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EDITORIAL

Thesis write-up and manuscript preparation: related but distinct tasks

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Writing up your PhD thesis is a bit of a 'rite of passage' and after years' worth of research and study this can be daunting, and many find it difficult to comprehend what they need to do at the final stage of their studies, culminating in the submission their thesis for examination. Equally daunting can be the preparation of your first manuscript for submission for publication in a peer-reviewed journal. These two tasks are related but also quite distinct – thesis writing will certainly inform the content of a manuscript but at the same time the style and scope of each work is different. What follows are some suggestions that may help navigate each of these tasks.

Thesis writing

Realistic goal setting

There is no point in simply setting your goal as 'I'll have my thesis written in 4 months'. While this might be the ultimate aim, the goal is a daunting one and should be broken down into more manageable goals. The problem with such an overarching goal is that there is only any sense of achievement once the entire thesis has been written. To succeed (and maintain your sanity) you must set smaller goals or milestones along the way, each of which will contribute to the overall aim. Importantly, initial goals must be realistic and based on your experience of how you get things done. Even then many will underestimate the time required to complete this task and especially so when you have no experience of writing such an extensive piece of work. What might be seen for someone as being a rather straightforward task may, for someone else, be something that will take much commitment, perseverance and time. In addition, there will competing pressures on your time whether these be, for example, just one final set of experiments, lab presentations, or conference attendance. If you set your first goals too high and you fail to meet them then you will feel a bit despondent and demoralized. Thus my first piece of advice is set your first series of goals as 'easy wins' – for example, completing a subsection of Methods in the first day of writing. Completion of these gives a sense of achievement and builds confidence. Subsequently the next set of goals you set should push you harder but the reward of their completion is greater and your confidence builds further.

Organization – do you have everything you need?

Make sure you have the information needed for the tasks in hand. This means, for example:

(i) for each of the chapters you are working on having (at least) drafts of the figures you need (especially true for Results) or know what sort of figure you are going to use to illustrate a particular point (e.g. as a summary diagram in the Introduction or a data figure in the Results);
(ii) getting raw data collated and analysed and a clear description of the statistical analysis used to report the results;
(iii) knowing the sources of equipment, chemicals, and composition of solutions etc.; and
(iv) creating a bibliography to use throughout the thesis – use a reference database to do so.

Each of these sounds trivial but there is no point is settling down to write only to find you need to leave a lot of blank spaces to go back to later as you haven't got the information needed to complete the task. When it comes to data you must know what your findings are – you can't write any conclusions without knowing the outcome of the experiments and how this informed your subsequent work. It can be very frustrating to find during your write-up that the data you thought implied one thing turned out to say the opposite or didn't indicate differences between control and experimental conditions. Thus, organization in data collection and analysis is key.

Thesis content and where to start the writing process

A typical thesis will have an organization as follows: General Introduction, Methods, Results (often several separate Results chapters each with their own very brief introduction but with full discussion), Overall Discussion and Bibliography. Additionally, there will be Acknowledgements, Indexes of chapters and Figures etc. My view is that for the actual writing process of a thesis the order of writing should be:

(i) Methods chapter
(ii) Results chapters
(iii) General Introduction
(iv) Overall Discussion

Methods should be straightforward; all you need to do is give a description of what you did and how you did it. But be careful as it's also the easiest chapter (along with the Introduction) where you can fall into the trap of 'cutting and pasting' from others' previous work – thus be mindful to avoid plagiarism. Your thesis might be screened using plagiarism detection software. Your actual methods usually don't change – they may be refined but protocols are quite standard, as are the processes used for data acquisition and analysis. The equipment you used, unless upgraded, will most likely have been there for the duration of your studies. In other words Methods sections should be quick and easy to write. I would set an early goal as getting this chapter completed within a specified (and reasonably tight) time frame. This will also help you set the scene for the rest of the thesis; however, don't expect that the ease with which the words flow for the Methods chapter will be recapitulated in the more demanding writing of the remaining chapters. Moreover, remember to revisit the Methods chapter to ensure

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it describes all methodologies you have used – particularly important if you have a few final experiments that need to be completed to support data collected much earlier on in your studies and which require the inclusion of additional methodologies.

Next, I would move to a Result's chapter. Don't feel you need to write Results' chapters in chronological order of experimental date or in the order that they will appear in the final thesis. Start where it's going to be easiest or where the chapter itself may form the basis of a manuscript in its own right – thus its completion will achieve two separate but complementary goals.

The General Introduction chapter of a thesis is the one where many struggle – you should read examples of predecessors' theses from your lab to give you an indication of style and content. There is no prescribed length but you need to be mindful that this chapter sets the scene for your thesis and should give both a historical and contemporary assessment of the literature in your research field and end with a short section on what your thesis will focus on in terms of hypothesis and experimental approaches you have employed. Mindful that good scholarship requires a detailed approach, it can be tempting for the Introduction to review the entire background to the field and become rather rambling. Thus, ensure that the details you include are also relevant; once completed if it is found that a topic described in detail in the Introduction is never returned to again in the thesis, this is a sure sign that this part of the Introduction is not needed. The Introduction to a thesis also contrasts with the Introduction to a paper, the latter needs to be much more focused and shorter, as discussed below. From my experience of supervising students, most find writing the Introduction the most challenging and therefore it can also be worthwhile ensuring you create an outline structure of its content early on in the thesis writing process. Revisit this outline frequently to ensure its content is relevant and if you find it the challenge of writing this chapter overwhelming, break it up into subsections so that completing these gives a sense of reward.

The Overall Discussion should not be a repetition of the text you have written as a discussion for each of your Results' chapters but rather bring together your findings and place them in context of your research field – commonly this chapter is quite short.

Illustrating your thesis

Hand in hand with the actual writing is the process of illustration. The way data are presented in the figures of a thesis is one of the most important aspects of the entire piece. Good figures tell a story and keep examiners happy but importantly are a legacy of your work. Figure making is a skill and some are better at it than others; there are no rules but as a starting point you should look at examples of figures you consider to be 'good' and ones you think 'bad'. These could found in lab colleagues' theses, papers from your lab or papers from others in your wider research area. A few tips include:

(i) legibility – don't use font sizes that require a magnifying glass to read;
(ii) consistency – be consistent in the way you present data, the format you use to illustrate control and drug treatments;
(iii) use the luxury of space in a thesis to separate panels into different figures; and
(iv) just because there is an infinite spectrum of colour available don't feel compelled to create a rainbow thesis. Be mindful that your thesis could be assessed by someone who is colour-blind, or is looking at a black and white version. No information should be conveyed by colour alone.

You may find that as you progress in the various stages of thesis writing that figures need to be revised or adapted and as such, the process of figure making is iterative. Furthermore, allow time to become familiar with your figure-making software of choice so that you can take advantage of what such packages can offer to ensure you create high quality illustrations. In addition, never underestimate the value of an informative figure legend. Ensure the legend describes all the data presented in the figure, abbreviations either are in common usage or explained, and that the statistical information presented is easily understood. The opening sentence of the legend show conveys the 'take-home' message. Consulting various journal's Instructions for Authors also provides valuable advice on figure designs (proportions, line thickness, font size, use of colour), presentation of data and statistical summaries.

Communication

Keep in contact with your supervisor and seek feedback on what you have written as you complete your goals. It will be demoralizing to give what you think is a final thesis to your supervisor only to find out that they have very significant comments on its content/style/emphasis etc. that mean you need to redo much of what you thought you'd finished. I recommend you have a meeting with your supervisor at an early stage in the writing process to go over a draft outline of content and organization and in subsequent meetings you should discuss what you've written and take on board comments and feedback that are aimed to improve the final output.

Rewards and relaxation

Most people are going to find the process of thesis writing tedious, frustrating, emotionally draining and you may question whether it will ever end. Thus, going back to my first point – realistic goal setting, you need to reward yourself when you complete the tasks you've set yourself. The goals need to be realistic, but should significantly advance your progress. Writing a single figure legend does not mean you deserve a week's break but similarly there is little point in denying yourself some time off if you are exhausted. Breaks are essential, especially if you have writer's block or you are waiting for something in order to progress. Get the balance right – you are best placed to know how the 'work hard, play hard' motto applies to you. However, don't lose sight of the fact that the completion of your thesis is your ticket to the next stage of your career and the more effort you put in the quicker this will come.

Preparing a manuscript

While the generation of a thesis is required for the award of a higher degree, it's probably fair to say that, despite the many hours of effort, the readership of your work is rather limited – your supervisor, lab members and colleagues who offer you feedback and your examiners, of course.

It will be a wonderful resource for those who share your specific research interests but otherwise this is not the 'go to' publication for the rest of the world to read about your findings. Thus, you'll need to communicate your research to the wider world through publication of one or more peer-reviewed papers in suitable journals. While the thesis has only your name on it, journal publications are almost always multi-authored and collaborative pieces of work, so it's unlikely that you'll simply be able to take what you've written in your thesis and submit it for publication. Your thesis writing efforts will be a great starting point, but the contributions of others will need to be incorporated; perhaps the story will need to be refined or segmented and it will need to be presented in a more concise format that uses far fewer words and fewer illustrations than the more reflective writing style of a PhD thesis. So how might you go about this task? For the purposes of this Editorial, it is assumed you have decided on the journal where you'd like to send your manuscript. You will likely need to discuss with your colleagues which journal will be appropriate for the scope of the work, taking into account the wishes of all authors and ensuring that the journal of choice meets any stipulations required by your funder(s) in terms of how the research should be acknowledged and licence requirements, such as Open Access. There are many journals to choose, and this guidance will apply to many journals, but here I have assumed you're preparing a submission to *The Journal of Physiology*.

What's the overarching hypothesis and what do your findings contribute to the research area?

In order that your manuscript is considered 'competitive' for publication in *The Journal of Physiology* you need to ensure that your study has a clear hypothesis, the quality of the data presented are high, there is a significant advance in knowledge of the field and should usually demonstrate new mechanistic insight into the underlying physiology. *The Journal of Physiology* does publish studies that are more descriptive in nature but these need to make a significant contribution to the research field – this is, of course, subjective and the peer-review process will determine whether such studies clear the bar for acceptance. *The Journal of Physiology* also considers computational and modelling studies as long as they are based on physiological data. Of course, your study needs to fulfil the publishing remit of *The Journal of Physiology* which is to publish "*original Research Papers in all areas of physiology and pathophysiology illustrating new physiological principles or mechanisms*". If your manuscript is not considered eligible in terms of this remit it will be returned to you without review or may be referred to another journal published by The Physiological Society. If your manuscript is not sent for full review, it does not mean your study is flawed, it may simply indicate that it is outside the scope of *The Journal of Physiology*. Equally, Senior Editors will also return to authors manuscripts which they feel are unlikely to receive favourable peer-review and are thus likely to be rejected after review. In 2020, approximately 40% of research submissions were returned to authors without external peer-review. Thus, to give yourself the best chance of having your manuscript accepted you must ensure it meets the criteria mentioned above. *The Journal of Physiology* prides itself in the quality of the peer-review process offered and is hugely grateful to its many hundreds of colleagues around the world who take the time to provide constructive assessments of manuscripts that are submitted. If your manuscript is returned to you without review or rejected after review, don't be disheartened. Your manuscript will find a home in another journal, and you can use the constructive (and usually very thorough) comments supplied by the Editors and Expert Referees to revise and improve your manuscript before you submit elsewhere. All authors receive rejections throughout their career, and dealing with rejection and responding to comments is an essential part of your academic journey. If you really feel that the manuscript has not been fairly reviewed, most journals allow authors to appeal decisions if they can rebut all the concerns raised during the initial peer-review process. Manuscript reviewing is a human process and can sometimes be flawed. Stand your ground if you know you are right, but don't get annoyed if mistakes have been made in the process. Always seek input from colleagues before responding to comments or contacting a journal to query a decision.

Who are the authors?

For your thesis the authorship is simple – just you. However, deciding on who qualifies as an author for a given manuscript and, in particular, where they should appear in the authorship list can be a tricky topic and is best decided at the start of a project and certainly before a working draft of the manuscript is produced. Such decisions are the responsibility of the senior (usually corresponding) author of the study but is always best done by consultation with all interested parties. *The Journal of Physiology*, like all reputable journals, adheres to the guidance provided by the Committee on Publication Ethics (COPE) and in matters of authorship follows the criteria required by the International Committee of Medical Journal Editors (ICMJE). Fundamentally, every author on a paper should be able to explain and defend the manuscript's findings and conclusions. Specifically, each author must have made substantial contributions to either (i) the conception or design of the work, or (ii) the acquisition, analysis or interpretation of the data, and (iii) must have *either* drafted the manuscript *or* revised it critically for intellectual content.

All authors must approve the final version of the manuscript to be submitted and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. These author contributions are listed in a section at the end of every paper that is published in *The Journal of Physiology*. Every published paper should also include a statement that everyone listed as an author qualifies for authorship and that everyone who qualifies for authorship is listed as an author. Like all journals, *The Journal of Physiology* allows equal contributions (e.g. joint first authorships) to be appropriately acknowledged.

Does your manuscript comply with *The Journal of Physiology's* ethical and statistical reporting policies?

Without exception, all papers published in *The Journal of Physiology* must conform to its policies and requirements. *The Journal of Physiology* has strict policies regarding human and animal experiments, statistical reporting and the provision of whole, original, uncropped gels/blots. Authors must read these policies prior to initial submission to ensure they can comply with the requirements if your manuscript is invited for revision. Several articles have been published to explain

these policies, such as the articles that look at the principles and standards for reporting animal experiments (Grundy, 2015), the visualization of data (Schultz, 2018) and reproducibility and data presentation (Forsythe *et al*. 2019). *The Journal of Physiology* requires a Statistical Summary Document is provided with every research paper published. As a Senior Editor, I find myself returning manuscripts to authors, without review, in order to seek clarification on their statistical analysis and therefore I urge you to pay particular attention to such requirements to ensure clarity in the presentation and analysis of data and stated adherence to ethical and welfare standards for human and animal experiments. The statistical requirements may seem onerous, but ensures only the most robust work is published. It is definitely worth the effort and readers will be able to better understand and interpret you research as a result. Appropriate care should be taken that your manuscript details funding support, acknowledges the help and assistance of others during the course of the study and states any potential conflicts of interest of any of the authors.

Structuring the content: where to start your writing?

As is suggested for a thesis write-up I think that a good place to start is with the Methods and Results sections of your manuscript.

Methods. Clarity in the Methods you use is essential so that readers know what you did and how you did it. Unfortunately, many journals, by placing Methods sections at the end of papers or as Supplemental Data, can give the impression that this section is less important than others – this is absolutely not the case. Detailed and accurate Methods are essential so others can assess and replicate your work. For *The Journal of Physiology*, the Methods section follows the Introduction and must include all relevant details not only of experimental protocols, sources of equipment and consumable items but, as mentioned above, it is here you need to state that your study complies with all of *The Journal of Physiology*'s ethical and statistical reporting standards. Methods should be written in the past tense.

Results. Drafting the Results section early in the manuscript preparation process is a good idea as, just like thesis writing, this will highlight if there are missing data or whether additional analyses are required. As with thesis writing make sure you have all the data to hand, they are fully analysed so that you know what conclusions can be drawn and that they are statistically robust. Figures should be prepared that illustrate the key findings you wish to convey. However, unlike a thesis, a single (multi-panelled) figure may need to convey several linked but distinct datasets – there may not be the luxury of space here that you have with a thesis. Unlike many journals, *The Journal of Physiology* does not impose any restrictions on the number of figures or tables you can include but don't use this lack of restriction as an excuse to be inefficient in your choice of illustrations. Reviewers and Editors will quickly spot redundancy, repetition and non-essential information. Likewise, they will advise if some information would be better conveyed in a figure or table format. Note that for papers published in *The Journal of Physiology* supplemental figures aren't usually allowed, so you must ensure that everything you want to illustrate and is essential for complete understanding of the manuscript, is included in the manuscript proper. There are some exceptions to this and these are described in the Information for Authors.

Discussion. A weakness of many manuscripts is that the Discussion recapitulates the results that have been described in the previous section. Take care not to fall into this trap and ensure the Discussion appraises your findings and places them in the context of what you have discovered and how these contribute to the research field. Avoid being over-speculative and please avoid statements such as 'these are beyond the scope of the present study' and 'we observed increases/decreases but these were not significant'. Ensure the focus of the Discussion is on the data that are presented not on future experiments that you may have planned.

The final elements. Other elements of the manuscript such as a Key points summary (a requirement for all Research Papers published in *The Journal of Physiology*), Abstract and Introduction are best written after you have compiled the Results section and have a good working draft of the Discussion – unlike your thesis these sections must only convey information related directly to the results included in that particular manuscript (there will likely be other manuscripts later that can cover more of the research covered in your PhD). Writing these last will help keep you focused on what should be included.

Key points summary. The Key points summary is your opportunity to highlight the key findings of your study, it's essential that these points can be understood by not only an expert in your research area but also the more general readership.

Abstract. The Abstract offers the opportunity to convey a more detailed and subject-specific summary of your work and remember this is what will appear on search engines and abstracting and indexing sites such as PubMed (hence the strict word limit). Abstracts must be revised with each revision of your manuscript. Data are not normally included in the Abstract. Tips on how to format your Abstract can be found here.

Introduction. The Introduction should be focused and set the scene for the study being reported, it should not be an all-encompassing literature review of the sort found in the Introduction to your PhD thesis. It needs to clearly explain the rationale behind the experimental data being presented, the overarching hypotheses being tested and can end with a brief summary conclusion of the main findings. As an indication, if you are unable to convey this information in fewer than 750 words then you probably need to ensure your study is focused and not so broad as to lose the essential message you want to communicate with its intended audience.

References. The Reference section should list all the work cited in your manuscript and should conform to the style requirements of *The Journal of Physiology* as this will save extra work in the long run should your manuscript be accepted for publication. Most of your references should be to peer-reviewed publications; preprints should be cited only sparingly.

Title. You are strongly encouraged to think carefully about the Title of your manuscript – it is the first thing anyone (i.e. Editors and Expert Referees) will read and so needs to capture their attention and convey the key message. *The Journal of*

Physiology strongly advocates for edits to the Title on accepted manuscripts if it is felt they are too niche or are likely to fail to engender a curiosity to actually read the published paper. The Title should contain no more than 150 characters (including spaces) and composed of approximately 15–20 words. Titles should be written in a way that will attract a broad readership. Titles should use positive language using verbs in their active form. Include the species, tissue, organ or system if this is important in the context of the findings. The Title should include the main concept of the research or frame the research question. Keywords that are likely to be used in search engines should be used at least once in the Title and Abstract. Non-standard abbreviations should not be used. Punctuation can be used to add clarity.

Get feedback

As with thesis writing it's essential to get comments from colleagues prior to submitting your manuscript. A fresh pair of eyes will very quickly highlight areas of confused writing, where there needs to be additional explanations, where data do not support the conclusions that are drawn and may also make suggestions for additional experimental data that are required to substantiate the conclusions you are advancing. In my experience the early circulation of a draft of a manuscript to a few colleagues can be a considerable time-saving exercise in the long run but make sure you give your colleagues enough time to provide constructive feedback. A word of advice – manuscripts can always be improved but the amount of improvement generally decreases with each iteration. If your manuscript is of interest to *The Journal of Physiology* and is favourably reviewed, assistance in improving writing style especially if you are a non-native English speaker can be sought to help improve its readability. Thus once you have your manuscript in a final form *that you are happy with* you're ready to submit – make sure you comply with all the requests made in the submission process and validate your submission to ensure it enters the review process. You should expect to receive a confirmatory email to say it is now under consideration.

In conclusion, each of the tasks outlined in this Editorial are just the initial stages in a valued contribution to the scientific community. There is no secret formula to either thesis writing or manuscript preparation to ensure a perfect finished product but as detailed above there are certainly some 'dos and don'ts' that can guide you along the way. The thesis should tell the entire story of your PhD studies, but each manuscript you prepare should be focused and reflect elements of your research knowledge and achievements, not everything you know about the subject as a whole. As you progress in your career not only will your research experience grow but your writing style will evolve too. Science requires clarity in communication no matter the intended audience.

References

Forsythe ID, Howells S & Barrett KE (2019). Reproducibility and data presentation. *J Physiol* **597**, 5313.

Grundy D (2015). Principles and standards for reporting animal experiments in *The Journal of Physiology* and *Experimental Physiology*. *J Physiol* **593**, 2547–2549.

Schultz HD (2018). Visualizing data in research articles. *J Physiol* **596**, 3431–3432.

Keywords

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