to wait 4-6 weeks (good), but sometimes up to 3 months, for a decision. If it's away for over 3 months, you should definitely make a query on the editorial management system.

    1. Once back from review, you'll get an email from the editorial management system with the decision.

- If it's **Rejected**, take the comments of the reviewers on board. Think about it for a couple of days, and then set about revising the manuscript. However

unfair you think the reviewers have been, there should be some important messages for you to consider carefully and discuss among the co-authors before going back to step 2.

- **Reject and resubmit:** This is a category that means you need major revision, but the journal doesn't want the time that it takes to do this on their stats. In many journals, this result has replaced 'major revision'. Back to step 3 with a track changes manuscript and response letter to reviewer comments.
- **Major revision:** essentially the same as 6b. Both 6b and 6c result in your ms being reviewed again. You'll need to carefully prepare both the ms and the response to reviewers as the reviewers will see both. Back to step 3 with a response letter.
- **Minor revision:** is unusual at this stage, but your ms should now only be assessed by the AE, so you should address your responses to them.
- **Accept without revision:** is practically unheard of. Possibly, your ms has already undergone some peer review (maybe as a preprint or in another journal). However, if you get this result after the first round of peer review, it's time to eat cake.

1. If you are resubmitting, aim to prioritise this to get it done in 2 to 3 weeks if possible.

- The reason is that the same reviewers are likely to be willing to look at your ms again within a month, and will remember all the points that they made. Similarly, the AE will remember all of the issues that they had. It's hard to stress how valuable this is, as keeping it all fresh will result in a swift response.
- If you don't or can't manage to get your responses back quickly, you might expect a rocky ride through the review process when you go back for the second round. The reviewers you had before might not be available, but the AE will be obliged to have at least 2 reviews again. This means that you may get new reviews. New reviewers are likely to throw up new issues, and could result in your ms getting rejected at this stage, or that you'll have another major review decision, sending you back to step 3 with a track changes manuscript and response letter to reviewer comments. This drags the whole process on for much longer and reviewers and AEs are likely to look less favourably at your ms.
- A better result is when there are only minor revisions. In this case the ms is simply bouncing between you and the AE and even if this happens more than once, it's fine as long as you can keep the response time reasonable (within a couple of weeks).

1. Hopefully by now your ms has been accepted, and you are entering the last stages of the process. Your accepted ms should be sent to the publishers for typesetting, and you can get the proofs back

very quickly (for some publishers). Most demand that the proofs are returned very quickly (often within 48 hours), and you should try to prioritise this if you can. If you can, please also send it to the co-authors. The more eyes the better at this stage for spotting errors. Don't expect to be able to change a lot in the proof process, it's really just for catching errors. Carefully check all figures, tables and legends. It's not unknown that typesetters cause problems when they make proofs (tables can be disasters).

- Check the acknowledgements again and make sure that your funders are included. You should always acknowledge your funders for their support. I also suggest adding in the reviewers (even if anonymous) for their help in improving the ms.
- If you (or a co-author) spot a fundamental error with your data or analyses at this point (or any of the other steps above), you should discuss it with all co-authors and decide what to do. It's better to withdraw the ms than to have to retract it later (see part 5).

The peer review process is not ideal, but it is worth remembering that it's there to help improve your manuscript. Different reviewers have different styles of review, and these tend to be culturally distinct around the planet. You should be aware that apparently 'rude' comments by reviewers might simply be attempts at humour (see chapter below). Try not to be disheartened by anything that you read in a reviewer's comments. You never know the conditions that they were in when they read your manuscript, or what their day was like. This is also a point to consider when writing a review for a paper.

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What is peer review?

Peer review is often considered to be the gold standard of science (Mayden, 2012). Manuscripts that have passed peer review should be considered to have been scrutinised to the highest level. If one's peers in the scientific community consider that a manuscript is worthy of publication, then it meets the high standards of peer review. The review of peers acts as the gatekeeper to all that is good in science, and excludes all that is bad.

While the views in the above paragraph are generally held, there is also a general acknowledgement that there are a lot of problems with peer review. That this has been widely acknowledged is probably an understatement as most people who have experienced would likely already know. If you look at the end of this chapter, you will see that there has been a lot of research on peer review, and there's a lot more out there that I haven't cited.

In this chapter, I attempt to explain what peer review is, how to do it, and some of the common problems associated with it.

0.41 How high is the peer review bar?

It is difficult to emphasise how high the peer review bar is. When your manuscript is scrutinised by your peers, it is very rare that it will get accepted without modifications. This is because the experience of academics tends to be so wide, and vary so much from individual to individual, that it is almost impossible to predict what a peer reviewer will see when they read your manuscript.

You should expect that your manuscript will not receive an easy ride through peer review. But you should also expect that it will be improved. As we will see later, this improvement might not be immediately obvious to you when you first read the comments.

0.42 Who are your peers?

Essentially the peers in peer review are people that editors find and persuade to conduct the peer review. it can be difficult to find people to conduct a peer review. Although only 2 or 3 reviews are needed sometimes as many as 20 or 30 individuals can be approached. Perry et al (2012) lamented on the increasing difficulty in persuading colleagues to conduct peer review of manuscripts.

0.42.1 Professionals

Peer reviewers are normally professionals. Academics postdocs or postgraduate students. Occasionally there are amateurs who have very high academic standards and who can be contacted to conduct peer review.

0.42.2 Scholars

Peer reviews should be familiar with the subject area to a good level of scholarly achievement. Undergraduates and many postgraduate students would not be considered eligible by many editors as selection for peer review. Personally I found that many PhD students, especially those in their final stages of studying are very good peer reviewers.

0.42.3 Specialists

Few reviews should be specialists to some degree of the area on which the manuscript is based. often it's not possible to be a specialist in every area of a manuscript. But in the case where you are not proficient it is important to inform the editor.

0.43 History of peer review

The history of peer review is surprisingly modern. We have already seen that journals themselves only date back to the 17th century (see chapter in Part IV[50]). These journals included a form of peer review in that letters concerning

[50] whatjournalfor.html

studies could be published, along with comments made at presentations. The type of systematic enforced peer review described in this book is very recent. The journal Nature for example only started systematic peer review for its articles in 1973, and mainstream editor led peer review only really started in the late 1940s (see Tennant, 2017). Typical society journals have followed a similar form of evolution from newsletters to scholarly journals (Measey, 2011).

0.44 How to conduct peer review

Most modern journals provide reviewers with a guideline for the expected to do. I encourage you to read the specific instructions that are given by journals on how to conduct peer review for them. There are also a number of excellent blogs to read about peer review (including this one[51] and this one[52]). A systematic assessment of these requirements in biomedical journals has been undertaken by Glonti et al (2019). This is worth reading for an overview on the different sorts of statements that peer reviewers come up with. You can see in this quantitative analysis that the overwhelming number of comments are those of skilled critics. This paper also makes it clear that the role of peer reviewer is often ambiguous and that reviews are not consistent in what they deliver.

Essentially peer reviewers are tasked with determining whether or not the manuscript is credible.

- Could the study be repeated?
- Are the methods legitimate in order to produce the results provided.
- Are the results sufficient to respond to the hypothesis posed?
- Can it be improved?
- Is the content of the manuscript appropriate to the journal?
- Does the experimental design contain sufficient controls?
- Did the authors try and stretch the implications of their results beyond the credibility of the manuscript?

Once you have conducted your peer review, you can log it publons[53] in order to get credit later on. Publons also carries your publication output and citations (tied to Web of Science), so can be a useful way of keep track of your own productivity (but see[54]).

[51] https://peerj.com/blog/post/73296165864/how-to-become-good-at-peer-review/
[52] https://publons.com/blog/6-common-research-flaws-to-watch-out-for-in-peer-review/
[53] https://publons.com/about/home/
[54] impactfactor.html

0.45 The spirit of peer review

At its heart a peer reviewer should be trying their best to improve the manuscript they read as much as they possibly can. This may simply represent an improvement in the way the text is worded. But it may also mean adding extra analyses or even experiments.

As McPeek et al (2009) put it, the golden rule of reviewing is to do unto others as you would have them do unto you. Baglini and Parsons (2020) provide some useful insight into how to remain neutral when making reviewer comments. Again, the emphasis is on being professional.

0.46 There are ethical considerations for reviewers

- Reviews may not share manuscripts with other scientists unless specific permission is given by the editor.
- Similarly reviews should not discuss the content of manuscripts that they are reviewing
- Reviewers should not try to take the work presented in the manuscript and copy it for publication (i.e. do not steal the ideas).
- Reviews should be conducted within a reasonable time frame. No reviewer should hold on to a manuscript especially if they have a vested interest (like a rival study) in not seeing it published. This should have been declared as conflict of interest.
- Any other potential conflicts of interest, including those that might make you positively predisposed to the authors.
- Be aware of their own prejudices and biases and not bring them through to the review process
- Whether or not to sign your review. Given the opportunity ~43% of reviewers will provide published open reviews (Wang et al., 2016).

In essence these ethical issues are overcome when reviewers conform to transparency. In order to facilitate transparency in peer review, Parker et al (2018) have produced a checklist that I encourage you to use if and when you are asked to conduct a review.

0.47 What are peer reviewers asked to do?

The peer review report consists of three major parts:

0.47.1 The review

Peer reviewers should sum up the manuscripts in their own words to demonstrate that they have understood the contents. This is important because being able to summarise what you have read demonstrates the reviewer's comprehension. If the reviewer gets this summary wrong, then it is either a flag to the editor that they lacked the necessary comprehension to make their review meaningful. Or, because there are two sides to comprehension, a flag to the authors that they failed to write their manuscript in a way that made it easy for the reader to comprehend.

The reviewer should then provide a general critique including positive and any negative aspects of the manuscript. They should provide detailed information on exactly how the manuscript should be improved, including any significant literature that might be missing from the manuscript. Lastly, they can provide a list of minor comments along the length of the manuscript that require further attention from the authors. When I undertake this last part, I tend to do it with page and line numbers (which is one reason why submitting a manuscript with line numbers is so important. If the minor comments get too numerous, then I tend to stick with major comments.

0.47.2 The confidential comments to the editor

I'm not a big fan of confidential comments but sometimes they are warranted. The reviewers are provided with a box where they can write to the editor without text being seen by the authors.

0.47.3 Their opinion of what the editorial decision should be

In many journals, the reviews are directly asked whether the manuscript should be rejected and resubmitted major or minor revisions. Personally I don't think that reviewers should be asked these questions as this is a decision for the editor after having read the reviewers comments and the manuscript.

0.48 What are reviewers not asked to do?

0.48.1 Peer review is not a trial by committee

Those of you who have experienced manuscripts being critiqued at a book journal club will know that there are very few published papers that leave a journal club without having many negative critical comments. Instead peer review is conducted by an individual, on their own and with their own personal limitations. Peer reviewers are forbidden from sharing the contents of a manuscript with others, without permission from the editor.

0.48.2 Correct English grammar

As mentioned in (Part II[55]), it's not the job of a reviewer to correct any faulty grammar on a manuscript. similarly it is not up to the reviewer to correct stylistic aspects of the manuscript.

I have noted that some reviewers have become quite obsessive about things like the Oxford comma - insisting that the Oxford comma should be inserted at every possible juncture. Instead I think that it is important for authors to keep their own voices. See chapter in part 2.

0.48.3 Tell the authors to cite their papers

Sadly, this is something that a lot of peer reviewers do. At most, the reviewers' own work can be cited, but only when relevant.

0.48.4 Tell them to cite other papers from the journal

This also happens see chapter on Impact Factor[56] often at the request of the editor.

0.48.5 Justify comments with their own beliefs and opinions

Peer review should always be an objective critique of a manuscript. It's not really the place of the reviewer to express their opinion or their beliefs about a particular study that they are reviewing.

[55] foreign.html
[56] impactfactor.html

Reviewers should stick to the evidence that they're provided with. If they are not provided with sufficient evidence then they should draw attention to the lack of information rather than extrapolate to what they believe might be the case.

Authors should be provided the benefit of the doubt and opportunity to respond to such criticisms especially when information is missing. It's unfair for reviewers to act as judge and jury. This is the job of the editor.

0.48.6 Assess aspects of the manuscript that are beyond their competence

Some manuscripts are cross-cutting across several subjects or may contain analyses outside it with the experience of a reviewer. In these cases reviewers should not attempt to review areas that are beyond their competence. Instead they should bring these aspects to the attention of the editor when they are submitting their review.

0.48.7 Ignore what is good

Is often thought that peer review provides only negative criticism. This should not be the case as peer reviewers should also be able to accentuate the positive aspects of manuscripts that they read. Even if a manuscript is not considered publishable the positive attributes should be bought the attention of the editors as well as those that are negative.

It is important for authors to understand what aspects of their manuscript are good. This kind of feedback from peer review will influence future versions of this manuscript as well as future studies from these research groups.

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Responding to reviewers' comments with a rebuttal

Peer review is the basis of guarding and maintaining quality in science. Whether you have just received examiners' comments on your PhD thesis, or you've just got a decision from a journal, you'll need to respond to the comments. This to and fro between authors and reviewers usually doesn't exceed two rounds. For examiners of your thesis, you'll usually only have to respond to the satisfaction of your advisor. In both cases, the approach is essentially the same. As you approach the comments, there are several points that it's worth bearing in mind.

Reviewers' comments can come across as harsh, upsetting, rude and even arrogant. While it isn't ok for reviewers to be rude, it does sometimes happen. I think that the reason why we find the comments so harsh is usually because we put so much effort into the writing process that it feels very personal whenever we receive criticism. Indeed, I think that there might be a correlation between how much effort you put in and how harsh the reviewers' comments seem. Just be aware that this is normal. Remember that the reviewers are humans, and they have sat down and given freely of their own time to read your work. The most important thing to be aware of is that all they had was what you had written. No background information, and possibly no information about the species or the system involved. They will be experts at some level, but perhaps not the type you might expect. Importantly, the editor asked them because they thought that their opinion would be of importance in helping them make their decision on your paper. This means that you also need to respect their opinion and comments, even if you don't agree with them or find them to be offensive, arrogant or even rude. Remember also that some apparent rudeness may just be a reviewer who has a sense of humour that you don't understand. There are lots of examples of this at ShitMyReviewersSay[57]. So no matter what you think of each comment, you should respond to it in a professional and courteous manner that shows that you are a professional scientist.

If you already know what it's like to receive reviewer comments, but struggle to understand why reviewers say what they do, then it's time for you to start reviewing papers. You can ask your advisor to mention you as a potential

[57] https://shitmyreviewerssay.tumblr.com/

reviewer (especially if they are going to decline because they are too busy). But probably the best way to get started is to participate with your lab or journal club in the review of a preprint (see part 4[58]). This has the advantage that you are not the sole reviewer, but will be in a group. Your group will get credit for their review (via a DOI[59]). You will get to discuss the finer point of reviewing with your team. Especially, you will likely hear remarks that might come across as insulting or unprofessional and it'll give you a chance to challenge these at source.

Why do scientists make disparaging or unprofessional remarks to their colleagues in peer review? Whenever two or three scientists get together, you hear tales of recent woes associated with peer review. The retelling of such stories is all part of the collective, cathartic unburdening of what can be a traumatic experience especially when we put so much effort into each piece of work (see Hyland and Jiang, 2020). Reading through a lot of these reviewers' comments, I can see that there is an attempt at humour (see here). This humour is not appreciated by those who receive the reviews. Perhaps I understand the humour, because I also come from that same culture that dominates STEM, but that is not understood or even recognised as humour by others. Writing humorous reviews is unprofessional, especially if it is used to accentuate negative aspects. Needless to say, we could all do without unprofessional reviews.

0.49 What to expect in your decision letter

Usually, you will receive a decision letter (email) after ~60 days. This depends on the journal, editors and reviewers, but it's worth checking with the editorial team after 60 days if you've heard nothing. When you finally receive it, the email will contain some stock text about the overall decision, some information about how to resubmit your revised version (if you have this as an option), and a time-frame. After the editor has signed off, you will find comments first from the Associate Editor (AE) who handled the review, and then from (typically) two reviewers, but sometimes three (or even more).

Dear Mr Another:

[58] preprint.html
[59] doi.html

Thank you for submitting your manuscript entitled "An appropriate title for a reasonable manuscript" to *The Best Journal*.

All manuscripts are assessed by a specialist member of the Editorial Board, who decides whether the manuscript is suitable for *The Best Journal*.

Unfortunately, your manuscript has been rejected at this stage of the assessment process. Competition for space is currently extremely severe, and we receive many more manuscripts than we are able to publish. On this occasion it was felt that your manuscript was unlikely to be able to compete successfully for a space in the journal.

Please find below the specialist Board member's comments. I hope you may find these useful should you wish to submit your manuscript elsewhere.

Sincerely,

A.N. Earnest-Editor

Editor in Chief

The Best Journal

Rejections are harsh, but totally normal (Day, 2011). You will feel bad, and this is also normal. You will need to pick yourself up, and take your manuscript back and try again. Learn as many lessons as you can from your rejection and quickly move on. Certainly, never dwell on a rejection and feel that this is anything more than a minor setback. All of us have been rejected, and continue to deal with rejections throughout our careers.

If you receive a Reject decision, then some journals will want you to submit to another journal in the same stable. Typically, these are Open Access journals where you have to pay a large sum just to get published. This is rarely a good idea. The standings of these journals is (typically) not great, and you'd probably be better off going back to your original list and selecting the next journal there.

0.50 What to do when you receive your reviewer comments

Your reviewer comments will arrive in an email when you are busy doing something else. If you have time to read them the same day, then my suggestion is that you read without trying anything further. Remember to forward them to your advisor as soon as possible. Simply read the comments and then close the email and mark it for further attention the next day. Your writing is very personal to you, and you might be surprised at just how hurtful it can feel to have someone critique your writing (and your experiment) without holding back. If you've not experienced this before, then prepare yourself. No matter how much effort you put into your text, sending it out for peer review is

a really high bar. Make an appointment with your advisor so that you can discuss the comments together. Whether good, bad, or bizarre, it is best to set aside some time to read through the comments carefully, so that you can respond.

Dear Ms Another,

Your manuscript has been reviewed for The Best Journal by Dr. Fitz Wilklewood, one of our Handling Editors, who made a recommendation to reject this manuscript with which I concur. As a result, I am unable to accept your paper for publication in *The Best Journal*. However, both Dr. Wilklewood and the reviewers felt that there were exciting and interesting aspects of the work and that if you could address the concerns outlined below, this manuscript could be appropriate for *The Best Journal*. Thus, I would be willing to entertain a resubmission of this manuscript if you can address the concerns described below. If you choose to resubmit, the revised manuscript will be assigned to the same Handling Editor for further review. This decision does not guarantee that a revised manuscript will eventually be recommended for acceptance; indeed a significant fraction of resubmissions are rejected after revision. The comments from Dr. Wilklewood and the reviewers are provided below.

If you wish to submit a greatly revised manuscript, address the points raised in the reviews and then resubmit your manuscript by 28 Apr 2021 to https://www.managereditorial.com/. Please provide a detailed response to the previous reviews in the "respond to reviewers" text box. I expect to return the manuscript, along with your response to the original Handling Editor.

Please review our detailed author instructions for proper manuscript formatting: "*The Best Journal* Author Instructions General" (Manuscript guidelines) and "*The Best Journal* Author Instructions Figures" (Artwork instructions). These files are located at

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Please make sure to submit editable source files (e.g. Word). We will return manuscripts which do not follow these guidelines.

Thank you for considering *The Best Journal* as an outlet for your research results. If you choose not to undertake these major revisions, then I wish you the best of luck in finding a more suitable outlet for your work.

Sincerely,

A.N. Earnest-Editor

Editor in Chief

The Best Journal

Comments to Authors from Handling Editor and Reviewers:

Handling Editor: These are the comments from the handling editor - in this case the esteemed Dr. Fitz Wilklewood. If you don't get any comments from the handling editor, I take this as a bad sign for the journal and their editorial regime (see chapter below).

Reviewer #1: Comments from reviewer number 1 follow. The order of the reviewers is not really of any consequence, although it does reflect that order in which they accepted to undertake a review. Hence, most often Reviewer #1 will be more positive than subsequent reviewers. The evidence for this comes only from my experience, and if there's not been a study done yet, then I think that it should be.

Reviewer #2: Of equal importance to Reviewer #1, but numbered just to make it easier for you to respond to.

Reviewer #3: You may or may not get three reviews.

The reviewers are usually given two boxes to write comments in. One pertains to the comments that you receive in your letter, and the second are confidential comments to the AE. Remember that the AE is acting on both of these sets of comments, and so the decision may reflect something that is said in confidence. This is not really in the spirit of transparency for peer review. The best peer review systems are open and online.

Once you've found the time in your week, sooner is better than later, sit and read the comments again. Normally, they will sound much better, and less harsh, on the second read (if not, try third or fourth). They will seem far more approachable than when you first read them. Most reviews will have a set of major (when applicable) and minor comments that you need to address from each of them. Try sketching a few responses down to the major revision comments before your meeting with your advisor. The easiest way to do this is to copy all of the comments from the email (together with those of the editor), and paste them all into a fresh document. Use a different colour text or a clear set of symbols (e.g. »») to indicate which text is your responses and which is the reviewers or editors. Or number each comment and reply. If it isn't clear enough, then the editor may well get confused about what is the comment and what is the rebuttal. One of the best ways I've seen of doing this was to make a table with all the comments in one column (each on a separate row), and the author responses in a new column.

Sketch out your responses to the major comments, and use a tick if you are happy with making the suggested minor comments. If there are comments that you don't know how to handle, simply leave them with a question mark. By making this start before you meet with your advisor, you will have an idea of what is likely to be difficult to tackle in the revision. Even if you've received a rejection with reviewers' comments, it's well worth having this same meeting with your advisor so that you can decide together what to do next. Skipping on comments from reviewers during a rejection appears to be very common (Crijns et al., 2021), but is a very uncollegial way of moving forward. I have personally reviewed manuscripts that were rejected, only to see them again as a reviewer in another journal with all of the same errors, even down to ignoring relevant publications.

At the end of the meeting with your advisor, you should have a clear idea of how to handle all of the comments, or where to go, what to read or who to talk to (perhaps another co-author), to sort out those you don't know. Together with your advisor, decide whether you need to send out the journal decision to co-authors now, or wait until you have your rebuttal ready to circulate. For me this decision is largely based on how much time the revision is likely

to take: if it's quick, rather send the revision and rebuttal together with the decision.

Next, when you sit down to write the rebuttal and revise the document, you need to make sure that you have pressed "track changes" on the submitted version of the manuscript. I find it easiest to have both the rebuttal letter and the revised manuscript open side by side on the screen. As you revise the manuscript in response to the comment, make a note to mark that it's done in the rebuttal letter. Mark any comments that you don't do. Your revision is written as a rebuttal to the editor. While you don't write your comments back to the reviewer, it is worth bearing in mind that the reviewer is likely to read them.

Three watchwords should be your guides for your response to the reviewers:

- professional
- polite
- precise

In addition to these, make the entire process easier for everyone by:

- Do make a note of the line number where the revision is made (note that these can shift around in the revision
- If you have reworded the text, do copy and paste that rewording into the rebuttal using quotes and corresponding line numbers.
- Simply use a word like "done" to indicate changes on Minor comments.
- Do be polite with your responses, but you don't get any extra points for wordy thankfulness or praise. So keep it succinct and to the point.
- Signal that you agree with the comment and that you have made a change to the text.

Do bear in mind that your reviewer is a human, and was likely operating under less than ideal conditions when reading your manuscript. They could have been getting constant interruptions. They could have been reading it after having read another three manuscripts. They could suffer from insomnia and read it in the middle of the night with no sleep for a week. Give the reviewer the benefit of the doubt. Do remember to thank your reviewers and editors in your acknowledgements[60]. They've been working and doing the best for your manuscript without any thanks other than what you will give them. So give them a boost and help make their day that much brighter.

[60] acknowledgements.html

0.51 What if you don't agree with a reviewer?

Most of the time, reviewer comments are sensible, helpful and genuine attempts at improving the quality of your contribution. If you don't agree with particular points, try skipping them and moving ahead with the easy points or those that you do agree with. Discuss any points that you don't agree with your advisor. Try to get another perspective on the comment. Do your best to try to see the comment from the reviewers standpoint.

For example, a reviewer might ask for details on a point in the methods, but they are mentioned in another section of the methods. This is a cue for you to add a flag to that point in the manuscript. For example, write: "see section 2.2.3 for an explanation of how this was done".

If a reviewer has made a comment that says that they don't understand something, this means that you need to make a change in your text so that the text is easier to understand. If they don't understand, then it could be that more people don't understand and you want your text to be understood by all people that are reading it, so make a change.

If you and your advisor both don't agree with the reviewer, then make it clear what exactly you don't agree with. Again, try to see it from the reviewer's perspective and write a courteous and clear explanation of why they might have misunderstood or misinterpreted what was written. Back up your comments with citations, even if these aren't cited in the paper. Provide full references for any citations you give. The more thorough your explanation, the more likely the editor will side with your perspective on the point that you don't agree with. You may find that you want to include some of this text in the ms, or that you offer to provide it in the Supp Info[61] (if there's a word limit on the ms).

Remember that the reviewer is likely to read exactly what you write in your rebuttal. Your job is to professionally explain why you don't agree. Forget any of the emotions that you might believe to be there. Revert back to professionalism, because you are a professional.

[61] suppinfo.html

0.52 When reviewers don't agree

Normally, you will have two reviews (possibly three depending on the journal policy) and comments from the Associate Editor (AE). The AE acts as a judge given the opinions of the reviewers, and so if the reviewers disagree, the AE should suggest the correct direction for you to take. Sometimes this means that the AE will consult a third reviewer (and occasionally even more reviewers). See the chapter below on why it is important for editors to read your work. If the AE gives you no direction (as is increasingly the case) then make this decision with your advisor and indicate to the AE the conflict between the reviewers and the reason why you've chosen the direction you have.

0.53 What if you feel that your reviewer is being unprofessional?

If you really feel that a reviewer is being unprofessional, it is worth flagging this with the editor. I would say that I've never had to do this myself, but I am aware that there is some unprofessional behaviour out there (I've seen it on ShitMyReviewersSay[62]). Discuss it with your advisor, but here are two potential options:

- If it's just one or two comments, then simply state that you don't feel that you don't know how to respond. Ask the reviewer to try again, or ask the editor to interpret the comment for you.
- If it is every comment from one reviewer, write an email to the handling editor and ask for their guidance. You should find their email address in the journal submission site. They will flag it with the editor and come back with a solution for you.

0.54 Appealing against a decision that you think is unfair

From time to time, a decision comes from an editor that is clearly unfair. I've had a few. As I've mentioned before, scientists are humans and humans do

[62] https://shitmyreviewerssay.tumblr.com/

have biases that manifest into their professional lives. This is the reason for double-blind review. Scientists in STEM are predominantly white and male, and express the views of this minority but powerful group. Their prejudices do manifest in their decisions, and it is important to push back against this when you feel that this is the reason for a decision.

Most (good) journals will have an appeals process and you should look this up and see what's involved. While doing this, it is worth reviewing the journal's policy on how they handle manuscripts; again good journals should have a clear policy. Of all the rejections and poor decisions I've had on my manuscripts over the years, I've only felt that decisions were unfair and worth appealing less than a handful of times.

Normally, an appeal is made to the editor in chief. Be very clear about why you are appealing and what in the decision does not tally with the journal's own policy. Remain professional and detached from the decision itself, and instead appeal on how the journal's own policy was not followed. For example, a journal may have a policy that the editor will sum up the reviewers' comments and use this as the basis for their decision. If the editor seems to have sided with one reviewer while not considering others, this can be the basis of an appeal.

Any appeal should be agreed with your advisor and the other co-authors before sending it.

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Why should an editor read your submission?

There is a worrying increase in poor editorial decision making, without any basis, because editors are not reading submissions.

When a manuscript is submitted to a journal, the submission goes to either the editor-in-chief or a handling editor based on the key words or journal section implied during submission. In some journals (like PeerJ[63]) the submissions are offered up to a whole group of editors who can take their pick. It seems that the next thing that happens is that the manuscript is sent out for peer review. But stop. That's not correct and it's really not a good way to proceed. Before sending it out, the designated handling editor needs to read the submission.

0.55 Why is reading so important?

The title and abstract really don't allow a handling editor to decide whether or not a manuscript should go out to review. There are a lot of manuscripts out there that should not have been submitted, because their authors do not have sufficient judgement of their own or because they believe that there is a reason to just 'chance it'. It is very important that handling editors read the submission, because without that they are moving editorial responsibility from themselves to the peer reviewers.

Some years ago, I co-authored a series of articles (Perry et al., 2012) that were published across many journals about how peer review was becoming very difficult for editors because so few colleagues accept to do reviews. This was a problem then, and it's still a problem now. I've recently sent out manuscripts to more than 15 people before getting two reviews. That peers are not prepared to review, or in many cases even to respond to the request, is very poor. However, more recently I'm experiencing a sharp increase in manuscripts to review that should never have been sent out.

My time is precious, and it's becoming quite expensive for my employers. I am happy to conduct peer review because it is an important part of the scientific

[63] www.peerj.com

publishing process, and I expect others to review my own work. However, I expect that any manuscript that I receive is worthy of my attention and time. If the handling editor has not read it, they cannot decide this and I really wonder what makes them think that they can send it to me (and presumably others) to read while they don't feel that they have time to do it themselves. Moreover, this appears to be a trend among younger less experienced editors (often associates) that have either not received any guidance in what their job as editor is, or they should not be editors.

0.56 If you are going to be an editor, then you must be prepared to read

I must admit that I've done it. I've sent out manuscripts to be reviewed as I didn't have the time to properly read the article, but a superficial skim suggested that it seemed fine. Not good. It's embarrassing to handle manuscripts that should be rejected without peer review. In the case I'm thinking of, once I'd read through the manuscript later on that day, I realised how bad it was and immediately wrote to those I'd asked to do the reviews and asked them not to. The article was rejected. I only do this if there's no science contained therein. It's horrifying how often that's the case, but I'd rather take on this burden as an editor than burden two or three times as many others to make the same call.

Sometimes, it's not clear whether or not a manuscript will pass muster. Articles can stand or fall on good or bad single judgements of the authors. But misjudgements aren't always obvious to editors. That's why peer review is important, and that's why it's hugely important for editors to send manuscripts to appropriate reviewers that have some expertise in a subject. For example, if I receive a manuscript about the calls of East Asian frogs, I shouldn't only send it to people who work on African frogs. It's really important that someone familiar with the animals reads the manuscript. This is because they might know something that others would miss. If they spot an error in the identification of the species call in the manuscript, the entire premise of the science might fall apart.

As I've discussed before, science is built on the work that others have done before, but basing your work on what someone else has written will mean that you have a good understanding of what they have done and how they have done it. Assumptions have to be made to get anything done, and it's a good exercise to sit down with a published paper (or even a manuscript of a colleague or your own) and read through listing all the assumptions that are made. Physicists might have a very long list if they read a biologist's

manuscript, but with some practice you learn to see the assumptions that the authors have made when designing their experiment, or going out to the field to conduct their study. An incorrect assumption could lead to the entire manuscript losing its value.

In my example above, the authors might assume that they had correctly identified the species when recording its call. Such assumptions should be backed up with museum and/or tissue bank accessions. But when they are not, the assumption that the authors are recording what they think they are, is vital. If this is placed in doubt, then the entire premise (description of a call to distinguish this species in the field) simply falls apart. In a case without vouchers, the assumption needs backing up by someone who knows the identification from another study, or without any foundation it becomes worthless.

0.57 I've been on the other end too

I've submitted manuscripts to journals where the editor clearly never read the manuscript. Editors who have made a decision without any guidance of their own gives this away. If your decision comes as a single sentence that asks you to revise according to the reviewers' comments, then you can be reasonably sure that your editor hasn't read the manuscript (and possibly not even the reviews).

It's not surprising that the editors have little to nothing to say; without reading the manuscript, the reviewer comments aren't really very helpful. Without reading, the editor has no idea whether the reviewer is biased or (as is sometimes the case) deluded. As an editor, you simply have to read. And if you don't have time to read, you shouldn't be an editor.

0.58 There is worse that goes on in economics

If the above makes some editors in Biological Sciences look bad, then I apologise. Being an editor for a journal is a pretty thankless task and there is no financial gain to do an editorial stint. However, if you're going to do it, then you must do it well. The half measures that I describe above are simply not good enough. But biological journals are a huge cut above those in economics. I've always had my doubts about economics as a subject. Rather like theology, it's based on a fanciful construct that puts its own practitioners in positions of power when we'd do just as well to flip a coin.

In May 2018 I was pursued for some weeks by the *International Journal of Finance and Economics* to conduct a review of an article submitted there. Even though I raised the flag that I was not an appropriate reviewer, the editorial assistant (not the editor) still wanted me to conduct the review. Apparently, 'the system recommended me' and this was enough for me to be selected. It appears that the problem of non-expert reviewers is on the increase. Consider this blog post[64] from the authors of Retraction Watch[65] who were invited to review papers on COVID-19! Essentially, this is the result of editorial management systems 'auto-suggesting' reviewers, and editors not doing their due diligence to determine whether any of these reviewers is worthy of conducting peer review on that submission.

Clearly, selection of reviewers must be done by the handling editor, and those people must be chosen based on their expertise (not lack of it). While editorial management systems might help editors, they can't replace diligence on behalf of those who are responsible for the upholding integrity of the peer review system.

0.59 Summing up on editorial blunders

The way to get round making the kind of editorial blunders I describe above is to read the manuscript. The guidance of how to read a manuscript should be explained to editors when they take up the position. There is plenty of information out there on the internet, but the journal's editorial policy should be understood by all of the editors (and preferably open to authors and reviewers too), and that should include reading manuscripts before sending them out for peer review.

[64] https://retractionwatch.com/2021/03/09/elsevier-journals-ask-retraction-watch-to-review-covid-19-papers/

[65] https://retractionwatch.com/

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When should you be an author?

Who should be an author is being increasingly regulated because of widespread abuse, including 'honorary authors' or excluding 'ghost authors'. Back in the day there were people that used to add fictitious characters to their author line (including their dogs!) as a joke. These days we have such a thing as ORCID that attempts to register all authors, turning them into numbers (see part 3[66]). The need for all this regulation is because publications have turned into a kind of currency for academics. And when there is currency involved, abuse quickly results in human systems followed by the need for regulation. Hence, one of the results of going transparent is that we all become registered numbers, and our dogs won't get authorship anymore. Perhaps this is just the loss of an age of innocence (at least on the part of our dogs!).

A lot of the literature on the subject of ghost and honorary authorships has come from the medical profession, perhaps as this profession is prone to ghost authorship via the pharmaceutical industry (Matheson, 2016), and honorary authorship from heads of large research groups (see Rennie and Flanagin, 1994).

0.60 Ghost authorship

Ghost authorship is when people are not included in the author line although they have not contributed to the study (Matheson, 2016). Note that ghost-writing outside science is usually when someone who has the talent to write, writes the ideas of someone who doesn't for a fee, and in return the latter takes the author line. This may well happen in science (especially when you consider the world of translation companies), but this is not really the meaning that we are discussing here.

There are many potential sources for ghost authors, including past students whose thesis work is taken by unscrupulous advisors, and published without their inclusion. More commonly, I believe, is that those who contribute sub-

[66] orcid.html

stantially are not included as authors for political reasons (they have fallen out with those who are the authors), or they are simply forgotten because they have moved away from the institution. Ghost authorship is a land of the disenfranchised. This is becoming increasingly prevalent in the world of contributions of data, which is also freely accessible. Some authors will take and use the data, only referencing the doi for where they obtained it. Others will include the original people who created the data as authors because they value their continued insight and input. Where the situation becomes very messy is when some people are included and others are excluded. This is my experience where a paper simultaneously contains both honorary and ghost authors. A study by Wisler et al (2011) found ghost authorship in medical publications at 7.9%, although I'd argue that their methods (contacting corresponding authors) mean that the real levels are likely much higher.

While the world of inclusion (see below) has a warm and friendly glow about it (everyone appears to benefit), exclusion is characterised by lack of information contact and reasoning. If you are excluded from a publication even when you have contributed, you will not be getting an email from the authors detailing their decision. You'll be lucky if they even send you a copy once it's published. Meanwhile, those who are included will remain in the loop.

0.61 Honorary authorship

Honorary authorship happens when people who have not contributed meaningfully to a study are included in the author line. If publications are the currency of science then you can see how being added to other people's publications increases your apparent productivity. While this might sound surprising to you, you should know that does happen and might be more common than you think. The Wisler et al (2011) study found that honorary authorship was as high as 17.6% in medical publications. It's worth noting that this may vary between disciplines as there are various traditions in some disciplines whereby the head of a large team may always be included as an author of a paper that emerges from the team, whether or not they were involved. In biological sciences, teams tend to be quite small with a single or rarely multiple Principal Investigators (PIs). This means that your PI will likely be directly involved with your research and therefore also an author. Imagine a very large team with multiple PIs working under a head who insists that they are an author on every publication. This could add up to hundreds of publications in a year (e.g. Yuri T. Struchkov is currently credited with >1600 publications on Scopus[67]), and such prolific authorship has been questioned (e.g. Rennie

[67] https://www-scopus-com.ez.sun.ac.za/authid/detail.uri?authorId=35427689100

and Flanagin, 1994). However, there appear to be very different levels of what could be considered credible and what incredible (e.g. 25 papers a year: Wager et al., 2015), and I respond to this, and the general question of how prolific authors are becoming, below.

In the biological sciences, the area of molecular phylogenetics has traditionally honoured those who collect tissue samples with authorship on the resulting phylogenies when published. As I mentioned above, this is not always equal and has also been used to politically honour or ghost. The reason given for honouring contributors in this way is that the studies could not have been done without the tissues. On the other side, some people have long lists of publications based on tissue donations and very little else.

0.62 A need for transparency - DORA {DORA}

Given the problems with both ghost and honorary authorship, there is clearly a need for transparency about who the authors are and what they have actually contributed. This was recognised by the Declaration of Research Assessment[68], which has a growing number of signatories as well as some solid ideas on the way forward in assessment of research and researchers. In particular, DORA is against the use of Impact Factors (see below[69]) and other journal based metrics, and instead assesses the research on its own merits. DORA also encourages everyone to embrace the opportunities offered by online publication, including colour figures and unencumbered word lengths. DORA also encourages specific information to be published about individual author contributions. In short, DORA stands for transparency and it would be worth you looking at their statement and finding out whether your institution is a signatory.

There are no universal rules about what or how much you should contribute in order to become an author of a scientific paper. However, some journals are independently initiating their own standards, and this might become mainstream. Thus, it is worth discussing the criteria for being an author with your advisor preferably in a lab meeting so that everyone knows where they stand. there's a chance that your thesis chapters (when they are published) will be authored only by you and your advisor. But this can become much more complicated if you collaborate with more people in order to do the work. In turn you may (or may not) be invited onto their papers as an author. Confused? Then let's look at this more closely.

[68] DORA:%20https://sfdora.org/

[69] impactfactors.html

0.63 Who should be an author?

There is an increasing number of journals that now give clear instructions on who should author a paper, and these have been formalised by the International Committee of Medical Journal Editors (ICMJE), and this has been rapidly evolving (Baskin and Gross, 2011). For some time, I have explained to my lab members that authors need to participate in at least three of the following five points before they can be considered for inclusion in the author line.

- initial conceptualisation for the work (hypothesis and/or question)
- raising of money (which often involves writing and submitting several research proposals)
- conducting the field work or experiment (the hard slog that many people will recognise)
- analysing the data (often much more difficult than anyone realises)
- writing it up (see lots of chapters of this book about the many requirements of writing)

This was a relatively simple scheme in which authors needed to be able to tick 3 of 5 boxes to be included as an author on a publication. At first glance it might look fine, but as ever the devil is in the detail. For example, this scheme does not stipulate how much one needs to contribute at each level. For example, is it enough to simply ok the final manuscript in order to tick the box that states that you helped write it up? Could you have been present in the room when the conception for the work was thought up, and present at the field site when samples were collected?

To help with these issues, some people have proposed a points scheme so that each person is allocated a number of points from a total for each level of the process, and then at the end points are totalled and a known threshold gives each person the right to be mentioned in the acknowledgements or be added to the authorship line. The idea for a points scheme comes from the psychology lab of Kosslyn (see here[70]). It is not entirely appropriate for biological sciences, and so it can't be adopted without modification.

[70] https://kosslynlab.fas.harvard.edu/files/kosslynlab/files/authorship_criteria_nov02.pdf

0.64 Rescognito, ORCID and the CRediT Contributor Checklist

A new initiative under the name Rescognito[71] has teamed up with ORCID[72] to formally list the ways in which researchers are recognised per publication. Rescognito maintains the Data Availability Checklist, Contributor CRediT Checklist and Funder Information Checklist.

The CRediT Contributor Checklist[73] contains 14 fields. Visit their website to learn more about these fields and to see whether or not your role qualifies. see part 3[74]

This field appears to be moving quickly with new initiatives and registries opening up quickly. We will see how many journals adopt these and what becomes of existing initiatives in the future.

[71] https://rescognito.com/
[72] ORCID.html
[73] http://credit.niso.org/
[74] credit.html

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Once your paper is accepted

The day your paper is accepted, tell your advisor and co-authors. If they are in the same physical location as you then buy a cake and celebrate with them at tea time. If cake isn't your thing, then find another appropriate treat for you and your co-authors. It's a great achievement and something you should share together. If you aren't in the same location then make a plan for next time you meet together, even if that's only online.

Remember to make sure that all of your coauthors have a copy of the accepted version of the manuscript. Sometimes referred to as a postprint, you and your co-authors should submit this to your institutional repository so that the article can be reached as Green Open Access[75] by anyone who is interested in reading it.

The next step in the publishing process once your paper has been accepted is that it will go for type setting. Depending on the journal and the publisher this process can proceed in several ways. Typically you will receive a notification that your paper proofs already and that you need to check them within 48 hours.

If you haven't checked proofs before then it is important that you read the instructions from the publishers carefully. They should tell you exactly what to do and if you are unsure about anything then talk to your advisor.

Typically the publishers will send you a set of queries that relate to your proofs. They always ask you to check every author's name and affiliation. Other typical errors are that there are citations in the text that are not in the references. Or that there's literature in the references that are not cited.

The process of checking the proofs is very important. Errors can creep in during the type setting stage. Pay special attention to the tables table legends and figure legends.

You may also have the opportunity to change the size or orientation of figures if it looks like they are not well presented in the proof. Especially if the journal prints into columns they may choose to put your figure in one column instead of two. Another option is to have your figure in landscape across the whole page. Journals are generally pushed for space and so may refuse some requests

[75] openaccess.html

for more room for larger figures. But you might get lucky if you make a good case.

0.65 Take your time with proofs

Probably the easiest way of doing proofs is to print them out and go through them with a pencil first. This allows you to take your time and you're more likely to spot errors this way than on the screen.

You should allow your advisor and co-authors to look at the proofs before resubmitting. I usually suggest that you make all your own corrections first before sending them around.

0.66 Once you have a publication date

Once your paper is published you have an opportunity to publicise it yourself. There are lots of different ways to do this, see the next chapter[76].

0.67 On the day you publish

This is a great opportunity to contact all the people who helped you in your study and send them a PDF of your paper. The easiest way to do this is to go to the acknowledgements section and write an email that includes everyone that is mentioned in the acknowledgements. write them a nice email in which you thank them for their help and explain briefly the significance of the paper.

It is a very good idea to keep all of these people informed about your publication as soon as it is published. You really want them to hear about it from you first and not from somebody else. This includes contacting any authorities that have issued permits. You may also want to contact funders.

[76] citations.html

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Writing a press release

Many of the same aspects that we've already discussed both in paper writing and in writing a popular article (see below[77]) are similar when writing a media release.

Try to make your text newsworthy. Remember that journalists are looking for new things that's why it's called "The News". Your press release must be about something that has happened recently. There's no point in writing a press release about a paper that was published six or nine months ago. It's very unlikely that you'll find anyone interested in writing something after that amount of time.

Here are 10 simple steps to take when writing your press release:

1. Choose your hook. The paper that you wrote may have several important findings. You are going to need to choose one easy to understand finding for your media release. It's usually quite simple to decide; take the thing that would most impress your Auntie Fanny.
2. Write your headline. Like choosing a good journal title or a popular story title the headline should try to encapsulate the study perhaps with a witty angle. Don't make it too long, 8 to 10 words at most. Most importantly your headline should connect with a wide and general readership. There's no need to get too fond of your headline because if they take your story news outlets are likely to want to write their own.
3. Crafting the first paragraph is important. You need to sum up the study together with the finding (just the book). Even if your reader only reads the first paragraph they should have an understanding of what you've done and found.
4. This paragraph should not be longer than 30 words.
5. In the second paragraph you should state who you are and where you are from, both geographically and the name of your institute. Here you need to concentrate on getting across the information on why you're finding is interesting. A typical second paragraph might read: Dr Frankella Smith from FitsSimon's University found a new

[77] popular article.html

species of lizard when bending down to tie her shoelaces last month. She published her findings today in the journal *Cobblers Saurids*.

6. In the next two paragraphs you should simply explain more about the background to your story and why the finding is interesting. Don't be tempted to deviate from the hook that you've chosen. After reading these two paragraphs your reader should be able to answer the question: So what?
7. Finally sum up your finding with a quote from you, the author. Either use the quote to emphasise the study, or you can try and humanize your findings. This means a way of connecting with the reader, especially if you feel that the rest of your texts won't:

"I never expected to find such a pretty lizard in my shoe", said Frankella. "I was flabbergasted when it turned out to be new to science." Include your name and contact details of the person that the press should contact in order to find out more about the story.

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8. Give the full citation to the paper with all the author names and the journal name plus a link so that any journalist can find the full text online.
9. Include one or two photographs or relevant graphics that the press can use. If they are not taken by you then make sure that you have permission to use them. If you can, include a picture of the sunny organism, or even better of you with the study organism.
10. Seek feedb ack. Your advisor is, as always, a fountain of knowledge in this regard, and you should always show them a copy before releasing it. Also don't forget to send the press release to your university's press office and ask for feedback. Those are the professionals and they should be able to help you.

Of course, the better your press release is, the more likely it will be that people will write about it. Remember that it also matters a lot about the subject of your paper. The media are likely to be far more interested if your work is on dolphin communication than if you are writing about caecilian communication (just like your Auntie Fanny). Having said this, never be put off just because your organism or system isn't cute and cuddly. Try asking your non-academic friends about the newsworthiness of your press release and see what they say.

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Why write a popular article?

There are many reasons why it is important to communicate science beyond your own discipline and into the wider public forum. Primary among these is that in a society based on decisions made on the basis of science, it is our responsibility as scientists to make sure that we make the findings of our work, upon which basis political decisions are made, understood to the widest of audiences. I do not mean that we are sharing science pejoratively to an ignorant public, but instead as equals in our collective scientific society. We share with a wider public in the same way that we share with those who are used to reading a well reasoned newspaper article, or listening to an informed political debate. By sharing our work, we help affirm that decisions should be made objectively, and we make the most important connection by reaching out to the rest of our society and to join them in the scientific project.

0.68 Here are some extra reasons why communicating by writing a popular article might be right for you:

- Inform tax-payers who funded research what you found
- Increase profile of your work and you as a researcher
- Reach other researchers (who also read popular articles)
- Reach other stakeholders like practitioners or policy makers
- Open more doors to other potentially cross-disciplinary work
- Gain new insights into how your work appears to the general public
- Public communication is a key part of social responsibility, quickly becoming a key aspect of an academic career
- Maintaining and furthering the Scientific Project

The sooner that you come to terms with the need to communicate your work more widely, the more comfortable you will be when you are contacted by a reporter, a vlogger or someone from TV or radio.

0.69 Here's a quick guide on how to get started writing a popular article.

0.69.1 What's the hook?

Your popular article will not be the same as your chapter or paper. You should plan to have a single fact or message that you want the public to walk away with after reading your article. This is unlikely to be the same as the main result in your chapter or paper.

When composing your article, you need to be single minded about achieving the understanding of your hook. The article cannot take any side roads or distractions, but must stick to the main point. Once that's done, provide the "so what" that allows the public to see the bigger picture, and maybe where you would go next.

0.69.2 Don't get complex or technical

If your whole article hinges on something technical, you might have to start by explaining it simply. If you can't easily explain it, then this is probably the wrong subject for a popular article. Don't worry about leaving out key details, you can always refer the reader to your article if they want to know more.

0.69.3 Always refer to your published work

Make sure that you always have some reference to your work that's published. Provide a hyperlink, but preferably give the full citation.

Be aware that news items count towards metrics of your article, so be sure to link it correctly.

0.69.4 Pictures, videos and even sound files

These are great to help readers engage with your work. Try to choose images that tell the same information as you have in your article. Try to remember that you will need these when doing your research as it will help later.

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Altmetrics from traditional and social media

In recent years, more emphasis has been placed on the way that scientists communicate their work. Many institutions now consider the degree to which scientists communicate their work as one of several key performance areas on which they are judged. Because administrators are always looking for simple solutions to evaluate the work of many different types of academics, commercial solutions to measuring the degree of communication for each publication have sprung up. The most ubiquitous of these in biological sciences is altmetrics (Priem et al., 2012): alternative metrics that aim to measure activity on the internet through social media (e.g. Twitter[78], Facebook[79]), online reference managers (e.g. Mendeley[80], Zotero[81]) blogs and news outlets. Because of the immediacy of these activities, altmetrics tend to accumulate much faster than traditional citations, giving a near immediate impression of the interest generated in an article.

A prominent company producing altmetrics for many biological journals is Altmetric[82]. The whirls they produce, known as 'Altmetric badges' are coloured to show the proportions of different media that have been scrapped from the web (Figure 4).

In biological sciences, there is a traditional bias in media coverage towards species with higher charisma (Ducarme et al., 2013). This means that if you work on whales or roses, your work is likely to generate much higher altmetrics than if you conduct equivalent work on phasmids or grasses. Traditional media is starting to make an effort away from only reporting on science with charismatic species, but they are driven by a public with insatiable demand for kittens and flowers.

There is a lot that you can do to improve the level of your altmetrics. I have provided this information elsewhere in this book, see preceding chapters. As communication is becoming so important in the careers of scientists, then I'd suggest that you remain aware of altmetrics and how they are used by your institution. Be aware of how to influence and increase your score. For example,

[78] www.twitter.com
[79] www.facebook.com
[80] https://www.mendeley.com/guides/desktop
[81] https://www.zotero.org/
[82] https://www.altmetric.com/

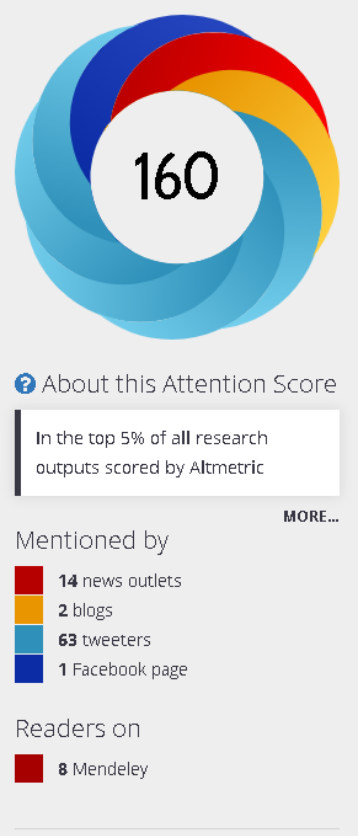

FIGURE 4: In this example, a paper by Baxter-Gilbert (2020) was covered by many Tweets, news outlets, some blogs and a Facebook mention. Altmetric provides an overall score, but different types of mentions are not, so a news outlet is awarded a higher score than a tweet. Although this paper did not garner interest due to a charismatic species, the story was of general interest to the public as it centred on island dwarfism.

if you and your friends tweet about your article, make sure that there is a live link to the article on the publisher's website. Similarly, if you are contacted by a news outlet about some of your research, you can insist that they place a link to your paper in their article. If the Alemetric scraper cannot find coverage on your paper, you can inform them here[83].

[83] https://www.altmetric.com/about-our-data/our-sources/

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Transparency in publishing

We have already seen (in Part II[84]) the need for transparency in preregistration of your research project to avoid confirmation bias. In order to make this effective, we need our journals to support the preregistration of research hypotheses and methods. Right now, journals should be openly advocating and encouraging preregistration with a plan to transition their journal in future. However, many editors are resisting this move as they feel that there is no support from the community. This may well be the case, but as we have seen, inequalities in science, and particularly in publishing (see Part IV[85]), mean that editors can either be instruments of change, or at the heart of inequality in publishing. Either our editors will lead us toward transparency, or we as a community simply need to demand that they change their practices. Where it is happening, editors are responding to calls in transparency by making small steps (for example asking for open coding: Powers and Hampton, 2019), rather than adopting transparency wholesale through the badge system set up by Kidwell et al (2016).

0.70 Removing the prejudice around confirmatory bias

0.70.1 Accepting the alternative hypothesis

At the outset of our scientific research we pose a hypothesis with the expectation that we will be able to accept or reject our null hypothesis (see Part II[86]). We often think of rejecting the null hypothesis as the only result that we are interested in, but if we only ever reported these results we would not be responsible in moving our field forwards. That is, in a world where we only report significant results (i.e. reject the null hypothesis) we would necessarily keep repeating experiments where the null hypothesis is accepted, because there would never be the evidence that the hypothesis had been previously

[84] transparency.html
[85] editors.html
[86] hypothesis.html

tested in the literature. This is called confirmation bias (also see Part II[87]), and it's actually practised by the majority of scientific journals who won't consider a null result. It's easy to see why this is a bad policy, but it is the prevailing culture in science.

As we have seen (Part II[88]), if journals only publish manuscripts that reject the null hypothesis (cf Franco et al., 2014), researchers are more likely to mine their data for positive results (P hacking), or re-write their hypothesis in order to reject the null (HARKing). Deceptive practices such as p hacking and HARKing are not in the interests of any journals (Forstmeier et al., 2017).

0.70.2 Inadvertent bias

But positive results don't only come from deliberate manipulation of results. As humans we are predisposed towards positive results (Trivers, 2011), and these can come about through deliberate manipulation of results, there are plenty of reasons why researchers might reach a false positive outcome. Forstmeier et al (2017) draw attention to cryptic multiple tests during stepwise model simplification, and the two types of researcher degrees of freedom (*sensu* Simmons et al., 2011): stopping rules and flexibility in analysis.

Cryptic multiple tests during stepwise model simplification relates to the way in which adding predictors to models inflates the total number of models to test, making it necessary to adjust alpha accordingly (for repeated tests). However, Forstmeier and Schielzeth (2017) report that even with Bonferroni adjusted alpha levels, using random data they found that models with one significant effect happen around 70% of the time. The only way to keep this under control is to use sufficient sample sizes to maintain the power to distinguish between true positives and false positives. A handy rule of thumb from Field (2013) is that sample size needs to be 8 times the number of model predictors plus 50. Better would be to run a power analysis on your study design, and to critically reassess your predictors to eliminate as many as you can before you begin your study.

Researcher degrees of freedom is the way that Simmons et al (2011) described ways in which researchers may inadvertently increase their chances of getting false positive results during analysis. The first is simply the way in which researchers decide to stop collecting data. Clearly, if preliminary collections showed a trend, but not a significant result, then collecting more data sounds like a good idea. However, as the collection of data is not independent (the first set is kept) then the first test is not independent of the second, and so the chance of getting a Type I error is cumulative. Even if multiple datasets are collected, those that are insignificant should also be considered

[87] TypeI.html
[88] TypeI.html

and reported in order to get an unbiased estimate. The second major way in which analyses can turn out with false positives is through potentially infinite flexibility in analyses. There are lots of ways to analyse your data and given enough trials, it is quite likely that you'll find one that gives you significant results. Moreover, on the road to conducting the test, there are many options that can change the outcome of the analysis:

- Inclusion or exclusion of an outlier
- Inclusion or exclusion of a covariate
- Transforming dependent variables.
- Inclusion or exclusion of baseline measures
- Controlling for sex (or another variable) as a fixed effect
- Excluding individuals with incomplete datasets

The potential list of ways in which the outcome of your analysis could change quickly grows as the number of ways in which you could analyse the data also grows. But don't despair. Transparent help is at hand.

0.70.3 Novel research

One criterion for many journals is that the research should be novel. This is increasingly practiced by journal editors as you move up the Impact Factor levels (see below). Novelty sells (just think of the meaning of "new" in newspaper), and that's the basis for selling higher stories from higher Impact Factor journals. We have already seen in part 2 the perils of testing unlikely hypotheses and how this inflates Type II errors as well as increasing the proportion of Type I errors. Novelty also stifles repeatability. If we can never repeat studies in science, then a fundamental tenet of the methodology is repressed. Reproducibility in science has received a lot of attention recently, as attempts to reproduce the results of highly cited research have failed (cites). This has been followed by general outrage among scientists that things should change (Anderson et al., 2007; Munafò et al., 2017), including a majority of those in biological sciences (Baker, 2016). The irony that these reports and requests are published in exactly the journals that will refuse to publish research that seeks to repeat work (is not novel) is clearly lost on the editors. However, more nuanced views are also coming forwards to actively introduce variable conditions and sampling of biological variation into the study design to more fully represent the nature of biological variation making studies more likely to be replicated (Voelkl et al., 2020).

0.71 Introducing transparency in peer review

As you will have already seen (above), the way in which editors choose and interpret reviewers can either reinforce their own prejudices, or help to make publication more open and transparent for everyone. The first step along this road is to move from double-blind review to triple-blind where editors cannot make decisions with prejudice towards certain reviewers (see above). Next is the need for open reviews with DOIs that allow open assessment of what reviews contained. For more details about problems in peer review, see above.

0.72 Removing profit from academic publishing

In order to change this culture to a more transparent selection of scientific studies for publishing, we need journals to sign up to be transparent. Sadly, when most journals are approached, the editors either ignore the email or make an excuse about why it is not possible (see here). Of course, some journals have adopted the road to transparency, and we should be encouraged by the fact that they still exist, and that we could build on these initial front runners.

Part III

Part V: Further challenges in academia

In this last part of the book, I have pulled together some chapters for those who are interested in furthering their career in academia, and some of the challenges that you are likely to find in doing so. It is a mixture of advice and opinion, but as with other parts of this guide, the opinion is meant to stimulate further thought and reading, rather than to dictate a particular viewpoint. If you aren't interested in staying inside academia, then you can comfortably skip reading most of this, except the last chapter which is full of insights for you.

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Preprints

0.73 What are Preprints?

So far in this book I have explained about the process of peer review how important this is and why it's the gold standard in science. Preprints came to us from the world of physics. An academic world that is moving so quickly that many inside it don't want to wait for peer review before making their work public.

Preprints do a little more than this because it not only makes the work public but allows it to be read by more peers. Many consider it as a kind of open peer-review system.

In biological sciences the most prominent preprint server is called bioRxiv[89].

0.74 Why might you want to post a preprint?

One of the advantages of posting a preprint is that it gets a DOI (digital object identifier)[90]. You can then use this DOI to refer to your work even though it is not published in a peer review journal.

For example imagine that you've just finished your thesis and only one of your chapters is published. How can you show to prospective employers how good your work is? Or if you are applying for money how can you refer to your work even though it's not published? A preprint is a simple solution to this problem.

Other benefits include having a wider scope of peer reviewers. if you know that in your subject area there are many people who may want to comment on your work constructively then this would be an opportunity to give them access.

[89] https://www.biorxiv.org/
[90] https://www.doi.org/

Importantly in a preprint because it has a DOI your work is not vulnerable to theft. It also allows you to stake your claim on the work that you've already done even though there may be a lag time between this and it coming out in a journal with full peer review.

If you do want feedback on a manuscript that you have posted as a preprint then you will need to tell people about it. A good example of this would be after providing a talk, or a poster, at a conference you might show a QR code where people can read your manuscript as a preprint. you can also publicise it to your community on social networks like Twitter.

If you get lots of feedback on your manuscript then you should expect to incorporate it. So be careful what you wish for, because you could be opening yourself up for a lot of comments.

0.75 Upload newer versions

If you, or others, spot errors in your preprint, or you find new literature to cite, you can update your manuscript with a new version. Indeed you should do this for as long as your preprint remains active. Once published, make sure that there is a pointer from your preprint to the published version.

0.76 Will you have to post a preprint?

This field is moving quickly. In December 2020 at least one journal (eLife 'publish then review') announced that they won't accept a submission until a preprint has been registered. Thus all reviews are made on preprints. Other journals, like PLoS, are announcing in house preprint servers. You should expect this area to rapidly change in the coming years, so no matter when you are reading this, you are more likely than ever to need to submit a preprint.

At the time of writing, there are still some journals that make it a condition of submission that there is no preprint. Make sure you check within your target journal list.

0.77 If we all post preprints, do we really need peer review?

As far back as 2002, William Arms (Arms, 2002) suggested that openly soliciting comments on the web might be an alternative for peer review of scholarly articles. Sixteen years later, this has come to pass in the form of preprints.

There is a growing trend for publishing preprints. Preprints are simply manuscripts that are submitted to an online server and available for all to view. Physicists started first with this phenomenon, but biologists have been hot on their heels and there are now a number of prominent preprint archives including BioRxiv[91].

Each of these sites maintains the open access manuscripts, and allows other users to post comments (partial or complete peer-reviews) of these online manuscripts.

There are problems in the world of publishing. Mostly related to the greed of publishers who demand large sums of money for content that they do not pay to produce, but charge for access. We must look for alternatives to the current model, so could we replace publishing with an open platform like BioRxiv?

0.78 Could these comments pages really replace peer review?

Peer review is held as a gold standard in scientific publishing, and there's certainly a lot to that. It ensures that published material has been read and its contents assessed independently. But peer review is fallible, because scientists are humans.

- Not all reviewers can assess all parts of a paper, especially papers that cover several disciplines
- Not all editors will choose reviewers that are independent and objective. Depending on the framework set up for the journal, friendly reviewers can be chosen or critical reviews removed. Perhaps the inverse is more common, although you are less likely to see these manuscripts published.
- Poor peer review is a growing problem.

[91] https://www.biorxiv.org/

- Lastly, and not least, there is an increasing difficulty in finding peers who are prepared to review manuscripts. (See the Perry et al (2012) editorial, which was a plea to the herpetological community to accept reviewing as a necessary duty).

In 2003, Stefano Mizzaro proposed changing peer review to the format that we now see in preprint journals. Let every reader become a reviewer. Another take on this same theme is provided by Heesen and Bright (Heesen and Bright, 2020) who argue for a more subtle change in the date of publication (prior to peer review as seen in preprints) instead of after peer review. Here their emphasis is on removing the wasted time spent reviewing and then rejecting manuscripts that will never be published. Their discourse is very persuasive, yet given that both models currently exist we need more ideas on how we could drive a preprint model forwards. More ideas do exist, and I encourage you to explore those proposed in a special issue edited by Kriegeskorte et al (2012).

In the preprint model, the first three problems (above) might all be overcome as no-one chooses the reviewers. Instead they choose themselves, and are motivated to do the work. Their competence to cover all aspects of the manuscript is not assured, but one assumes that independently motivated reviewers will only comment on parts that they are able to assess.

All of this is very good, but will people actually read and comment? A quick look at the sites will tell you a lot about the level of reviewing that is currently going on in biosciences preprints. A quick look through the top 10 articles on BioRxiv zoology section confirmed my suspicions. Plenty of tweets about the articles, but none of them had any comments. Indeed, a further trawl through PeerJ Preprints also found no comments.

Further, I'd suggest a greater move to this culture might produce comments for well known labs, a certain amount of trolling for labs with ongoing disputes or rivalries, making this kind of comment review a sort of trial by popularity. But I don't see a situation where potential reviewers will take time-out once a week (for example) and hunt for manuscripts that have received no comments. It seems far more likely that the authors will have reciprocal agreements with other groups to review each other's manuscripts. This nepotistic tendency then puts us back into the area of peer review that we've been working hard to overcome now for sometime (double-blind reviewing, editors' codes of ethics, etc.).

0.79 When should evaluation end?

One point raised many times in the special issue edited by Kriegeskorte et al (2012) is that evaluation should be open ended: **ongoing evaluation**. There was a consensus to see reviewers continue to question the contents of papers long after publication. But these authors don't appear to have a realistic perspective on the time of authors to defend their work. Imagine the effort that you currently put into a rebuttal letter (see chapter above). Now consider that your first rebuttal might come after a few months, and then you need to compose another after a few years. Perhaps you are the only author still working (especially if it is the work of students). Perhaps all of your co-authors are dead! Suddenly you are called upon to defend your work, potentially decades after completion. Can you do it? Would you want to do it? What would be the consequences of not doing it?

While I am regularly the first in the queue to criticise the current peer review system. I am also very grateful that publication represents a line in the sand under which I won't have to continue working on a project. In a world in which I had continually documented every step of every experiment (see part 3[92]), I can imagine that it is potentially possible to find a defence for every step in a protocol. But the painstaking nature and time involved in going through old work would be an added burden that I cannot welcome with any enthusiasm. Personally, in a world when I have the option of working on a new project or endlessly and repeatedly defending old ones, I'd pick the new project every time.

0.80 Are preprints published?

As they each have a DOI (Digital Object Identifier[93]), they are in their own way already published.

Another point is that these articles are picking up citations. And there is a new concern that these articles are being cited, even when they are subsequently available through a published journal. This is one of my personal concerns with using a preprint service. I'm happy to put the paper out there for public comment, but the idea that it'll remain there and that readers won't necessarily be redirected to the peer-reviewed version does concern me.

[92] methods.html
[93] doi.html

Another question is what happens to manuscripts that are placed on preprint servers, are then sent out for review but not published because they are fundamentally flawed? It's not as if the reviews are not made, but there is no automatic link to the reviews by the journal that conducted them.

Whether or not there is a paper inflation, there is certainly an ever increasing number of papers. The rejection rate is not insignificant, and while many of the papers are not rejected because they are flawed (they may well go on to be published in another journal), there are certainly a lot of manuscripts out there with fundamental flaws. These are often sent for peer review, but those reviews pointing out the errors won't necessarily make it back to the comments page on the preprint server. I think that this is a serious problem. The reviewers have spent time and effort and the very reason they do this is so that manuscripts with fundamental flaws don't find their way into the literature. However, preprint servers have, perhaps unwittingly, found a loophole that allows manuscripts that are not scientifically robust a backdoor to citations.

0.81 But if they are fundamentally flawed, shouldn't everyone be able to spot it?

No. Reviewers are chosen with great care because the area is in their particular domain. They have insights that not everyone will be aware of and these are an important aspect of the purpose of peer review.

I edit for the journal PeerJ. Although there can be various reasons to be rejected from PeerJ, normally it means that your paper is not scientifically sound. As PeerJ has no selection for impact, rejection does not normally mean that it can be simply submitted to another journal. I have noticed that manuscripts that I have rejected from PeerJ are still available as PeerJ-preprints without any comment on their failure to go through peer review. In my opinion, this is not good as it essentially ignores the input given by both reviewers and editors. The article appears as if it has had no comments or attention, when this is not the case. In a system where we move to relying more on preprints, why would we want to ignore chosen peer reviewers for whom this article was within their specialist area?

Moreover, I note that the preprint in question is also receiving citations (according to Google Scholar), again raising concerns that rejection by peer review is not a hurdle to entering the scientific literature.

0.82 In my opinion, comments pages won't replace peer review.

If we end up abandoning our current way of publishing in favour of a comments page, I think that we'll all be worse off. Much more likely is that increasing numbers of journals will require preprints as well as open peer review, hopefully leaning towards a more open and transparent publishing experience.

We simply need to overcome the vanity of having our manuscripts set out in a pretty way. If you are a postgraduate student reading this, then you are the first who will suffer from the mistakes of your community over the past 40 years. But you can also be the solution, mostly because you will be so badly in need of a solution that the system has to change for academia to survive. Us oldies will eventually be happy to accept unformatted manuscripts as the way science is presented, I think we'll be able to move on without the involvement and the exorbitant costs that the publishers extort from us. What will be a bigger challenge is to topple the provaledge from those who control STEM with the editorial roles. The temptation will always be for the younger elite to take on that privilege, to benefit as previous generations of academics have. Breaking that circle of abuse will require widespread adoption of new rules for peer review.

0

Writing a literature review

The first chapter of many PhDs is often a place for a literature review. Writing a review of the literature is actually a very useful task to undertake during your PhD, preferably towards the beginning. Firstly it will get you familiar with all of the relevant literature in your field. It will give you some idea of the historical context of your subject area. And it's especially good to help you spot gaps in the literature that may not have been realised before.

Reviewing the literature should make you familiar with the bigger questions in your subject area. This will make it easier for you to introduce each of your subsequent chapters.

0.83 Having a purpose

Writing a literature review is easiest when you have a clear purpose. The objective can be particularly tight, or can aim to use the literature in order to answer a broader question. Either way having a clear purpose for your literature review will help you to define exactly what literature you're looking for.

Without an aim a literature review can be extremely daunting. There will be literally no end to the literature that you could include and it may well overwhelm you. If your question is more broad it will help to define a clear time period in which you are searching for literature. For example you may want to just consider the last 10 years. Remember that the amount of literature is increasing almost exponentially and so if you are covering the same ground as a previous review a lot can happen in 10 years.

If your aim is quite narrow then you can legitimately cover all of the literature. This may require delving back more than 100 years. But as we know from previous chapters the first journal only began around 150 years ago.

If you want your review to have an objective or statistical angle on the literature then consider writing a systematic review or a meta-analysis.

0.84 Systematic reviews

I prefer to conduct a systematic review. This is where you define your search criteria and the databases that you want to use and then include all of the literature that comes out. You will need to provide clear criteria for the inclusion of literature. As well as explaining exactly how you decide to include or exclude papers that result from your search terms. Systematic reviews require a flow diagram to show how this literature was included or excluded. This means that you have to be systematic in how you record weather a paper is included or excluded.

I'm my opinion, a systematic review is less subjective than a review where the author is essentially cherry picking the literature in order to tell the story as they see it. It also allows you to conduct statistical tests in order to answer some of your questions (a meta-analysis). Lastly, it avoids one of the oldest problems in science: confirmation bias: Simply looking for articles that back up your own view. Too many old reviews are really just written by academics seeking to confirm their standpoints, and so moving forwards we must place the emphasis on being objective through systematic reviews. This view is now growing so that increasing numbers of journals will only accept a review if it is systematic.

0.85 Using Google Scholar

Google scholar has distinct advantages over other literature databases as it searches words inside the contents of an article, not just in the title, abstract and keywords (like Scopus and WoS). However, the output style of Google Scholar is infuriating as it resists being able to capture search results into a simple table (database) format. In addition, it does not support the boolean search operators (see part 2), and has a far broader range of literature that is included.

Help is at hand for those of you who would like to use Google Scholar and get a database output with the publication of Publish or Perish software[94] (Harzing 2007). The original purpose of this software was to calculate personal research metrics for promotion purposes, and it still does all this. But it also provides a single platform for searching many different literature databases: Scopus, Web of Science, Microsoft Academic, Google Scholar.

[94] https://harzing.com/resources/publish-or-perish

Google Scholar has an important attribute over many other databases in that it returns results in languages other than English. Using only English to provide the basis for your review might lead you to draw an unreasonable conclusion with a literature bias (see Nuñez & Amano 2021). Language is only one of several potential biases in a literature review (see Amano & Sutherland 2013).

0.86 The meta-analysis

A meta-analysis is a type of systematic review that uses the results of all of the studies included in order to provide a synthesis. While more powerful than a systematic review alone they take an awful lot of work. If you are expecting to get a lot of literature then consider putting a team together in order to conduct a meta-analysis.

Once written they can be very rewarding as they tend to attract a lot of attention and citations.

0.86.1 Combining topics by combining people

The literature review that you conduct for your PhD will likely only have you doing the bulk of the work. But reviews become especially insightful when you combine topics together. To do this you may want to find somebody else who is an expert on the literature in that field. This might be somebody in your lab group. It might be somebody who is also just starting a PhD and is writing a literature review.

This brings me to another very important point. Share your enthusiasm for your topic. Remember to talk to people around you both in your laboratory and in your department about the work that you're doing, and tell them about the interesting things that you're finding. If they also tell you about their work then you may find that you have somebody to combine your literature review with in a novel angle that's never been thought of before. The paper that results could be a smash hit.

0.87 Don't try to do too much

Whatever your aims were before you started compiling the literature, remember to remain flexible as you proceed. it's hard to know exactly how many papers you will encounter on a particular subject unless you already know it very well. If you're prepared to remain flexible while conducting your review it may save you from overreaching. Always be open to reducing the scope of your review or seeing particular questions or issues while you're reading that may be better than your initial idea.

0.88 In summary

if you come to the end of your PhD and have not yet done a literature review then now is the time. You should already know a large chunk of the literature in your particular area and you will be looking for future questions to tackle in a postdoc. Conducting a literature review at this stage in your career will not only help you to highlight unanswered questions and interesting topics, but it will get your name out there. Once you've done it you'll be glad you have.

0

Is Open Access good?

Open access appears to be a great initiative that acknowledges that everything should be free to view. Neither scientists nor the public that fund them should be barred from accessing the knowledge that they produce. What could be wrong with this?

0.89 So what is open access?

I have covered the many different kinds of Open Access (OA) elsewhere in this book (see part 4[95]). Here I concentrate on the fiscal implication of OA. Someone needs to pay for the work done. Who should pay and how?

Open access is probably one of the best scams that the publishers have come up with to date. Now the scientists pay for making their own content open for anyone to read. They pay a once off fee to the publishers to typeset the manuscript and host it on their site without a paywall. And how much do the publishers want for this service. Prices start from USD 1000 and go up to around USD 12 000. More frightening, and evidence that publishers are simply taking advantage of scientists, is that prices increase with the Impact Factor of the journal (Gray, 2020), although the costs involved to the publisher remain static.

The money comes from the funds that would otherwise be reserved for conducting science. So now the money for research goes directly into the pockets of the publishers upfront. Money that ultimately comes from you as tax-payers goes directly to publishers. Still happy?

[95] openaccess1.html

0.90 So does that mean that these journals are now free?

Mostly no. The majority OA model (hybrid OA[96]) means that a minority of articles in these journals are free, but the universities are expected to subscribe to those same journals at ever increasing prices because much of the rest of the content is still behind the paywall[97]. This is because most authors cannot afford to pay the exorbitant fees charged by the journals (although some countries now have this payment as mandatory - PlanS, they and their scientists are still in a minority). There are some journals that are entirely open access (gold OA[98]). These are (almost) exclusively online and have never been part of traditional packages that university libraries spend so much of their budget on. Hence the fact that they are entirely free does not impact library budgets. As a scientist, it will make an overall increase to papers that you can access.

But paying for open access has not reduced the cost of access to scientific journals for libraries. This cost constantly goes up. Hybrid OA[99] was a brilliant scam dreamt up by the publishers, because for much of this content we pay not twice but thrice (Buranyi, 2017)!

0.91 Nature Publishing - pay for review

The Nature Publishing Group has now proposed to go one step further: pay to submit your paper for review! In this new twist on the OA scam, the exclusive Nature publishing group is offering a discount to their new USD 11390 OA charge if you pay USD 2665 upfront before review. In this case, you will have the benefit of being told that your manuscript (most likely) is not publishable in Nature, but you can pay some more money to them in order to publish in one of their other journals. The most lowly (Nature Communications) would be another USD 3160, leaving you a few hundred dollars short than if you had submitted there originally. Or you could be rejected outright, and your USD 2665 is, of course, non-refundable.

- Are Nature Publishing Group taking advantage of authors who aspire to publish in their exclusive titles? **Yes**.

[96] openaccess1.html
[97] paywall.html
[98] openaccess1.html
[99] openaccess1.html

- Will they use the money to plough back to the benefit of science, scientists and the taxpayer? **No**.
- Will the cover price of Nature go down when some of the articles inside are free to read? **No**.
- Will it be cheaper for libraries to subscribe to Nature? **No**.
- Will they line their pockets? **Yes**.
- Will they pay the scientists who conduct the peer review that they want to charge for? **No**.
- Can you see the common thread in the greed of publishers and the willingness to prey on scientists who need to publish in high IF journals for their career? If not, read part 5[100] again.

For a lot of academics there is a trade-off: vanity for cash. We know that for a lot of academics, their vanity will mean that they are prepared to find the money (even if it comes from their own pockets). However, for as long as enough are willing to pay, we will continue to be exploited. Instead, we really need a new model for publishing. For some academics they will be paying directly for a chance at getting a job[101] or getting tenure[102]. The chances of these individuals reaching their goal from a privaledged institution then simply becomes reinforced.

This is not a system that we should ever support, and one that we should do all we can to remove for the sake of transparency and equality in the greater scientific project[103].

0.92 A new model for publishing without publishers - the blockchain journal

0.92.1 The problem

There are growing problems with publishers. Publishing has become very expensive for scientists, and the public who fund science. Many funders are now unwittingly funding publishers instead of science. I've discussed the history of scientific publishing before (here), and explained how commercial publishers have had a role right from the very beginning. This relationship continues to the present day, but while the origins saw learned societies commissioning publishers and then distributing their content, today the publishers have

[100] part5.html
[101] jobinacademia.html
[102] habilitation.html
[103] beforeyoustart.html

climbed into the driving seat, conceiving and owning many of the current journal titles. This is not to say that there are no scholarly societies that still dictate terms to publishers (The British Ecological Society, BES, do this very well), but they are few and far between, and even when society journals are involved, the goliath publishing companies easily outweigh any control that they might have once possessed (and I'm speaking from personal experience - see part 5[104]).

The result is that publishers have become gigantic corporations that now dictate to the scientists that produce, edit and review all of the content. They charge incredibly high fees to anyone who might want to read the publicly funded content. The budgets of university libraries run into USD 100 000s just to access content. The result is that many universities can't afford all of the content that their researchers need. Publicly funded content, and by that I mean that you dear reader are paying for the original science of the content in your taxes (yes, you all pay taxes, even if it's only VAT), and then you pay a second time for the researchers (who themselves produced the content) to access the content. Who benefits from the fact that you pay twice? The publishers. Why aren't you upset about this? Probably because you are unaware. But if you are upset, then join in the discussion to decide how to emancipate ourselves from the publishers who are merrily munching on through this publicly funded cash cow.

0.92.2 What do publishers do?

The publishers would claim that they do an awful lot. All they really do is pay for the layout and printing of journals. These days 'printing' really means hosting electronic pdfs only, as there's very little paper that's printed, and you can be sure that paper subscribers now pay the extra cost of any additional fees. The layout from the manuscript (most often a MS Word doc) into a pdf does take some skill and talent, although nothing like what you might expect given how much the publishers charge. You can be sure that they don't pay much for this service as almost all layout is done in India, Bangladesh, Sri Lanka, etc. Quality can be good, but more often quality control is completely lacking. Most authors have stories of how manuscripts have come back mangled, although my own impression is that the worst days appear to be over.

This is not to say that there are no skills in the publishing world. I also want to make it clear that I am not condemning all those employed by all publishing houses. I have interacted with many excellent staff at publishing houses that have some of the worst practices. It's important to note that these staff do not get the fiscal benefit of the aggressive and unethical behaviour

[104] paywall.html

of their publishing companies. These profits are retained for the directors and shareholders. One might also question whether the sales reps of these companies who make deals with academic libraries don't also receive unethical bonuses for their undisclosed financial arrangements.

0.92.3 What is publishing then?

Once publishers have 'printed' the manuscript, they 'publish' it by placing it behind a paywall on their website. I would be the first to admit that there are massive costs in doing this properly, and big journal companies have invested a lot to do this very well. The electronic hosting of journals is (in my opinion) truly excellent, except for that paywall. However, once they've set this system up, adding another 10 or 20 journals comes at practically no cost compared to the revenue that each one can be expected to gain.

To get behind that paywall, university libraries need to subscribe. Publishers bundle journals together and sell subscriptions at very high prices. If you are inside the university IP address, this access should be seamless. If you are outside, you might need to log in through your university's library. There are other tactics for getting around a paywall (see part 2[105]).

So far, the publisher hasn't produced any content. The scientific content has been produced by the scientist at the cost of the public purse. The editing and peer review (see part 4[106]) has all been done by the scientists, which has also cost the public purse but has been completely free to the publisher. OK, so there are some small costs associated with manuscript handling software subscriptions that the publishers normally pay. The publisher has also paid for the typesetting (although they've done this as cheaply as possible - see above), and they've paid for the servers that distribute the pdfs maintaining that all important paywall. What else? Nothing else. Now they simply charge everyone to look at the content (and because it's by subscription), actually charge everyone whether or not they are looking at the content. Bergstrom and Bergstrom (2006) showed the difference between the costs of subscribing to society journals in 2005 was US$ 0.29 while for profit journals cost US$ 1.42, irrespective of any degree of quality. Fifteen years on, most society journals have now been captured by for profit publishers and now we all pay the higher price.

> 'Open access is one of the best scams that publishers have come up with'

[105] paywall.html
[106] preprint.html

But don't take my word for it. Read the excellent article by Stephen Buranyi (2017): Is the staggeringly profitable business of scientific publishing bad for science? In it, Buranyi makes the point that the profit margins of academic publishers are in excess of 40%. Something that even drug dealers, pimps and the mafia struggle to achieve. This situation seriously needs to change.

0

The problems with peer review

Some people have argued that peer review is untested and that the effects are uncertain (Jefferson et al., 2002). Perhaps more worryingly, studies designed to test peer review (by deliberately sending out manuscripts with errors) have shown that most reviewers are unable to find all errors and some find none (Rothwell and Martyn, 2000).

Essentially, the major problem with peer review is that it is conducted by humans, and that like humans in societies everywhere, reviewers tend to have their own set of biases. The above sections should have given you some idea about the frailties of the peer review system.

Demonstrated biases in peer review include the following:

- Evidence of bias against female authors is well established (e.g. Tregenza, 2002; Manlove and Belou, 2018), and against female reviewers (Helmer et al., 2017)
- Evidence of bias towards author reputation, favoring acceptance of manuscripts with poor reviews (Bravo et al., 2018)
- Evidence of bias towards authors from more prestigious institutions (Tomkins et al., 2017; Manlove and Belou, 2018), so-called prestige bias (Lee et al., 2013)
- Evidence for both nationality and language bias also exist in peer review (Lee et al., 2013; Manlove and Belou, 2018; Nunez and Amano, 2021)
- Confirmation bias (the tendency for journals and reviewers to favour significant results) is one of the biggest issues for our current system (see Fanelli, 2010, and part IV[107])

But that's not all, as this is only a set of biases that have already been investigated. Given that over 280 biases have already been catalogued (I encourage you to look through the online catalogue[108], many more different types of bias are likely to exist in peer review. Let's not forget that our biases have evolved because they are very useful. They exist as a way of shortcutting exhaustive decision making based on random variables. But maybe peer review needs some more of this. And perhaps that means that I should be tolerant

[107] transparency.html
[108] www.catalogofbias.org

when I'm asked to review an economics journal, as these folk clearly weren't exhibiting any biases associated with economists when they picked me (see below[109]).

Perhaps the biggest problem facing those who wish to reform the peer review system is that it all starts with editors who are choosing reviewers. Those editors themselves have their own inherent biases. When they look for reviewers, they are likely to sample from within their own group of peers who have the same biases. Interestingly, bias (in general) is more easily perceived by early career scientists (Zvereva and Kozlov, 2021). My experience is that soliciting reviews from people that I don't know and have no connection with (are outside of my field) are more likely to fail - they will say no, or they won't reply to the request (Perry et al., 2012). This is even for academics that are publishing within the same area.

Editors are the people who select reviewers, and inspection of most editorial boards will reveal that they reflect the same biases found in peer review. That is editorial boards are mostly made up of white men from Europe and North America. Rectifying this bias will take time and the acknowledgement that there is a problem together with the willingness to do something about it. In 2020, I have seen that there has been a big movement to redress the imbalance in science at all levels. I hope that this will continue into the future so that at least some of the biases in peer review will fall away.

0.93 All reviews are not equal

If you are an editor and you receive three reviews from three researchers each suggesting something different, I have argued (below) that the editor should make their own decision on what action to take. But what if one of the reviewers is very negative and is a leader in their field? Should their review count equally with the others? Should their opinion be given more weight than the others? Of course, they could be using their position to influence their field, to make sure that opinions they hold are reinforced. Lee et al (2013) provide a good overview of the potential way in which influential reviewers could bias the peer review system. But the power sits with the editor to make this decision. Interestingly, Thurner and Hanel (2011) make the point using an agent based model (much as you might use in biological sciences) to show that only a small number of biased (for whatever reason) reviewers are needed to seriously degrade the quality of peer review, and thus the science system as a whole.

[109] editors.html

The truth is that all reviews are not equal because some reviewers will put in more effort than others. Some will know the literature better. Some will be experts in the field that should be better placed to comment. These people are actually more likely to be less senior, PhD students or post docs. However, the importance for the editor is not to take account of the names of these people, their rank, their institution, or other demographics such as their gender, race or nationality. There are great editors out there who can do this, but my impression is that the majority fail. In this case, the only way to do this is for the triple blind method. Here the editors will invite the reviewers (by name) but the reviews that result will not be marked with the reviewers' names. This will make forgetting who they are easier for

0.94 Decisions rest with editors

A good editor will look at the reasoning in the reviews and make a decision in an unbiased way. A poor editor may be swayed by the perceived influence of an important reviewer irrespective of their argument. An increasing trend that I've noticed is that editors will simply take a decision that follows the consensus of all reviewers: that is, they rate all reviewers equally (see also Rothwell and Martyn 2000). However, I would argue that this is also bad editing. Irrespective of the bias from reviewers, guarding the integrity of the process of peer review lies with editors.

Today, editors are so busy with the other duties that their jobs as academics that their decisions are hurried and expecting them to take the time and space to overcome their personal biases might be a lot to ask. Instead, I think that it is time for the triple review concept to move into the mainstream so that editors can more easily not be led by potential biases of their reviewers.

Another important problem with peer review comes when editors are not independent of authors. This can happen when an editor is known well by the authors. They could be in the same department or even in the same research group. Similarly, there could be a group of editors for different journals that have some quid pro quo arrangement, that might even be unstated, whereby their manuscripts do not undergo equal scrutiny to other manuscripts that are submitted. One could argue that whenever editors know the names of the authors, there's a possibility for the system to be corrupted.

Despite all of the problems with peer review that are acknowledged above, we stick with it as the majority system in science. It could be that peer review favours exactly the same people who uphold the system and prevent it from moving into something more equal, just and fair. These are the editors and

reviewers who have, for the most part, managed to make their careers inside the system, and have therefore mastered it to some degree.

To you, dear reader, I can only suggest that you be aware of all the potential pitfalls with peer review, and never stop striving for something better.

0.95 The social side of peer review

There is so much more to peer review than peer review. Being selected by an editor to review a manuscript represents an important standing amongst your peers. Literally it means that your opinion is valued. But there's much more to it. Doing a good job at peer review means that you improve other people's work. This help can be valued to the point where those colleagues get in touch and want to work with you. That this can happen has now been shown in a study, and has been termed the 'invisible hand' of peer review.

0.95.1 The 'invisible hand' of peer review

In another study, Dondio et al (2019) found that reviewers were more likely to provide positive review comments to authors who were close [3 steps] to their collaborative networks (see Adams, 2012). In this case, a close reviewer to the author was calculated by a social network where a distance of 1 meant that they had co-authored together [1 step], co-authors of the reviewer may have collaborated with these authors [2 steps], or co-authors of reviewers and authors had collaborated [3 steps]. Surprisingly, they obtained this result even though the journal practiced a strict double-blind review system (reviewers didn't know who the authors were, and vice versa - see part 4). Referees that were not close [i.e. 4 steps] were more likely to provide more negative review comments. Those who helped authors more during peer review (i.e. asked for major revisions), were more likely to cite the manuscript, once published, and eventually more likely, than random, to publish with those same authors, even if manuscripts were eventually rejected. The authors concluded therefore that peer review may accelerate the potential for collaboration in science.

This appears to be based on the fact that peer review can/should be constructive. Authors and peer reviewers are in fact collaborating to improve the quality of a manuscript. The process is orchestrated by an editor who can and should join in to improve the manuscript. Dondio et al (2019) make the point that this interaction is inherently social, and the peer review therefore has a function that develops relationships within and between networks of researchers.

This evidence that peer review is a collaborative system towards the betterment of science is, to me, a sign that all is alive and well in science, and that peer review is acting as it should. However with any social network comes the fragilities of human bias. This means that while peer review may function well for some, for others it may more often than not fail. The bigger problem is that it might depend on your sex, the colour of your skin, the name of your institution, or your country as to whether you are selected as a potential reviewer (i.e. to join the club), or having submitted your manuscript, find that peer review is going to work for you. In addition, if you are never asked to review then you will never benefit from this network.

Casnici et al (2017) tracked the fate of rejected manuscripts and showed that if the reviewers had several rounds of peer review before rejection, these manuscripts benefitted later by being accepted to journals with a higher Impact Factor, and/or obtaining greater numbers of citations, even if the reviewers were instrumental in rejecting the manuscript. This suggests that in working collaboratively on a manuscript, reviewers are more likely to promote, cite and help authors. The alternative is that reviewers agree to re-review an article again because they see merit in it, even if they also see flaws. And having spent considerable effort on manuscript, they are more likely to remember and cite it. But this doesn't take away from the idea that reviewers and authors are collaborating in a social way.

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What are predatory journals?

Predatory journals are publications that purport to be from scholarly publishing houses, but have little or no editorial oversight or peer review. They exist in order to extract the Article Processing Charge (APC) that is so ubiquitous in Open Access journals. They continue to exist because publishing is moving towards APCs, and there is little difference between what they do and some supposedly 'legitimate' journals. For example, some definitions of predatory journals include that their APCs far exceed their publishing costs, but this can now certainly be said of some legitimate journals.

0.96 If the line is so grey, how is it possible to tell whether or not a journal is predatory?

This is a surprisingly difficult question to answer. Predatory journals have become so sophisticated at what they do, that it can be very difficult to determine whether or not they are legitimate. Moreover, their electronically published journals can create new titles faster than the time that it takes to check that they are legitimate. An example of a publisher in the grey zone is Hindawi, that were once considered predatory but were later removed from Beall's list. At the time of writing, I considered that Hindawi still had some questionable practices and so suggested continuing to avoid them. However, in a new twist, January 2021 Wiley (a well respected publisher) acquired Hindawi for USD 298 million[110] (yes folks, your science is big business because of the big profits that Wiley expect to make out of you and your tax paying funders). This news goes to show how quickly the publishing world is reacting to the new world of OA, but also how publishers intend to dominate the market and maintain their stranglehold on scientific publishing.

Most academics have an interaction with predatory journals through email. Indeed, the numbers of emails that academics are spammed with is astounding (VanDenBerg et al., 2021), and while the best advice is to use a spam

[110] https://scholarlykitchen.sspnet.org/2021/01/11/wiley-acquires-hindawi-interview/

filter, I still find that too many legitimate emails got there too. These emails are not straight forward and seek to manipulate the reader into submitting a manuscript (Bett, 2020). Moreover, predatory journals target the most vulnerable in the community, poorer researchers who do not have English as their first language are deliberately targeted (Bett, 2020, Lund and Wang (2020)).

At the same time, legitimate journals have become increasingly predatory in their habits, and it's difficult to tell them apart from predatory journals. There was a time when it was possible to categorically state that no journal will ever approach you with a general email that invites you to contribute. However, there are now several legitimate journals that send out unsolicited emails. Realistically then, in the current publishing world, there is a continuum from predatory to legitimate. It was not always this way, and that means that as an emerging researcher you are facing difficulties not faced by your advisor or other more senior academics. Not only do you need to avoid publishing in predatory journals, but you should also avoid citing their articles.

However, help is at hand. There are some definite ways that you can determine whether you are choosing a legitimate journal. Here are my 5 steps that you can take to safeguard your submission.

0.96.1 To spot a predatory journal, use the following list in a stepwise fashion

1. Use an index. Web of Science and Scopus both curate contents of legitimate journals. If your journal of choice appears in one of these, then it is very likely to be legitimate. Note that Google Scholar includes many predatory journals, so please never use this to determine whether or not a journal is legitimate. Note also that it takes a journal several years to gain enough kudos to get accepted onto Web of Science and/or Scopus. Therefore, it can still be legitimate and not be there. We have previously discussed how to choose the right journal for your publication (see part 4). If the journal you want to publish in is not in Web of Science or Scopus, then proceed to the next step.
2. Ask your librarian. Librarians are fantastic sources as well as custodians of information, and journals are one of their key knowledge areas. Don't hesitate to get in touch with your librarian and ask their advice. They are likely to be very well placed to respond to your request. They may also be guardians of granting APCs at your institution, so it is in their interest to make sure that these valuable monies don't fall into the wrong hands.
3. Ask your advisor or an experienced colleague. It's worth doing this with them so that you can see the steps that they follow. Given that steps 1 and 2 have already come back with uncertain answers,

spreading your net more widely will help with step 4. However, be warned that there are increasing numbers of senior scientists that have been caught out by predatory journals, so checking their contributors is now no cut and dry way to differentiate between them and legitimate journals.

4. Who is on the editorial board? Journals publish names of their editors, associate editors and the editorial board. Look through these lists and see whether there are names that you recognise. If you know any of the people, you (or your advisor) can contact and ask them about the journal (they should be happy to respond). Be warned that it is easy to place someone's name on a website, so unless they have personally told you, keep away.
5. Check against a known list. In the past, this might have been the first thing to do, but the number of predatory journals is proliferating so quickly that it's hard for any list to keep up. Beall's list retired in 2017. The next best list now has more than 3 times that. See here for an interview with the keeper of the new list, Simon Linacre. Sadly Simon's list is behind a paywall, so you can't expect to access it. One of the reasons why Beall gave up is that the new tactic for these publishers is to produce lots of new journals. Curating a list is real work and has implications for the publishers on it, hence you now need to pay to access an up to date list. There are more lists: Cabell's Predatory Journal Blacklist, Beall's list, DOAJ delisted journals, Scopus discontinued sources, etc
6. If predatory journals are becoming more like legitimate journals, where's the harm in publishing with them?
7. Your reputation is important. As an emerging researcher, your publishing record is what many people will see first. It is all that is shown in your Google Scholar or ResearchGate profile. It's your shop window or showroom. What prospective employers will want to see is that there are plenty of publications (appropriate for your career stage), and that they are in appropriate journals with good reputations. You might confuse having a good reputation with a high impact factor. The two need not be the same. High impact factor journals don't accept all types of submission, and you may have data that simply doesn't fit into one of their mandates. I would say that it's still important to publish this, and there are many journals with good reputations where you can do so. Let's leave discussion about the impact factor for another chapter.

The other reason why you would be best to avoid a predatory journal is that they attract very little in the way of scientific impact: few people will read or cite them (see article here). One thing that you definitely want for your work is for people to use it. To do this they must read and cite it. If you publish in a predatory journal, many scientists won't even consider reading the content

as it has not been, nor will it be, peer reviewed. Thus, unlike a preprint, it is not being openly offered to the community for review.

Due to the ambiguity of whether or not these papers have been peer reviewed, I would also suggest that you do not cite publications that you think may be from predatory journals. You can use the same steps (above) to determine whether or not what you want to cite is from a legitimate journal.

0.97 What do you do if you have already published in a journal that others consider predatory?

The first step would be to write to the publisher and withdraw the article. Whether or not you paid an APC, having it on their website is not good for your reputation. Beware, these journals don't adhere to an ethical code, and so they might refuse to withdraw your paper. Or they may want to charge an additional fee to remove it (remember that they are in it for the money).

Do not cite the paper, or put it on your CV. You can easily remove such articles from your Google Scholar profile or ResearchGate. Don't put it in your showroom.

Prepare a statement that explains how it happened. You may not have been responsible for the submission, or aware that the publication was from a predatory publisher. However, in time you are likely to forget the exact reasons. It would be a good idea to prepare a statement, so that if you are asked (for example in a job interview), you can explain how it happened. People can be very understanding when provided with an explanation, but if you say that you can't remember or can't give any details, then you may sound evasive.

Predatory publishing is a big problem in South Africa where 4246 papers have been published in 48 predatory journals: take a look at this article (Mouton and Valentine, 2017). And it's not just publishing where the predators are lurking, they are also waiting to invite you to a conference (see here[111]). Your work is valuable to you and to your advisor, so please try to make sure that it doesn't end up in the hands of a predator!

[111] http://flakyc.blogspot.com/

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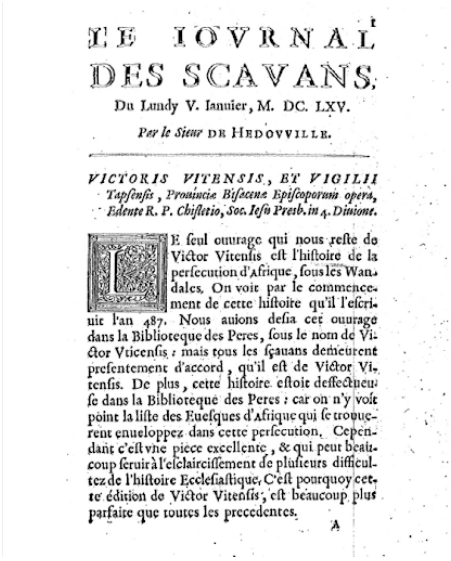
Why did some journals go behind paywalls?

Academics are not (usually) superstars, nor looking for enormous numbers of readers, but there would be little point to recording our work if we had no readers, or if our work were inaccessible, and so publishing is a necessity. However, we have got into a state in which much of our work is behind a paywall, and thus inaccessible to most. Whether or not we need our work to look pretty and appealing speaks more to our readers as humans than academics. Perhaps it goes without saying that an audience is likely to be larger the more appealing the presentation, and that's not just the writing style but the layout and presentation of the text itself. And this is not new.

The first scientific journals appeared in 1665: Journal des Sçavans, and three months later Philosophical Transactions of the Royal Society of London. It is clear that the papers were type set and presented in the manner of a book, perhaps analogous to a collection of short stories. At the start, these were reports of studies that were presented at meetings. Producing proceedings of learned societies became the way in which most scientific journals began. Only later did it become possible to submit a manuscript that had not been presented. And later still when publishers began to manufacture their own scholarly journals in the absence of any academic society.

Being the editor of a society journal means being elected by members of that society, and being responsible to an editorial board, normally made up of the society's members. Until very recently, and I'm thinking back to my first interactions with editors for my first few publications, submitting to the journal meant producing three (or sometimes more) double spaced copies of a manuscript and mailing them to the editor. Editors of bigger journals had secretaries dedicated to handling the administration of the paper. Following a telephonic enquiry, the copies were sent out to referees by post and sent back to the editorial office with a typed report often together with the marked up manuscript. Once the editor had received all reports, they communicated their decision back to the corresponding author (i.e. the one to whom correspondence was addressed) and, once accepted, the article went into production. Prior to personal computers being commonplace (only 25 years ago), each journal would have had to have had a publisher to set the type and print the pages. Clearly, this was beyond the scope of individual societies and the publisher was a necessity. Libraries had to pay for copies of journals, as the cost of publishing had to be offset by the society.



LE IOVRNAL
DES SCAVANS.
Du Lundy V. Ianuier, M. DC. LXV.
Par le Sieur DE HEDOVVILLE.

VICTORIS VITENSIS, ET VIGILII Tapſenſis, Prouincie Biſacene Epiſcoporum opera, Edente R. P. Chifletio, Soc. Ieſu Presb. in 4. Diuione.

LE ſeul ouurage qui nous reſte de Victor Vitenſis eſt l'hiſtoire de la perſecution d'Afrique, ſous les Vandales. On voit par le commencement de cette hiſtoire qu'il l'eſcriuit l'an 487. Nous auions deſia cet ouurage dans la Biblioteque des Peres, ſous le nom de Victor Vticenſis : mais tous les ſçauans demeurent preſentement d'accord, qu'il eſt de Victor Vitenſis. De plus, cette hiſtoire eſtoit deffectueuſe dans la Biblioteque des Peres : car on n'y voit point la liſte des Eueſques d'Afrique qui ſe trouuerent enueloppez dans cette perſecution. Cependant c'eſt vne piece excellente, & qui peut beaucoup ſeruir à l'eſclairciſſement de pluſieurs difficultez de l'hiſtoire Eccleſiaſtique. C'eſt pourquoy cette édition de Victor Vitenſis, eſt beaucoup plus parfaite que toutes les precedentes.

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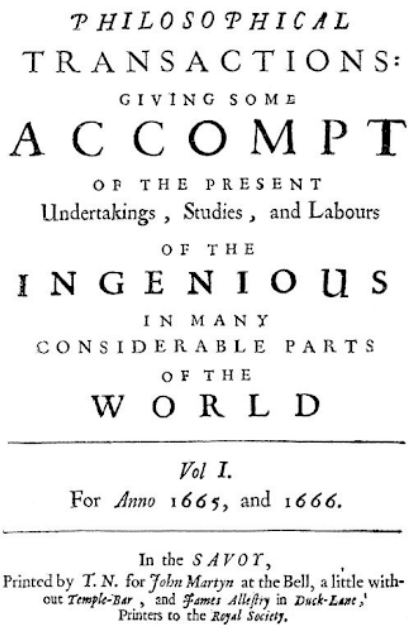

PHILOSOPHICAL
TRANSACTIONS:
GIVING SOME
ACCOMPT
OF THE PRESENT
Undertakings, Studies, and Labours
OF THE
INGENIOUS
IN MANY
CONSIDERABLE PARTS
OF THE
WORLD

Vol I.
For *Anno* 1665, and 1666.

In the *SAVOY*,
Printed by *T. N.* for *John Martyn* at the Bell, a little without *Temple-Bar*, and *James Allestry* in *Duck-Lane*,
Printers to the *Royal Society*.

FIGURE 5: The first issues of the World's first scientific journals

FIGURE 6: Note that the Journal des Sçavans ceased publication in 1792 due to the French Revolution, but that the Philosophical Transactions of the Royal Society of London continues to this day as the world's longest running scientific journal.

The advent of desktop publishing changed the need for publishers and brought many small society journals onto a larger platform where they could produce attractive content (over the typewritten documents that had been stencil duplicated or similar) and sent around to members. However, for small societies there was no professionalism involved as it devolved to the editor to publish society material. This is where I entered the stage in 2009 when I took over as editor of the *African Journal of Herpetology*. Thankfully, email had taken the place of the postal service, but once a manuscript was accepted I was the one who needed to type-set the documents (in Quark) and send out proofs to authors. Once proofs were corrected and the issue was ready, I had to find quotes from 3 printers, deliver discs and ultimately collect boxes of printed journals. Back at home, I also packed all of the copies into labelled envelopes (with some help from friends)[112] and carried the boxes once again to the post office.

After the first issue, I realised that I could not do all of this work indefinitely. I knew that there were publishers who were interested in acquiring the journal into their stable, and I contacted them and started negotiations. In 2011, the first copy of AJH from a professional publisher emerged, and allowed me to go back to editing the content through peer review.

At the time, I was aware of Open Access and considered this as an option for the journal. Open Access would have required that someone pay for the type setting, and the society would still have to pay for an online dissemination platform, given that they did not have their own platform. This would have meant that authors paid for getting their manuscripts into print. And then, like today, the decision was that our authors would not be willing to pay. Other, richer, societies were able to go Open Access with the costs being covered by the authors. For some this became an incredibly successful model, with submissions increasing as well as the Impact Factor. They demonstrate that Open Access is possible on an independent platform.

0.98 Why don't all society journals do without publishers, and go Open Access independently?

The first problem is that societies generate income from journals. Subscribers to print or virtual copies pay the society, and this can defray a large part of the cost of publishing otherwise carried by the members. Some make a profit, and this profit can enable the society to do more for their community of members. This could include providing small grants, subsidising conferences for students

[112] https://youtu.be/sJReMVz7Yxk

and other much appreciated initiatives. Going Open Access means losing this revenue, as well as taking on the extra costs.

The second problem for many societies is that their members are paying, and the councils or committees elected to represent the members do not feel that it is fair for their members to pay for open access for everyone else. Part of the privilege of being a member of the society is having a free (or more accurately paid through membership) copy of the society's journals. The costs are not high, and the exclusivity of members having Open Access while it is denied to others is perhaps just a hangover from the days when the only other copies were in the library. Certainly, the costs are nothing like those which authors are now charged by publishers to turn their accepted manuscripts into Open Access.

But the current situation is unsustainable. Tax-payers (in the main) pay for science to be conducted at universities and other institutes. In places where Open Access is mandatory, the tax-payer pays again to have the research published at a cost that is far inflated from the actual production costs. Publishers are getting fat, and the losers are the scientists (whose funding is reduced to pay publication costs) and the tax-payers who end up feeding the greedy publishers.

0.99 What will it take to break the vicious cycle?

We need new models for publishing. Society journals are still kings in this game and ultimately hold the cards for moving away from filling the pockets of publishing companies. What we have seen in recent years is that journals can come from nowhere to become dominant players in the system. Think PLoS ONE, and the even more recent Scientific Reports. These mega Open Access journals didn't exist 10 years ago. And they don't need to exist 10 years from now. What is needed is for the actual costs of publishing (not that currently inflated by publishers) to be covered by the institutions that employ the academics. This could cover type-setting and the additional IT infrastructure (on-line submission system and online dissemination platform). Most (if not all) societies are not-for-profit organisations, and only need to cover the costs of publishing.

0.100 Can we afford not to change?

If you are from a rich country or institution, then you can probably afford the current system. Those who cannot are researchers in disadvantaged countries. In some cases, the cost of publishing Open Access is greater than the cost of the research. These are insurmountable costs for many researchers. We have a massive hole in scientific contributions from the poorest of nations, and the current Open Access models will see their work being the most hidden from view, while the countries paying for their work do so disproportionately. But even developing countries could be winners in a new Open Access model. By sourcing the relevant IT skills in the country, governments of middle-income countries could facilitate the content of their own society's with relative comfort. In my opinion, everyone should publish work from scientists in the poorest countries as Open Access without any charges.

0.101 Societies need money. Editors can't be publishers.

We need free software. We desperately need good, free editorial management software. There are some free versions out there, but what we need are free versions that are at least as good, if not better, than existing platforms (e.g. ScholarOne; Editorial Manager). Galipeau et al (2016) make the point about the ever expanding role of editors in the modern publishing era. There is no scope for editors to take on extra work.

We need a free La-Tex interface with robust templates for all societal journals. Ideally, this would be packaged with the above editorial management software. This must have the ability to cope with figures and equations, and the unusual demands that some society journals have.

We need a solution for hosting and disseminating the Open Access society journals (and their supplementary information if not hosted elsewhere) in perpetuity. This last point is perhaps the most expensive, and almost certainly requires government assistance. Maybe this is an interesting use of the blockchain with libraries keeping the data. It would be an interesting way to build a doi with editor and referee unique IDs, and the document's information hanging off.

We need to take back our content stuck behind paywalls. Yes, it's time for you all to dig up those old submitted manuscripts and submit them to an institutional repository where it can be accessed for free.

0.102 A paywall is never acceptable wherever you put it

Any paywall, whether it be high (i.e. EUR 9500 for Nature in 2020), or 'considerably lower' (i.e. EUR 900 for NeoBiota in 2020) is a wall that excludes many researchers, and certainly those from many developing countries. I have made this point before (Measey, 2018). While previously I lobbied for the source of these publishing fees to become public - which would show that for a great majority of researchers, publishing fees are coming from research funds. Funds that would otherwise further knowledge are going directly into the pockets of publishers. Publishers instantly refused to do this. Now I think that our energies would be better spent demolishing the paywall (what they refer to as Diamond Open Access). And for almost all of us, this means doing so without the benefit of a rich uncle.

Until we have Diamond Open Access for all, having the paywall after publication is actually preferable for most of us, as most of us cannot afford to pay anything as we simply don't have this type of discretionary funds. We do have to publish our work, and would rather that it was out there behind a paywall, than not out there at all.

I am not advocating a paywall, but I disagree that by placing the paywall before publication (i.e. on acceptance) solves anything for anyone other than the most privileged researchers. In the words of Peterson et al (2019), "do not replace one problem with another". Instead, what we need is to tear down the paywall with a completely new publishing model for academia. We are all quick and ready to agree that Open Access is the best way forward for all scientific results. The aims and objectives of Science Europe are laudable and will lead to a far better publishing environment for European scientists. Scientists from other high-income countries will also benefit from this decision, having a far greater number of journals in which to publish Open Access.

If current trends continue, scientists from low-income countries will be granted full fee waivers. Many journals use the Hinari Eligibility list of countries[113] to separate Group A (free access) and Group B (low cost access – normally billed at a 50% reduction in fees). The lists are made up from five global economic and development criteria.

Middle-income countries are missing from these lists, and receive no support for fee waivers. Their governments provide scientists with no means of paying fees. Scientists who pay fees often do so from their own research budgets. The increasing number of journals that charge unjustifiably high publishing costs are forcing middle-income scientists away from Open Access journals. In my

[113] http://www.who.int/hinari/eligibility/en/

own lab, publication fees are regularly more than the cost of conducting much of our ecological research.

0.103 The answer lies inside our University Libraries

The university library has undergone a massive transformation over the last 20 years. During my PhD, I made a weekly visit to the library to physically pick up the latest issues of all the journals that came through the postal service from all over the world. For papers that I found out about but had no access to, I had a stack of postcards that were specifically for reprint requests, and I enthusiastically filled them out and posted them off to researchers the world over. Librarians arranged these issues on the shelves and eventually sent them off for binding into volumes and then worried about the physical space that was available inside the library as every year publication inflation (Larivière and Costas, 2016) meant more pages to be supported within their walls.

Probably the most stressful time in the library now is around negotiating the next contract with a mega-publisher. Will they be able to meet next year's demand for cash? How much are other universities paying? Of course, the bundles are sold with non-disclosure agreements, so that librarians who successfully negotiate a lower price at one institution cannot influence the negotiations at another. Doesn't this sound like an extortion racket?

The solution then would be for our learned academic societies to come to agreements directly with university libraries. Today, publishing is less about type-setting (which many top publishers outsource and do very poorly), and more about dissemination. This is something that our library and academic librarians have been doing for decades, and do far better and far more cheaply than any publishing house. Given the choice, most of us would prefer to entrust our academic endeavors to our own libraries rather than to for-profit publishing houses.

There are more reasons why it makes sense for libraries to take on the roll as publishers. Most of us are employed by universities or research institutions that also fund our libraries. Linking the work we do (writing, reviewing and editing) more closely with our institutions would result in a greater appreciation for this part of our workload. Editors and associate editors will appreciate that they get little credit from their institutions for a considerable extra amount of work that they perform.

Libraries have fantastic networks, and are our professional long-term storage partners. They developed efficient and impressive information technology (IT) long before it hit most academic departments. Their inter-library networks are

what we now need to disseminate the knowledge that we generate without any walls.

The idea of libraries as the new publishers isn't new. Raju and Pietersen (Raju and Pietersen, 2017) proposed this as a solution in Africa. Here I extend the same idea as an exclusive way of publishing academic journals for the world.

0.104 We need to give up our addiction to fancy layouts

Once the storage and dissemination of our contributions are taken care of, the only service left from the publishers is a fancy layout. This is mostly a historical legacy which I've talked more about in the past (see above). I have to admit that I really like seeing my work being nicely produced and printed. But I'm happy to give this up if it means demolishing paywalls. In reality, LaTex can solve most of these problems so that we simply use the journal (library) produced template, that will need minimal manipulation afterwards.

We also need to persuade our employers to stop their obsession with publishing metrics, for example by adopting the San Francisco Declaration on Research Assessment[114] (known as DORA).

No doubt, there will be some institutions that will invest extra to have nicer layouts. But I feel confident that this will not change the impact factor, or any other metrics, as academics will value the content for what it contains rather than what it looks like. Admittedly, nothing about the contents of the highest ranking journals suggests that impact factor is consistently related to research quality.

If you have read this far, then I hope that you will join the call for Diamond Open Access - no paywalls for anyone.

[114] https://sfdora.org/read/

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Are researchers writing more, is more better and who should be an author?

The concept of some kind of 'literature inflation' in science has interested me for a while. The idiom 'publish or perish' suggests that researchers will increase their output in order to obtain positions and promotions. And if a researcher's productivity is measured by their publication output, shouldn't we all be writing more papers?

Similarly, if we should all be writing more, then wouldn't some people start publishing two (or more) papers, when one would be adequate? This idea of 'salami slicing' to inflate outputs would be an understandable strategy if researchers were all trying to increase their output. Alternatively, the names of authors might be added to papers in which they did not make significant input via ghost authorship or hyperauthorship (see Cronin, 2001, for an interesting historical perspective).

A study by Fanelli and Larivière (2016) has a new take on the above questions, by asking whether researchers are actually writing more papers now than they did 100 years ago. They used Web of Science to look for unique authors (more than half a million of them) and determine whether the first year of publication and the total number of publications resulted in an increasing trend.

0.105 Researchers' Individual Publication Rate Has Not Increased in a Century

Fanelli and Larivière's (2016) trend line for biology is very stable at around 5.5 publications whether you started publishing in 1900 or 2000 (note that earth science and chemistry do both increase dramatically).

However, they found that the number of collaborators is increasing, and so they adjusted publication rates for co-authorship. Their finding was then that there is no increasing trend in researcher productivity. This then poses another question. Who are these people that are publishing so much more than 5.5 publications, and are they unfeasibly prolific?

0.106 If we are all writing the same number of papers, are some authors unfeasibly prolific?

This was the question posed in a study that examined prolific authors in four fields of medicine (Wager et al., 2015). This publication piqued my interest as it turns out that they decided that researchers with more than 25 publications in a year were "unfeasibly prolific" as this would be the equivalent of ">1 publication per 10 working days". Their angle was to suggest that publication fraud was likely, and that funders should be more circumspect when accepting researchers productivity as a metric. Looking back through the peer review of this article (which is a great aspect of many PeerJ articles), I'm astounded that only one reviewer questioned the premise that it's unfeasible to author that number of papers in a year.

I have published >25 papers in a year, and I know other people who do this regularly. To me, there is no question that (a) it is possible and (b) that they really are the authors. Firstly, the idea that prolific authors constrain their activity to "working days" is naïve. Most will be working throughout a normal weekend, and working in the early morning and late evening. A hallmark of a prolific author would be emails early in the morning and/or late at night. This gives you an indication of their working hours, and how they are struggling to keep up with correspondence on top of writing papers.

Authorship of a publication is often the result of several years of work. Thus, publications that I co-authored in 2017 frequently had research conducted in 2014 or earlier. For example, one of the publications, Measey et al (2017) is the product of aSCR work that started in 2009, funded in 2011 with fieldwork in 2012, and required the development of software for analysis by Ben Stevenson and colleagues (2015), before it could be completed and submitted. Thus, from my perspective, when I look at authoring a lot of publications it reflects the activity of the initial concept for the work, raising of money, conducting the field work or experiment, analysing the data and then writing it up (with the subsequent submission and peer review time). Thus, publications in 2017 result from a lot of work done for more than 3 years.

0.107 Is writing a lot of papers a good strategy?

This is a question of long standing, and one that you may find yourself asking at some point early on in your career. I'd suggest that the answer will be more about the sort of person that you are, or the lab culture you experience, over

any strategy that you might consciously decide. If you tend toward perfectionism, this will likely result in fewer papers that (I hope) you'd consider to be of high quality. If on the other hand your desire were to finish projects and move on, you'd be more likely to tend toward more papers. It is clear that the current climate leads towards the latter strategy, with increasing numbers of early career researchers bewildered at the idea of increasing their publication metrics (Helmer et al., 2020). But what should you do?

Given that the 'best' personality type lies somewhere in the middle, you can decide for yourself whether you identify with one side more than the other. But which is the better strategy? Vincent Larivière and Rodrigo Costas (2016) tried to answer this question by considering how many papers unique authors wrote and seeing how this relates to their share of authoring a paper in the top 1% of cited papers. Their result showed clearly that for researchers in the life sciences, writing a lot of papers was a good strategy if you started back in the 1980s. However, for those starting after 2009, the trend was reversed with those authors writing more papers less likely to have a smash hit paper (in the top 1% of cited papers). Maybe the time scale was too short to know. After all, if you started publishing in 2009 and had >20 papers by 2013 then you have been incredibly prolific.

One aspect not considered Larivière and Costas (2016) is that becoming known as a researcher who finishes work (resulting in a publication) is likely to make you more attractive to collaborators. Thus, publishing work is likely to get you invited to participate in more work. Obviously, quality plays a part in invitations to collaborative work too. Thus pulling the argument back to the centre ground.

If you find yourself becoming preoccupied about which is the best strategy for you, I'd suggest that you get back to finishing what you were writing before you got distracted!

0.107.1 Natural selection of bad science

In 2016, Smaldino and McElreath proposed that ever increasing numbers of publications not only leads to bad science, but is currently selected for in an academic environment where publishing is considered as a currency. They argued that the most productive laboratories will be rewarded with more grant funding, larger numbers of students, and that these students will learn about the methods and benefits of prolific publication. When these 'offspring' of the prolific lab look for jobs, they are more likely to be successful as they have more publications themselves. An academic environment that rewards increasing numbers of publications eventually selects towards methodologies that produce the greatest number of publishable results. To suggest that this leads to 'bad science' Smaldino and McElreath (2016) conducted an analysis in trends over time of statistical power in behavioural science publications.

Over time, better science should be shown by researchers increasing their statistical power as this will provide studies with lower error rates. However, increasing the statistical power of experiments takes more time and resources, resulting in fewer publications. Their results, from review papers in social and behavioural sciences, suggested that between 1960 and 2011 there had been no trend toward increasing statistical power. Biological systems, whether they be academics in a department or grass growing in experimental pots, will respond to the rewards generated in that system. When grant funding bodies and academic institutions reward publishing as a behaviour, it is inevitable that the behaviour of researchers inside that system will respond by increasing their publication output. Moreover, if those institutions maintain increasing numbers of researchers in temporary positions, those individuals are further incentivised to become more productive to justify their continued contracts, or the possibility of obtaining a (more permanent) position elsewhere. Eventually, this negative feedback, or gameification of publishing metics, produces a dystopian and dysfunctional academic reality (Helmer et al., 2020).

0.108 At what rate is the literature increasing?

A study using several databases (Web of Science, Scopus, Dimensions and Microsoft Academic) back to the beginning of their collections at the start of scientific journals in the mid 1600s. They suggest that the inflation rate of scientific literature runs at 4.02%, such that the literature will double in 16.8 years (Bornmann et al., 2020). This means that there is literally twice as much published in 2020 as there was in 2003.

Although the early period of scientific publishing was notably slower than today, it is since the mid-1940s (following the end of "World War II") that science has seen an exponential growth in productivity, with annual growth of 5.1%, and a doubling time of 13.8 years (Bornmann et al., 2020).

0.109 If more is being published, will Impact Factors increase?

Yes. If the numbers of citations per paper remains constant, then the Impact Factor[115] of journals should increase annually at 5%. My impression is that

[115] impactfactor.html

citations are increasing in papers as the literature increases, which suggests that Impact Factor will grow at a faster rate.

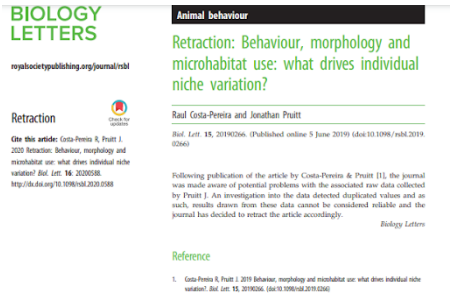
0

When should you retract your paper?

A retraction of a paper is when your paper is effectively "unpublished". This happens at the discretion of the editor (and often the entire editorial board), and is a very serious issue. Retractions are rare. They normally only happen when fraud is involved (especially the fabrication of results) or ethical guidelines have been transgressed (such as when authors lacked required permits or ethics permission).

FIGURE 7: You should not cite a retracted paper. Once papers are retracted they don't disappear. They continue to be available at the publisher's website, but with a clear notice that they have been retracted (see below). In addition, a separate publication is made announcing the retraction of the work.

If you downloaded the article before it was retracted, then you will not be aware of what has happened unless you are following that particular publication. Similarly, if you get your search results from Google Scholar, there is no


BIOLOGY LETTERS

royalsocietypublishing.org/journal/rsbl

Retraction

Cite this article: Costa-Pereira R, Pruitt J. 2020 Retraction: Behaviour, morphology and microhabitat use: what drives individual niche variation? *Biol. Lett.* **16**: 20200588. http://dx.doi.org/10.1098/rsbl.2020.0588

Animal behaviour

Retraction: Behaviour, morphology and microhabitat use: what drives individual niche variation?

Raul Costa-Pereira and Jonathan Pruitt

Biol. Lett. **15**, 20190266. (Published online 5 June 2019) (doi:10.1098/rsbl.2019.0266)

Following publication of the article by Costa-Pereira & Pruitt [1], the journal was made aware of potential problems with the associated raw data collected by Pruitt J. An investigation into the data detected duplicated values and as such, results drawn from these data cannot be considered reliable and the journal has decided to retract the article accordingly.

Biology Letters

Reference

1. Costa-Pereira R, Pruitt J. 2019 Behaviour, morphology and microhabitat use: what drives individual niche variation? *Biol. Lett.* **15**, 20190266. (doi:10.1098/rsbl.2019.0266)

FIGURE 8: You can however, cite the retraction which is published under a separate citation string, like this one (Costa-Pereira and Pruitt, 2020).

indication that a paper has been retracted. Contrast this with search results of Scopus and Web of Science, both of which clearly indicate if an article has been retracted. The problem that even highly publicised retrations continue to be cited by articles that follow (Piller, 2021). This is likely to be a problem that both authors and editors move on once an article is accepted. Clearly, the community is still responsible for watching what happens to the literature, even once a paper is cited. Of course, the publishers could be using items such as DOIs to track retracted papers and query their citations.

0.110 A corrigendum is more likely

It is very unlikely that you will be in a position where you will need to think about retracting your paper. If you notice a mistake, especially one that results in a difference to how the results are presented, then you should approach the editor about publishing a correction (also termed a corrigendum).

0.111 Retraction Watch

To learn more about retractions in science, I encourage you to read the blog at Retraction Watch (`https://retractionwatch.com/`). This will give you an idea of the reasons why retractions are made, and give you some perspectives about the practices (and malpractices) that go on in the scientific environment.

0.112 Fabrication of data

The fabrication of data does happen. A growing body of retractions and alleged evidence on the tampering of data in spreadsheets has led to the suspension of a top Canadian researcher, Jonathan Pruitt. Pruitt's case is becoming increasingly untenable as more editors backed by co-authors are retracting papers where he contributed data (see here). For Pruitt, this has become a threat to his career and livelihood. Similarly, his university is facing the possibility that they hired a fraud. Consequently, this whole debacle has slipped into the legal world.

Some have suggested that the pressure to obtain a permanent academic position is enough to drive some scientists to commit fraud (Husemann et al 2017; Kun 2018). The idiom 'publish or perish' is one that we have already come across (see part 1), and the importance of publishing will be made later under the chapter about looking for a job. However, I hope that by shedding some light on unethical practices, this book equips you to avoid these together with those that may espouse them, and instead show you that there is a better path to success.

Pruitt's case highlights another issue which is that, while it might be easy to fabricate data, it is hard to make it stick. Reading the evidence posted by the concerns of Pruitt's co-authors, it seems that Pruitt made up numbers relating to behavioural observation data, and that the distribution of these numbers didn't stand up to scrutiny. Thus, if you are worried about the veracity of the data contributed by a collaborator, this would seem to be a good point to start.

0

Are you bullying or being bullied?

I am going to talk about academic bullying because it is currently prevalent in academia, and because most of the bullies are unaware of what they are doing. In a 2019 survey of graduate students (see here[116] Figure 9), 22% felt that they had experienced bullying during their PhD program. The only way of improving the situation around academic bullying is for everyone to become more aware. It may not be happening to you, but it may be happening to people around you either in your lab or in another lab in the same department or faculty. If you think that this is very rare behaviour in academia, think again (Devlin and Marsh, 2018).

0.113 How to spot a bully

A bully is anyone who abuses or misuses their position of power in order to humiliate, denigrate or injure another. This does not need to be your advisor, or someone in your lab. It can be anyone in your working environment (watch the video here[117] or here[118]). These people are usually in positions of power with influence over you and your future. As in my example (below) you may be worried that the power they have could be used by them to negatively impact your future. If you are worried about this, then their behaviour most likely conforms to bullying. Bullying often involves harassment that is designed to undermine your dignity, often through sexism, racism, or another prejudice (Krishna and Soumyaja, 2020). Even if you think that your bully didn't mean to cause offence, the fact that they did upset you and that this behaviour was unwanted is enough to fulfil the criteria for bullying. Thus, it is not what they intended, but what you felt that is important in bullying. A direct consequence of this is that bullies often don't recognise this as a description of their behaviour. It is worth bearing in mind that bullies are often damaged individuals who are repeating behaviour that they have themselves

[116] https://www.nature.com/articles/d41586-019-03459-7
[117] https://youtu.be/bZmmp7i9Tsc
[118] https://youtu.be/lKUONMm-pWo

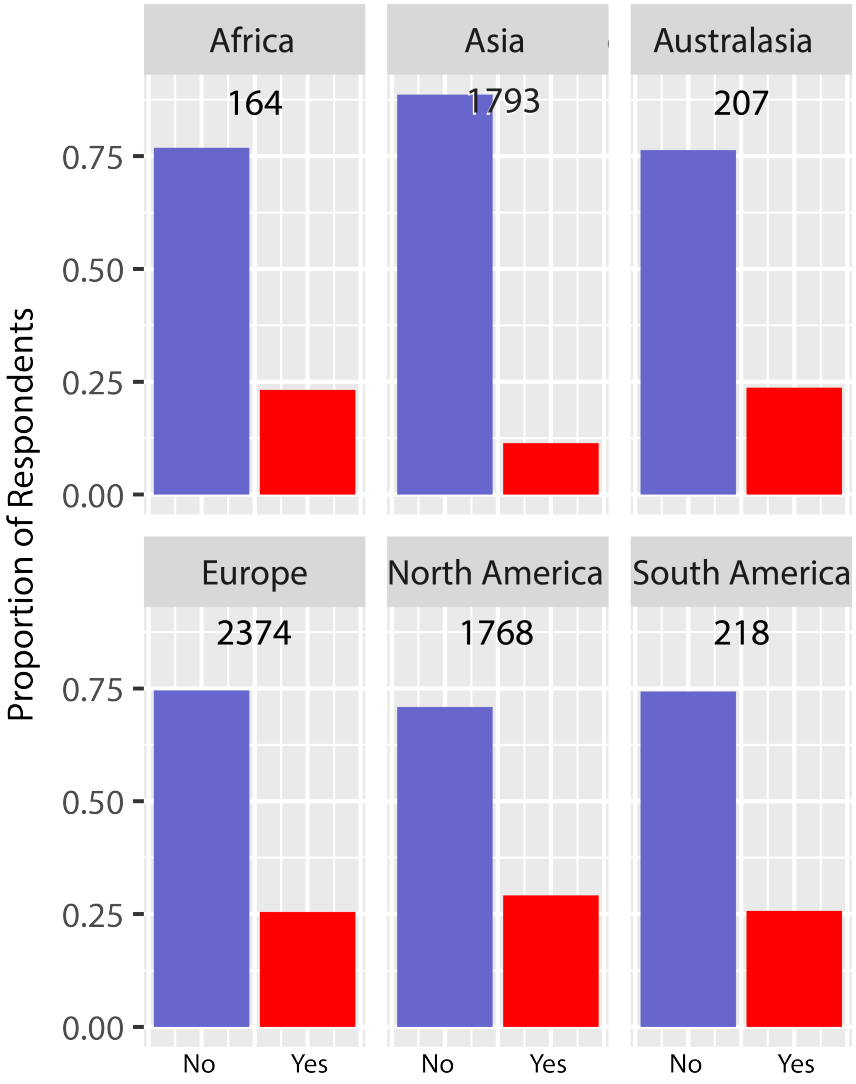


FIGURE 9: Responses to a survey of graduate students (in 2019) demonstrates the changes in bullying propensity in different research cultures.

experienced from others. This doesn't excuse their behaviour, but they may think that such behaviour is normal.

What you should ask yourself is if someone were to observe this behaviour from the outside, would they recognise the interaction as normal or see that something was not correct? Of course, if you observe this going on with someone else in your group, or outside your group. Take the initiative to approach the person after and determine whether they feel like a victim: remember that not all interactions are as they appear from the outside. This is where a good set of institutional rules about bullying is important.

0.114 What to do about bullying

First, you need to find the rules that your institution has regarding bullying. If your institution has no rules, then they will need them and so helping them achieve this would be a good place to start (Mahmoudi and Keashly, 2021). No one wants to be the first case study, but there may need to be a first in order to set up a protocol.

Avoid the bully when asking for your institutional rules, but you should be able to find them via your departmental secretary, administrative support staff in the department or faculty. Read the documentation carefully and learn about how and by whom such reports are dealt with. Become aware of resources that are available; paritymovement.org[119] is a great place to start. Read more about other people's experiences and be aware that you are not alone (Mahmoudi, 2020, Malaga-Trillo and Gerlach (2004)).

Next, document your case. Make some notes about the incident(s), when they happened, what was said, how you were made to feel and what power you feel the person has over you.

Share your burden with a trusted friend or colleague. It is worth sharing the incident with others to see what they think about your predicament. In the survey mentioned above, more than half of the respondents who said that they experienced bullying felt that they could not discuss their experience for fear of reprisals. However, you do not have to discuss it inside the workplace, and often it's better to talk to people outside as the context is not so important in bullying. In your description, attempt to strip down the interaction into the component parts.

Follow your university's rules about who to go to with your complaint. Don't leave it to the next person in your lab to experience, they may not be as strong

[119] https://paritymovement.org/

or as resourceful as you. It may not be your career that is destroyed, but the next student might not be so lucky.

0.115 What to do if the procedure against bullying at your institution doesn't work?

My worst experience of bullying happened when I was a PhD student. It happened to me, and I witnessed it happening to other members of my lab. It wasn't hard to spot. Students would come out of my advisor's office in tears, and recount horrific stories of how he had debased and humiliated them. At the time, our department had no specific code on bullying, but there was a complaints procedure which started with the head of department. Unfortunately, as my advisor was also the head of the department, I could not follow the procedure as it was supposed to be done. Instead, I went to the academic who was responsible for postgraduates. The first two times, that staff member simply went to the head of department (yes, my advisor) and I was called in both times and bullied some more: how dare I complain about him?

The last time I tried to complain, once I had finished my PhD and felt much safer from the bully, I went to the dean of the faculty. He was the line manager of my advisor (still head of department) and was a lot more sympathetic. After listening to my story, and how my other lab mates were still suffering, he called them in one by one. And one by one they each denied all of the bullying that had happened. They were afraid. Unlike me, who had finished, they were still relying on their advisor to get their postgraduate degrees. The result was that without any corroborating evidence, there was no case for the dean to take forwards.

What should you do if the procedure at your institution doesn't work? You become a survivor. You also become more vigilant against bullying in the future. Whatever happens, don't be tempted to become the bully yourself. Support other survivors and make progress to improve the system for future postgraduate students. Bullying is in human nature, and it won't stop. But we can make people more aware of it, and we can have procedures that work both for the bullied and the bullies.

0

Keeping track of your mental health

Stress is a natural part of life and many people are at their most productive when they are under some degree of pressure, such as a deadline. Although deadlines don't work for everyone.

Douglas Adams famously claimed:

> "I love deadlines. I like the whooshing sound they make as they fly by."

Problems arise when we become overwhelmed by stress and are unable to fully respond. When this occurs productivity can drop off and survival responses can be triggered as if responding to an actual physical attack. These responses include fight, flight or freeze responses. Anxiety and panic can be triggered. In this state additional demands on your time may also push your life off balance, so that you start to neglect your personal wellbeing which can negatively impact on relationships, exercise regime, or even nutrition and personal hygiene see part 1[120]. ome people can find that the additional stress can cause physical symptoms that may even need medical treatment. Your sense of competence and mastery can be negatively impacted such that you may even suffer from feelings of inadequacy or imposter syndrome (see part 2[121]).

Although there are not many studies on mental health for PhD students, those that exist (as well as surveys: Nature 2019[122]) all suggest that there is

[120] healthy.html
[121] fear.html
[122] https://www.nature.com/articles/d41586-019-03459-7

a significant toll, which is proportionately higher than for others in society (Levecque et al., 2017). Whatever your prior experience of stress in a working environment, academia is known to be particularly stressful, and as a PhD student you are likely to absorb a significant amount of this stress into your own life (Stubb et al., 2011).

The General Health Questionnaire (see GHQ-12 in Table 0.2) is an instrument used to measure psychological distress. It is quick, reliable and simple to score, so you can use it at any time during your PhD studies as an indicator of whether you need to reach out to personal, occupational or professional support networks.

Right now, I suggest you complete the GHQ-12 (Table 0.2) and record your answers as a baseline. Keep the scores somewhere safe. During the course of your PhD, if you feel that your scores may have changed, take the test again and compare them with your baseline scores. Although there are no hard rules, if three or more of your scores have moved by two or more points it could be worth discussing with your support network to help you decide whether or not to seek professional help.

TABLE 0.2: A General Health Questionnaire with 12 questions (GHQ-12) that you can use to keep track of your mental health

General Health Questionnaire: Have you recently…	0	1	2	3
been feeling reasonably happy, all things considered?	Better than usual	Same as usual	Less than usual	Much less than usual
lost much sleep over worry?	Not at all	No more than usual	More than usual	Much more than usual
been feeling unhappy and depressed?	Not at all	No more than usual	More than usual	Much more than usual
felt you couldn't overcome your difficulties?	Not at all	No more than usual	More than usual	Much more than usual

General Health Questionnaire: Have you recently…	0	1	2	3
felt under constant strain?	Not at all	No more than usual	More than usual	Much more than usual
felt capable of making decisions about things?	Better than usual	Same as usual	Less than usual	Much less than usual
been able to face up to your problems?	Better than usual	Same as usual	Less than usual	Much less than usual
been thinking of yourself as a worthless person?	Not at all	No more than usual	More than usual	Much more than usual
been losing confidence in yourself?	Not at all	No more than usual	More than usual	Much more than usual
been able to enjoy your normal day-to-day activities?	Better than usual	Same as usual	Less than usual	Much less than usual
been able to concentrate on whatever you are doing?	Better than usual	Same as usual	Less than usual	Much less than usual
felt that you are playing a useful part in things?	Better than usual	Same as usual	Less than usual	Much less than usual

Even if you don't feel you need the support of your institution now, it is worth finding out how they can support your mental health in the future if needed. Although there has been some stigma attached to difficulties with mental health in the past, most institutions accept that pressures are mounting on

postgraduate students and that they may require support. Most institutions have experienced councillors available to support you if needed. Importantly, you should realise that none of these symptoms are unusual and that there is a high probability that many of your colleagues may also be struggling. Knowing that your problems are shared and reaching out to support networks early is an excellent way to prevent them from escalating beyond your control.

A study into the mental health of PhD students in Belgium exemplifies the kinds of difficulties that they face when compared with other similar groups (Levecque et al., 2017).

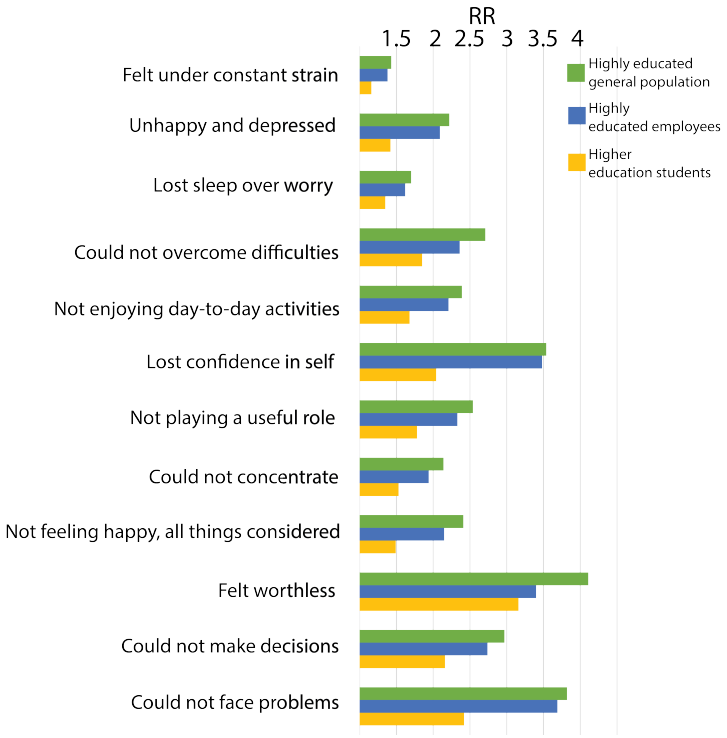


FIGURE 10: A comparison of the mental health of PhD students (data from Levecque et al., 2017) with highly educated general population, highly educated employees and higher education students using the General Health Questionnaire. The Risk Ratio (RR: adjusted for age and gender) in PhD students in Flanders, Belgium is consistently higher (>1) when compared to any of the other surveyed groups.

No matter how well you think of your own abilities to cope with mental health issues, doing a PhD will cause you additional stress and can trigger maladaptive coping mechanisms. Learning how to cope with additional stress early in your career can be beneficial for future personal development.

Academia is recognised as a particularly stressful environment; you will likely take on some of this environmental stress in addition to any stress associated with your studies. Additional stressors come from home and family situations. Your best means of coping will be to try and develop a support network and to understand where and with whom you can discuss any difficulties as they arise. Knowing who this is and how and when to approach them will put you in a stronger position if you need them in future.

0

Getting a job inside academia

I have already written at the start of this book (see part 1) that competition is high to get jobs in academia and your chances are therefore diminishing. However, academia needs new academics, and so I wanted to try to provide some key insights into what might be important in getting a job as an academic. Of course, there is no single way in, and your path is likely to be different to mine and others that you meet.

During lockdown in 2020 my lab held some meetings with invited guests from all over the world. What follows is a list of key insights that came from a meeting with four academics on four continents. if you are interested in getting a job in academia then take a look and consider these.

0.116 Key Insights if you want a career in academia

Here is a list of key insights that our team shared. They are in no particular order, but each one probably deserves a lot more information.

- Academics often suffer from imposter syndrome[123]
- A suite of skills that are all are required:
  - Need a logical mind: even OCD
  - Good writing skills
  - Computational skills
  - Attention to detail
  - The importance of finishing the job
  - Being creative (not just for arts students)
  - Need to read (a lot)
- The coolest job in the world as you're paid to learn
- Research has to be fun
  - Once you have a tenured position metrics are unimportant to you (but remain important to your students!)

[123] https://en.wikipedia.org/wiki/Impostor_syndrome

  - Have to produce a publication that you are proud of

- You have to tolerate rejections
  - Papers
  - Conferences
  - Positions
  - Promotions

- Don't be harsh on yourself - it happens to everyone
- Don't rely on how people used to get hired, or that positions you see now will become available in the future
- Don't ignore the importance of natural history observations
  - Write the notes as they demonstrate productivity
  - They make your CV look stronger in the early stages
  - Use them to get things published strategically
  - Don't fill your CV exclusively with these notes (there are more important things)

- There is still a glass ceiling in employment institutions
  - Things are improving
  - Don't allow comments phase you - many people don't understand their own prejudices or discriminations.
  - Share the down sides, you'll find out that lots of other people experience them, and not just you

- Role models are very useful in science
  - Especially someone with whom you can identify, preferably from your own background
  - Use your network to explore which role model might fit best

- Someone needs to fit into the context of the job
  - This means that not every job will be right for you as other people might fit better [not the fault of you or your CV]
  - Could be why lots of people get jobs from the inside - they are already known to fit into the team
  - Many institutions pride themselves on their position in the community, and will look fondly on people who are clearly committed to the place. This could include: ++ Speaking the local language ++ Writing popular articles for a local audience ++ Engaging with the local press and media ++ Giving talks to local groups
  - Give back into the faculty or institute - can you demonstrate that you do more than just conduct research and write papers. Are you active in your community (both big - academic community and small - departmental community)

- Learn about opportunities and take advantage of them [you make your own luck]
  - Many people don't know about opportunities that are out there.
  - Meet people one on one at smaller meetings [big meetings aren't good for this]
- Moving around [in postdocs or between jobs] can make it more difficult to get accepted into some places that have a culture of staying put
  - If you know where you want to be, it's worth investing time to that institution and community [but don't count on it!]
  - Try to keep multiple irons in the fire
- Even though career paths look linear, this is really only in hindsight. In reality they are wondering paths that sometimes wonder right out and back in again
- Writing small grants isn't a waste of time as it develops this as a skill
  - Grant writing is different to thesis writing or paper writing
  - Having a CV with evidence of lots of grants gained (even if they are small) demonstrates to people that you know this stage of the process
  - Showing that you can finish the same projects and produce outputs is even better
- Try saying yes to opportunities (especially early on in your career)
  - You never know where it will take you
  - Establish collaborations outside your direct circle
- Creativity includes reinventing yourself and your science as you move through your career
  - Each grant proposal is to do different work and take you into new paths and directions
  - Some will work out and open up whole new areas or specialities. Others won't
- It's easier if you can describe exactly what you do early on in your career
  - A very mixed up CV leaves some people unclear about who they are hiring and for what
  - This doesn't mean that you have to be overly focussed, but early on it's useful to have a tag (or a few specific categories like "systematics", "comparative anatomy", "natural history" to organize your publications if they're really different from each other)
- What type of job do you want?
  - Teaching - then get teaching experience
  - Research - then make sure your CV is strong

  - There are more types of jobs out there, but if you know what you want (or don't want) then make sure that your CV reflects this

- Your first job is not necessarily your last job
  - But it could be if you love it
  - You can use it as a springboard to go elsewhere
  - You might need to take the first job to get somewhere else

- Learn about what you are good at and embrace it
  - This might require some honest reflection

- It's totally possible to have a job outside academia and then move back in
  - Some jobs might even give you an advantage in getting an academic position
  - Many academic subjects are applied, and so experience in the relevant jobs really help [industry relevant experience] ++ You may then have inside knowledge to subjects that are taught
  - Maintain your understanding of the field (to get back in)
  - Make sure that there is a continuing narrative, a reason why you left and why this helps you come back in

- Keep irrelevant jobs off your CV
- Knowing what you don't want to do can be as helpful as knowing what you do want to do
  - Internships are great opportunities for this

- Get feedback on the letters that you write when applying for jobs
  - Ask people whether they will give you a letter of reference, and if that will be positive
  - Take note of what the job is asking for and ask specifically for those aspects to be mentioned
  - Different regions of the world have different styles for letters of reference ++ US letters are thorough [and often over the top, even flamboyant] and very long ++ Europeans tend to be understated and more direct ++ Some parts of the world may provide just a few sentences
  - I ask students to draft their own letters that accentuate what they themselves want to underline about their experiences. I won't use the same words, but it will help remind and inform me of what colleagues have done.

0

Habilitation, DSc and Tenure

These are qualifications post-PhD that exist in some countries and might be prerequisites to getting some positions within academia. I do not go into these in detail here because they are country specific, and you are likely to learn much more about them at the institution where you are conducting your PhD. If you need to do one of these further qualifications, then you are best advised to seek this information within your institution. The brief inclusion here serves as a guide to their existence, and for you to be aware that different rules apply in different countries and that if you are mobile in your career there may be additional steps that are required of you before you can apply for a job or certain promotions.

0.117 Habilitation

Habilitation from the Latin *habilitare*, "to make fit", started in Germany first as part of the PhD process, and later as a separate post-doctoral qualification in the 1800s. This process has been adopted by a number of (mostly European) countries as a requisite step in teaching or directing research. In countries where this qualification exists, it is usually a prerequisite before being able to apply as a candidate for a professorship. In some countries, most notably Germany, the habilitation comes after having already held a job as a researcher and lecturer, and comes with a serious expectation that this will lead to a promotion to become a professor. In this way, it could be seen as a similar process to going for tenure in the US.

In France, the related qualification is the Habilitation à Diriger des Recherches (Accreditation to Direct Research or HDR). Like the German system, the HDR is applied for by someone who already holds a position as a lecturer (Maître de Conférences) for several years, when they hold sufficient research to put together a portfolio. You need to be accredited with HDR before you can advise PhD students. Ironically, this portfolio should include the supervision of at least one PhD student. Thus, you'll need to arrange to be a co-advisor who is actually the main advisor before moving forwards with your HDR

portfolio. Given that your first PhD student may take some years to finish (see part 1), this would be worth finding a sympathetic person with an HDR sooner rather than later in once you are in your Maître de Conférences post.

In the biological sciences, most requirements for habilitation are cumulative, meaning that you can assemble a set of published research papers that you have written or led. The number and quality of such publications will depend on where you are submitting this thesis, meaning that in some places it may take as long as 10 years. Importantly, the habilitation is not advised.

0.118 Doctor of Science (DSc)

In the absence of any requirement for habilitation, there is the possibility (at many universities) of compiling published papers, that you have written or directed, into a thesis that can be examined for a Doctor of Science (DSc). Like the PhD, the DSc allows you to call yourself Doctor (although you likely already can) and put the letters DSc after your name. The DSc is touted as an advanced doctoral degree. You will need to register as you would for a PhD, but in most cases your thesis will not be advised.

One interesting point to note is that registration for a DSc need not have possession of a PhD as a prerequisite. If you are in a position where you have never done a PhD, but have worked within or alongside academia, including publishing papers, for a considerable period, you might be in a position to register for a DSc.

0.119 Tenure

Obtaining tenure (in the USA and Canada) gives you a special kind of academic freedom such that it is very hard for you to be removed from your post. In some states this means that you are not required to retire (a job for life - although there are increasingly attractive offers for professors[124] to retire[125]). Tenure exists around the need for independent academic freedom: that as an

[124] https://www.theatlantic.com/business/archive/2016/06/colleges-offer-retirement-buyouts-to-professors/487400/#:~:text=Since%20about%2090%20percent%20of,traditional%20retirement%20age%20of%2065.&text=They%20were%20able%20to%20impose,past%20the%20age%20of%2070.

[125] https://www.thecrimson.com/article/2018/5/23/yir-aging-faculty/

academic scholar you are free to hold your own, scholarly, views and as such cannot be censured by the state. Getting tenure, therefore, at the university where you are employed is an important step, vital if you want to move from contract to permanent employment. In practice, if you don't get tenure it will most likely mean that you won't get to continue at that university: tenure or bust.

In order to obtain tenure in most US universities you will need to provide: - A portfolio of peer-reviewed published research - The proven ability to attract grant funding + A significant amount of which goes to the university - Teaching excellence + As assessed by undergraduate and postgraduate students - Academic visibility + The recognition of your research by peers through inclusion in conferences, invitations to give seminars, etc. - Administrative and/or community service + This includes roles such as being an editor for a journal + Peer review for journals and grant awarding bodies + Serving on your university's committees and panels

The relative importance to each of the above aspects will depend on the type of college where you are trying to get tenure. Unsurprisingly, a teaching college will require you to have excellence in teaching, while a research university will place more emphasis on your research portfolio and your standing as an academic in the international community. If you aren't from North America, it is important that you know what the priorities of your institution are before you apply for a position, or even before you try to do a postgraduate degree (see part 1).

Once you are in an untenured post at a US university, you will have a limited amount of time to achieve the above portfolio in order to achieve tenure. Getting tenure often comes together with promotion (to professor) and a reduction in (undergraduate) teaching load. The time limited nature of getting tenure is such that even after you have received your PhD, this is a much higher hurdle to attain.

0

Leaving academia for a job outside

In addition to thinking about jobs inside academia we also invited some past members of my lab who have got jobs outside of academia. They also provided us with their key insights into how the world outside academia is different to that inside. Again, if you are thinking about it getting a job outside academia take a look at some of these key insights.

0.120 Key Insights if you are looking for a career outside academia

- The importance of the networks that they had made during their times as academics. In addition, the importance of how to manage and grow a network.
- Many jobs these days involve project work, and include generating the funding from donors as well as completing the project and writing the report. Post graduate degrees really help with learning how to start, manage, and complete projects.
- Although papers and citations gained during academic life won't help with some jobs, they allow flexibility in the job market (potentially to re-join academia). They also demonstrate your ability to write. More papers are likely to improve your chances and some jobs include writing research papers as part of the job.
- Employers are interested in the experience and skills that you've acquired during your academic work. Instead of just listing papers you need to sell what you've done in cover letters and interviews:
  - What kind of experience do you have with your specialist area?
  - Do you understand about management?
  - Do you have good organisational skills?
  - Have you done fieldwork?
  - Have you managed students?
- Regardless of your academic background, you should expect to enter into

your job at quite a junior level or even as an intern, and then work your way up
- Employers are looking for 'emotional intelligence' (the ability to understand and manage your own emotions, and those of the people around you). They will expect you to be a good team member, work with different stakeholders and clients. Conflict management skills are important.
- You might not need to wait for a job advert. Use your contacts and write to people who are employers
- You might need to become 'comfortable with feeling uncomfortable': your work might be so different from what you've done before that you should and you should be able to adapt
- There are expectations from employers that you will meet challenges that your employers place before you (and not shy away)
  - Pay special attention to the Key Performance Areas (KPAs) of the position you apply for. These are what you will need to report on in order to have your performance in your job assessed.
- You might need to get used to different working cultures that are meeting focussed (even when you have meetings about having meetings)
- The working culture might not be static, and could change with the replacement of a manager or director.
- If you are employed by a governmental agency, it will be expected that you are accountable to your employers as well as the public that pays through their taxes
- The position you are employed in will likely involve you constantly acquiring new skills, such that you feel like more of a student then when you were studying. This really adds to the interest in the working life, and allows you to meet new and unexpected challenges.
- New subjects and other areas might be well outside your expertise, but can be just as rewarding once you rise to meet the challenges.
- Jobs outside academia are especially challenging in working out how to apply the results of scientific studies.
- Your employers might expect you to conceive your projects, as well as carrying them out.
- You are expected to be an authority in your work, and interpret your results in context and with reasonable confidence

At the end of the day, you need to discuss what you want and what you expect from your job outside academia with as many people as possible in that profession.

Last note

I really hope that this book has been helpful and that it has achieved what I set out to do: provide you with the guide on how to write a PhD in biological sciences. If you feel that this book has important items missing, out-of-date or simply wrong, then please help. Any good guide relies upon the people that use it to keep it viable.

You can contribute to the project at the Github pages for this book, using bookdown.

If I could emphasise one really important aspect of all of your PhD studies; that is to enjoy them!

More to Say

Yeah! I have finished my book, but I have more to say about some topics. Let me explain them in this appendix.

To know more about **bookdown**, see https://bookdown.org.

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