Research Writing and Journal Publication Guide

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Journal Submissions

"The measure of greatness in a scientific idea is the extent to which it stimulates thought and opens up new lines of research."

– Paul A.M. Dirac

Three Ways to Increase Your Manuscript's Chance of Acceptance

As a researcher, you spend countless hours pursuing answers to important questions about how our world works. This research consumes a significant amount of your time. Sadly, none of it matters when you must face a sad truth:

your work's merit is judged by whether your findings are accepted for publication and where.

Several studies have concluded that scientific output is growing exponentially. In fact, one study indicates that the growth rate is roughly 8-9% each year [1]. The increasing number of published articles does not necessarily reflect new knowledge, however. According to a *Nature* interview [2] of Anthony van Raan, scientists have been splitting their research across several papers. Thus the amount of new findings is probably much less than the number of published works. So, what does that mean for you? Trying to get your article published in a high-impact journal is competitive and frustrating!

The good news is that Thomson Reuters recently sold its intellectual property and science business [3]. The new owners will probably overhaul the journal impact factor system, but until then, you will continue facing pressure to write articles acceptable to high-impact journals.

So, what can you do to increase the chance that your manuscript will be accepted?

For starters, let's examine what editors like to read and what they will automatically reject. Elsevier Connect conducted two surveys to understand what editors look for in manu-

scripts. The results culminated in two sets of publishing tips: "Eight reasons I accepted your article" [4] and "Eight reasons I rejected your article" [5]. Not surprisingly, these sixteen points often fall on two sides of the same coin. In this article, we will boil down the Elsevier Connect survey results into three categories: technical aspects, methodology and issue framing.

By understanding these three points, you will be able to write a stronger manuscript and improve your chance of getting accepted.

Technical aspects: follow guidelines

- Publishers have standards, and they cannot be ignored. Failure to follow a journal's Guide for Authors will lead to automatic rejection. You can avoid this by using a good checklist and carefully reviewing your article before submission.

  ➡ **TIP: Make sure the formatting is correct and that your documents contain all the parts required for submission.**

- Each journal has a narrow scope and aim. Take the time to understand the objectives of each journal and make sure your manuscript matches your target journal's scope. One way to avoid the problem of mismatch is to write a manuscript for a particular journal.

  ➡ **TIP: The first step in your drafting process should be to decide which journal you want to submit your article to. By doing so, your writing will be focused, and you will decrease the chance of submitting the "wrong" story to the target journal.**

- Editors and peers expect articles to be written in clear English. If English is not your native language, and even when it is, reread your article many times and have others review it for errors. We firmly recommend hiring an experienced independent copy editor to review your documents.

  ➡ **TIP: Beyond proofreading, your editor can provide substantive comments about the structure and flow of your manuscript.**

Wouldn't it be tragic if your brilliant ideas were rejected at first glance because you failed to find help to clean up language and style issues? Again, this rejection reason is 100% avoidable.

Methodology: be thorough

- Sometimes articles are rejected because they are incomplete. You should ask yourself whether your manuscript discusses a full study or only makes some observations. Does your article ignore any significant relevant works in your field or use outdated references?

  ➡ **TIP: Make sure your manuscript shows that you are up-to-date on current developments in your discipline and understand the complexity of the problem you are trying to solve.**

- Another common reason for rejection is using flawed methods. If you did not follow recognized procedures, then have you explained your methodology in a way that can be repeated by others?

- Finally, does your data support the conclusion presented? We will discuss this problem further under "Issue Framing" below, but remember that your data must logically support your conclusion

- As with the technical aspects described in the section above, the methodology behind your manuscript is fully within your control, with proper review and planning.

Issue framing: ask the right question

- The hardest aspect to address when editing your article before submission is "framing." Unlike "technical aspects" and "methodology," framing is a fuzzy criterion. What is framing? It's how you present your research; it is the question your study answers.

- According to Elsevier Connect's survey on reasons for acceptance, editors liked articles that "provide insight

into an important issue" and are "useful to people who make decisions." What exactly does that mean?

- Let's start with what that does not include. We're not talking about groundbreaking research that challenges paradigms or introduce new theories. While everyone hopes to one day produce this type of result, new theory creation is rare. If you want to contribute many articles, theory development cannot be your primary focus.

- Rather, practical application seems to be what editors are looking for. Can your research impact many people? Can it influence how people make decisions at an organizational or social unit level?

  ➡ **TIP: When you write your title and abstract, think about what important questions people might have in response to your research. How can your research help others? That is the question you should ask in your paper, and your results and discussion should be organized to answer that question.**

- Another aspect of "framing" is making sure that your draft tells a good story. Did you frame the right question around the data you have? After discussing your data, is your conclusion the "logical next step" in the story? If not, you may want to think about reframing your study to create a compelling article.

Over the next few articles, we will explain how to draft your article from start to end. In particular, we will consider the three factors above (technical aspects, methodology and issue framing) to teach you how to write a successful article. We believe that with these tips and checklists, you will have the right tools to submit your articles with confidence and improve your chances of acceptance!

How to Choose the Right Journal for Your Manuscript

Submitting your manuscript to the wrong journal is one of the most common reasons why editors might reject your paper. With over 28,000 scholarly peer-reviewed journals [6], it's no surprise that finding the right match for your research paper can be difficult. Admittedly, the process can be so frustrating that you might even want to give up.

What's the secret to successfully publishing your paper?

Let's face it, not every research project yields truly paradigm-shifting discoveries. Nonetheless, even obscure research topics can find their way to the hallowed pages of a high-impact journal. So, what's the secret to convincing editors to review your paper further? The answer is a three-word phrase that all writers should know, no matter the field.

Know your audience.

While journals aim to support the research community by facilitating idea exchange, always remember that publications are businesses. Editors must make sound business judgments about the content they curate for each issue of their journal. Competition is tough in the research publication industry, and journals are constantly pressured to outshine their peers and grow their readership [7]. But the only way to accomplish those goals is to provide reading material readers would find useful and engaging. Consequently, even if your research is solid on its technical merits, failure to match the interests of a journal's readership would likely mean that your research would fall on deaf ears. Thus,

if you want to save time, effort, and heartache, you should think carefully about how your work would benefit a journal and its readers.

Factors to Consider During the Journal Selection Process

Below, we use the three factors mentioned in Section 1 of this book to explain what you should consider when selecting the right journal for your research article.

Technical aspects: know your target journals

- Journals outline their goals and scope in several places. The two main ones are their website (usually in the "about us" section) and in their submissions criteria (e.g., guide for authors), which include the specific parameters editors will accept.

  ➡ **TIP: Read both the journal self-introduction and its Guide for Authors carefully. Not only will these indicate what types of articles it will and won't accept, but sometimes, it also will specifically state what types of research it won't accept.**

- While conducting research, read avidly. Even if you know a journal's specific requirements, reading its papers extensively will help you better understand the types of research and articles its editors like.

  ➡ **TIP: By surveying papers from the past few years, you can see how its editors' define criteria terms such as "novel," "interesting" and "sufficient conceptual advancement."**

- Similarly, think about which journals are publishing research similar to yours. If your investigation belongs to a particular niche, then selecting a specialized publication would increase your odds of being accepted. Additionally, you would maximize target audience reach.

  ➡ **TIP: If your article is published in the right specialist journal, a higher percentage of subscribers would likely read your paper or find it relevant to their own studies.**

- Which brings us to a journal's Impact Factor (IF). Although there are strong arguments regarding its use to determine quality, IF is still the preferred method of gauging a journal's prestige. Nevertheless, you should consider the time and effort it would take to try and submit to the highest-ranking journals and decide whether it is feasible or worth it.

Methodology: examine each journal's submission process

- One factor to consider when you select a journal is its submission process. In particular, what is the journal's peer-review process? Is it closed? Open? How are the different publication criteria weighted? Do reviewers separate technical review from broader questions about research significance? Would you be happy having your work reviewed in this manner?

- How long is the submission process? Some journals have sped up the review process, while others could take months. Does the timeline match your goals? Do you think that the journal's average review time will be sufficient for the nature of your work?

  ➡ **TIP: Consider the efficiency of each journal's submission process and decide which journal best accommodates your goals for publication.**

- What is the journal's publication method? In other words, do you want your article to be open access or available only through traditional subscription services?

- If you are having difficulty creating a shortlist of potential journals, then you can use various online journal finder tools to narrow your choices. Tools like Elsevier Journal Finder [9], Journal/Author Name Estimator (JANE) [10], and Springer Journal Suggester [11] allow you to search databases using keywords, your manuscript title and abstract to find suitable matches for your research.

Issue Framing: draft your manuscript from the right perspective

- While it's obvious that certain aspects of your research might never fit within a journal's scope, before you give up on a journal choice, stop and ask yourself this question:

  Can I use my research to support a topic that would further the journal's objectives?

In other words, how can you package your research in a way that would be interesting and useful for the journal's readers? Structure your research paper to answer questions that would genuinely interest the journal's audience. As you are well aware, journals care about their readers' reactions to published content. Will their readers find your work engaging? Will they learn something new that can help them with their own work? These are the questions you should be answering in your article. Although your research might seem very specific, always think of the bigger picture and use your manuscript to show others why you spend hours slaving away pursuing the work you do!

➡ **TIP: When you describe your research, can your results support a conclusion with a greater global impact?**

How Do I Know If My Manuscript Matches a Journal's Aim and Scope?

In our last article, we talked about the general factors you should consider when deciding which journals to target for submission. In this article, we will look more closely at one of these aspects: a journal's aim and scope.

What is scope?

Scope, simply stated, is the journal's purpose or objective. It's what the publication wants to achieve by delivering its content to its readers.

Also known as "aim" or "mission," a journal's goals contain many factors you will want to consider when deciding if the journal is right for you. For example, *Nature*'s scope [12] states the following:

Nature is a **weekly international** journal publishing the finest **peer-reviewed research** in **all fields of science and technology** on the **basis of its originality, importance, interdisciplinary interest, timeliness, accessibility, elegance and surprising conclusions**. *Nature* also provides rapid, authoritative, insightful and arresting **news** and **interpretation of topical and coming trends** affecting **science, scientists, and the wider public**.

Here, we can see:

- the frequency of the publication (weekly),
- the circulation size (international),
- the type of review (peer review),

- ✦ the criteria for selection ("originality, importance, interdisciplinary interest, timeliness, accessibility, elegance and surprising conclusions"), and
- ✦ the types of articles it publishes (news, research articles ("research in all fields of science and technology") and editorials and commentaries ("interpretation of topical and coming trends")).

The journal also includes a mission statement:

> First, to serve **scientists** through prompt publication of significant advances in any branch of science, and to provide a forum for the reporting and discussion of news and issues concerning science. Second, to ensure that the results of science are rapidly disseminated to **the public throughout the world**, in a fashion that conveys their **significance for knowledge, culture and daily life**.

Based on the above, we also learned that its audience includes not only scientists but also the general public. Moreover, its content aims to improve our understanding of culture and daily life.

Where can I find the scope?

Typically, you can find a journal's aim and scope in the "About Us" section of a journal's website. Sometimes it will be presented all in one location. Other times, it may come in separate sections, as in the above example of *Nature*. More detailed information can also be found in a journal's “Guide for Authors” or "For Authors" Section. Finally, reading through a few recent back issues will give you a better sense of how the referees define selection criteria such as "novelty," "originality," "importance," etc.

How do I know if my research topic matches a journal's scope?

Once you read a journal's scope, you should ask yourself several questions, including the following:

1. **Is your research information that would likely be relevant when it is published?** For example, let's say that your research substantively matches *Nature*'s scope. We know that it is a weekly publication and its turnaround is relatively quick. As such, it's unlikely your research would be outdated if you submitted to this journal. But if the turnaround were seven months, for example, you might have a problem if your research were time sensitive and you were aware that other people who were researching similar topics might be close to publishing.
2. **Is your research relevant to the audience targeted by the journal?** For example, if your study focused on a small ethnic group on one continent, would it make sense to aim for an international journal?
3. **Are the implications of your research multidisciplinary?** If your journal prefers studies that can be useful to experts in multiple subjects, will a specialized project be interesting to that journal's readers?
4. **Is my research too technical for a layperson?** A journal with a large, general subscription will want articles to be written in plain English containing little jargon.
5. **Does your research cover work similar to those contained in other articles published by the journal?** Some similarity is good, but too much overlap might mean that your research is no longer "original" for the journal's purposes.
6. **Does the journal accept your manuscript type?** If you are doing a clinical study, but the journal you are contemplating does not publish any, perhaps you should keep looking. Likewise, if you want to write an editorial, but your selected journal does not accept them, it would be a waste of time to submit to that publication.

After you have determined that your draft is a good fit for your target journal, make sure that you convey this in your cover letter and abstract. For example, if a journal wants research that has policy implications, you should make sure to include some discussion about how your research could influence policy. Now you can see why it can sometimes be helpful to choose a handful of similar journals and keep them in mind as you start writing your manuscript!

What Is Peer Review, and Which Type Is Best for You?

To round out this week's discussion on how to find the right journal, we're going to explore the different types of processes journals use to evaluate manuscripts. When you make your list of target journals, you need to consider not only the journal's aim and scope but also the kind of review it conducts. There are two main categories of review: editorial review and peer review. We can divide the latter category into several types. In this article, we will define each method, and, more importantly, we will explain how these methods impact your chance for successful publication.

What is editorial review?

As the name suggests, editorial review is a system in which the editors decide whether your manuscript matches their journal's needs. Typically, if your paper is non-research based, such as a commentary or an opinion, then only the editorial staff will review it. If your work is research-based, however (which is probably why you are reading this article), then editors serve as the first step in a journal's review process. Editors consider many elements in deciding whether to forward your manuscript to peers for further consideration. We discussed many of these factors, including the most common reasons for rejection, in an earlier article.

If you pass the first screening, then the editors will contact a small number of peers — usually two to three — and forward your document for review.

What is peer review?

Journals employ several methods of peer review. Some journals have strict policies about which type of peer review they conduct. However, others, like *Nature*, allow authors to

choose between single-blind and double-blind review. Which option is best for you? Let's take a closer look.

What is single-blind review, and how should you prepare your manuscript accordingly?

In a single-blind review, the reviewers know who you are, but they remain anonymous. In this arrangement, you don't need to remove any author-identifying information from your submission. For the advantages and disadvantages of this type of peer review, please see the table below titled "Which method is right for me?"

What is double-blind review, and how should you prepare your manuscript accordingly?

Double-blind means that all of the relevant parties' identities are hidden. You don't know the reviewers' names, and they don't know yours. If you submit through a double-blind process, then you must carefully remove all self-identifying information from your manuscript. Be careful to follow all of the instructions provided by your target journal. Generally, the anonymization process includes the steps listed below.

General Checklist for Preparing Double-blind Submissions

- Strip author, institution, any affiliate names and other identifying information from file metadata. Check file properties to make sure author name, institution, etc. are not indicated in fields such as "Author," "Manager," "Company," "Last saved by" and any custom fields you might have created.
- Identifying information should be included in a separate file from the manuscript. If submitting as a hard copy, submit an extra title page that includes personal data.
- Include acknowledgements or author and contributor information in the cover letter but NOT in the manuscript. After the review process has been completed, you can re-incorporate this deliberately omitted information.
- Make certain the author and institution names do not appear in any figures or legends.
- Double-check headers and footers to scrub personal data.
- When citing, use the third person to refer to yourself. For example, instead of "We have previously...," say "Jones and Thompson (2015) have..." Alternatively, you can write "...has been shown before [Anonymous, 2015]." Similarly, in your reference list, you can write, "Jones and Thompson, 2015" or "[Anonymous, 2015]." You should consistently apply the third person or "Anonymous" throughout the submission.
- Do not include referenced works that have not yet been accepted for publication.

What are open review and hybrid review?

In an open review, everyone knows the authors' and reviewers' names. The comments, however, may or may not be disclosed to the public. Some journals offer a hybrid process. An example is the Electronic Transactions on Artificial Intelligence. Here's how this works.

- This hybrid system starts with editors' conducting the normal editorial review in which they decide whether a manuscript has the appropriate scope and is substantively sound.
- Once a submission passes this first hurdle, it is then uploaded to a discussion board for open review by all peers.
- Questions and comments are made visible to everyone for several months. Editors moderate the forums to make certain that all content is relevant and exhibits some minimal level of quality.
- After this process has been completed, the authors may edit their draft based on the open feedback received.
- The revised document is then delivered to hand-selected experts through a single-blind review system. In this final phase, the referees (peer reviewers) merely

decide whether to accept the manuscript for publication. No further substantive discussion is needed because extensive comments would have been made during open review.

Which method is right for you?

Now that we've examined the various peer review systems, how do you decide which avenue to pursue when looking for the right journal? We've summarized the advantages and disadvantages of each type of review in the table on the following page. As you will see, the primary factors to consider are whether you are ready to handle tough questions made public through an open review system and whether you think disclosing who you are, where you are from and your reputation may positively or negatively influence a peer's assessment of your manuscript. If you are a newer player in a popular field, a blind system might prove more beneficial than an open one because your research would likely be judged solely on its merits. If you work in an obscure field, your reviewers might be able to quickly identify you, even in a double-blind system. In this scenario, an open system might be to your advantage since public scrutiny of your work could reduce bias and encourage objectivity.

Peer review types, advantages, and disadvantages

Method	Advantage	Disadvantage
Single-blind	✦ Reviewer can freely critique article without fear of being pressured or challenged. ✦ Author identity might help give context to the research subject and provide reviewer with more information with which to assess the submitted paper.	✦ Personal bias: a reviewer might judge the author instead of objectively focusing on the written work. ✦ Other discrimination like gender bias and regional bias might play a role in deciding the fate of a work (e.g., some people might be skeptical of research conducted in the developing world).
Double-blind	✦ Regional or gender bias and other discrimination based on author's background is significantly reduced. ✦ Neither author nor reviewer would be subject to personal negative attacks or pressure.	✦ Having an author's background might actually aid in understanding the research being reviewed. ✦ The system is not perfect. Reviewers might guess an author's identity based on the research topic, writing style, etc.
Open	✦ Transparency reduces manipulation and bias.	✦ Reviewers may feel pressured into providing a desired response or refrain from giving a strong negative critique even when it might be deserved.
Hybrid	✦ Transparency reduces manipulation and bias. ✦ Reviewers have the opportunity to provide extensive comments for all to see and to interact with authors over an extended period time. ✦ Authors can claim publication priority as of the first day of open discussion. ✦ Rejection rates decrease because authors will carefully decide whether their research is complete and their methods are sound before submitting manuscripts.	✦ During open review, authors may face challenging, unavoidable questions. Even so, this aspect effectively deters premature submission.

Why Proper Journal Authorship Should Matter to You

In the last section, we explored ways to improve your manuscript's acceptance rate by examining the factors editors consider when making their decisions. We also looked at how to choose the right journal, examining aspects such as a journal's scope and the peer review process. In this section, we will discuss practical issues about manuscripts before we launch into identifying the best practices for writing a successful journal submission.

When we write an article, one of the first questions, we should be asking ourselves is "Who are the authors?" The answer to this query might seem obvious at first, but the more we reflect upon the matter, the more complicated it becomes. Claiming authorship declares to the world that the ascribed names conducted the research discussed in an article. The order of the author names is also an important indication of who did the work and so on. Accordingly, if we incorrectly name people as authors, serious unintended consequences could result. Let's take a closer look at why authorship determination is important.

What is authorship?

In the literary world, an author is someone who creates a written work. In the academic research world, however, an author is much more. Indeed, many journals follow the recommendations promoted by the International Committee of Medical Journal Editors (ICMJE) [13]. To obtain authorship credit, a person must partake in **all** of the following four phases of research publication:

- substantial contribution to research design, data collection and analysis;

- ✦ drafting or revising any important intellectual content;
- ✦ final review and approval before article submission; AND
- ✦ agreement to be accountable "for all aspects of the work" necessary to ensure that "questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved."

Manuscripts authored by a large group would need to list not only the name of involved organizations but also the members who satisfy the four authorship criteria listed above.

Who should be acknowledged as a contributor?

If someone does not meet all four criteria to be named as an author, the ICMJE recommends acknowledgment credit instead of authorship.

This distinction between authorship and acknowledgment exists to identify those who should be held fully responsible to the public for the research being introduced.

People who have only engaged in a small segment of the research, therefore, should not be held to this standard. While their contributions might have been essential (e.g., a financial sponsor or lab technician), these contributors are not as intimately acquainted with the research as those who should be called "authors."

When deciding how to acknowledge contributors, more specificity might mitigate any negative feelings someone might have about not receiving authorship status. For example, the ICMJE suggests descriptions [13] like

- ✦ "participating investigator,"
- ✦ "served as scientific advisor,"
- ✦ "provided study patients," and
- ✦ "participated in the writing or technical editing of the manuscript."

Why does authorship matter?

As stated above, the purpose of authorship guidelines is to hold named authors accountable to the public for their research. The academic community functions because we trust each other. If we cannot confidently rely on each other's word, then our pursuit of knowledge comes to a grinding halt. If a person can lie about who conducted and later interpreted a specific set of data, how can we believe the data or the published results? Consequently, assigning proper authorship is crucial to maintaining faith in our efforts to promote academic collaboration and shared knowledge.

Credibility is not the only issue with wrongful attribution. Where a submitted paper requires additional scrutiny, the public needs access to those who are in a position to provide answers. Research, by its nature, is about investigation — challenging current knowledge and testing its sturdiness. If we are unable to communicate with the right individuals to assess a study's merits, then the academic work is useless to us. The purpose of peer review is to appreciate who the authors are, to understand how this new work adds to the previous body of knowledge and to point the way to future research opportunities.

Moreover, inappropriate authorship can lead to discord among team members. Consider the following situation: a group of people collectively develops a project, but only some of them are named as authors. The remaining contributors may feel slighted and lose interest in any further cooperation. In severe cases, this resentment can spiral into the concealment or careless manipulation of important findings. Years of work can be quickly destroyed because the parties involved failed to agree on who would be named author at a project's onset.

Finally, we must remember that a journal's editorial staff is not responsible for assigning authorship, and any disagreement about attribution after a paper has been submitted can decrease your chances of having the article, or future articles, accepted. From a publication editor's perspective, its value is in its trustworthiness. A journal must be able to verify that the works it publishes have been thoroughly vetted and that the underlying research comes from sound provenance. If editors cannot make these statements confidently, then why would they take the risk?

➡ **TIP: If you approach a journal with solid research, but there is a clear dispute about who should claim authorship, you have lost credibility in the editorial staff's eyes. This problem can be avoided, however, if you reach an agreement among potential co-authors before the manuscript is drafted.**

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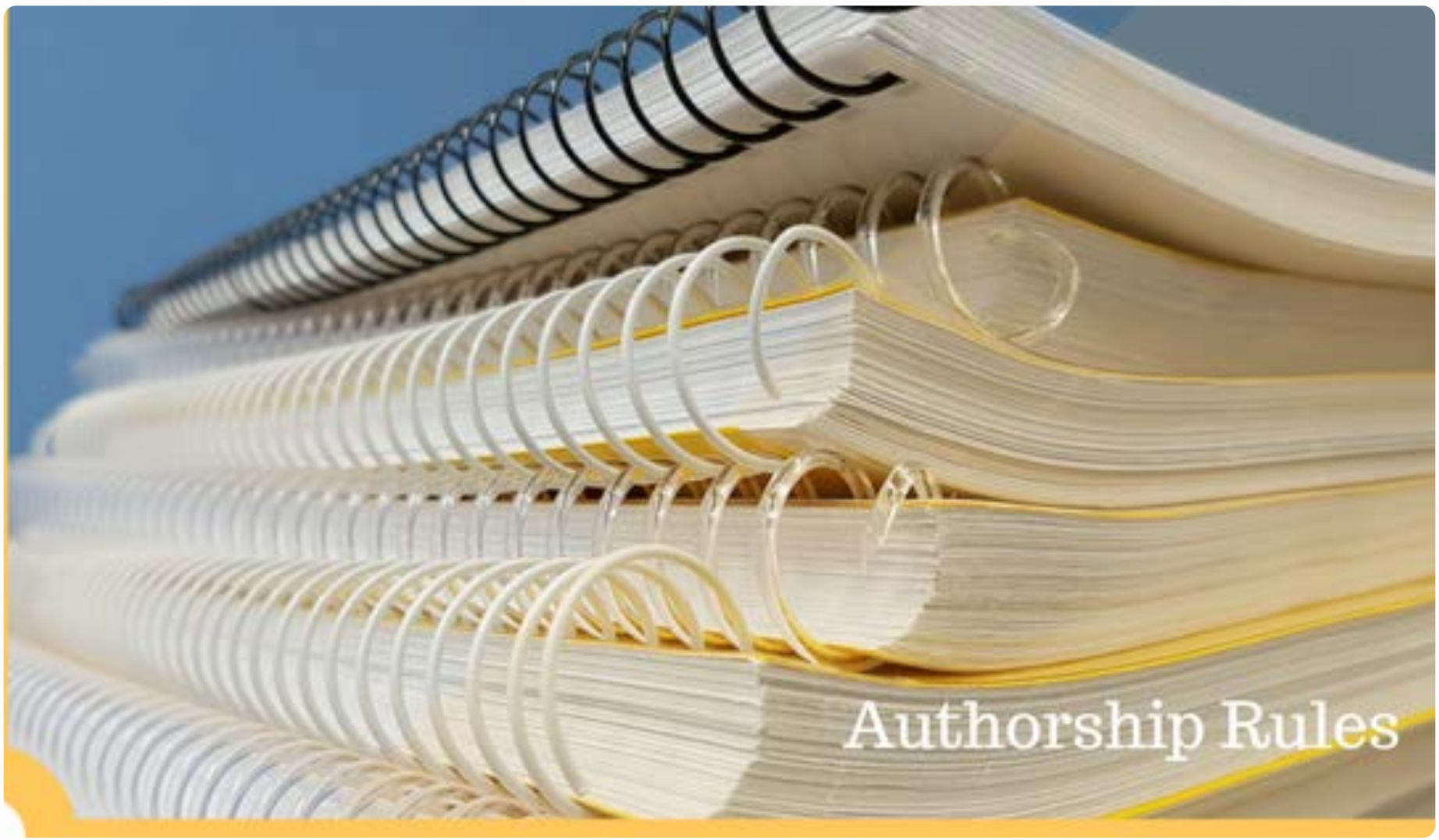
Now that we have a better understanding of the risks of improper authorship designation, in our next section, we will examine best practices for avoiding these risks and how to double check and spot authorship issues before submission.

Three Issues about Naming Authors for a Manuscript



As you may recall from our last article, we defined "authorship" according to the guidelines developed by the International Committee of Medical Journal Editors (ICMJE) [13] and explained why authorship matters. Other, more flexible, definitions also exist, including one proposed by the Committee on Publication Ethics (COPE): While "there is no universally agreed definition of authorship… [at] a minimum, authors should take responsibility for a particular section of the study" [14]. Whether we use the ICMJE's four-criteria test or a more relaxed definition like COPE's, how exactly should authorship be determined?

Most journals have their own ethical guidelines that include rules about authorship in their Guide for Authors, so the best practice is to read these guidelines when submitting a manuscript. However, to help you understand generally accepted practices, this article will examine some specific questions you may have about the author-naming process. In particular, we explore a category of authors called "ghost" authors and explain how these people should be acknowledged in a journal manuscript.

What constitutes "substantial contribution to research design, data collection and analysis?"

According to the ICMJE standards, an author must have substantially contributed to the research design, data collection and analysis associated with a project. The ICMJE's "recommendations are intended to ensure that contributors who have made substantive intellectual contributions to a paper are given credit as authors..." Thus, we can infer that participation at an intellectual or creative level holds greater weight

than participation at a mechanical or procedural level. For example, a graduate student who helped design the experiments and determined the study's scope would have a stronger claim to authorship than a lab technician, financial sponsor or supervisor.

What happens, however, when the "author" is an organization? Arguably, while an individual might have executed parts of a research project, the work itself might have been controlled by a large group. Who, then, should have authorial credit? If only part of a group is listed, the unnamed members might feel slighted. Indeed, the ICMJE frowns upon excluding these "ghost authors" because "all persons designated as authors should qualify for authorship, and all those who qualify should be listed" [15]. Conversely, if only a group is named, accountability to the public becomes less meaningful. How would the public know which person was responsible for which part of the research and drafting process?

To address these issues, some journals have requested full disclosure of group members and their specific contributions. However, this requirement can be impractical, especially given the increasing complexity and size of interdisciplinary projects. For example, a 2010 article [16] had over 2,080 authors. This would be a coding nightmare for many journals. In addition, too many listed authors has the same impact as too little author information: no one will know who is truly accountable for each part of the work. As a result, where it isn't feasible to list every member or expect each named author to take responsibility for all aspects of a project, some journals have asked the group to designate a guarantor for each article. The guarantor is responsible for the integrity of the work as a whole and serves as the principal liaison between the public and the research group.

Who shouldn't be counted as an author?

Another way to better understand who should be an author is to examine who should NOT be one. The latter usually falls into one of three categories.

- The first category is "honorary" authors. These people have contributed little, if anything, to the research and publication process, but their names are generally included because they hold senior positions (e.g., department heads) at the corresponding institutions of study. Since these honorary authors fail to meet the first prong of the ICMJE's "author" test, they should not be included as authors. Nevertheless, this practice often remains due to cultural considerations or efforts to enhance people's perceptions of a work's merit.

- “Guest” authors’ names may be included solely because people believe that including guest authors’ names might improve publication odds. This type of authorship has no effect, however, in double-blind peer reviews since reviewers do not see the authors' names.

- Finally, a third category of "authors" is "gift" authors. These individuals are included to help increase their publication lists.

If not an author, then what should we call them?

Apart from the byline, the "Acknowledgments" section can be used to include people who don't meet the ICMJE's four-criteria test or who can't be held accountable for an entire project. Many journals support the idea of acknowledgments where true authorship can't be established. For example, some journals agree that lab technicians and assistant writers should be listed in Acknowledgements sections. Acknowledgments are also perfect for journals that limit the number of authors that can be listed in a byline.

Any names listed in the Acknowledgments section should be accompanied by a description of the individual’s specific contributions to the project, such as "clinical investigator," "served as scientific advisor," "collected data" or "provided study patients." Additionally, people listed in this portion of a manuscript should sign a disclosure form or otherwise confirm their agreement to being listed. They should also disclose any potential conflicts of interests.

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Now that we have taken a closer look at the practical meaning of an "author," in our next article we'll examine how to spot and avoid authorship issues and, where unpreventable, how to cope with existing conflicts.

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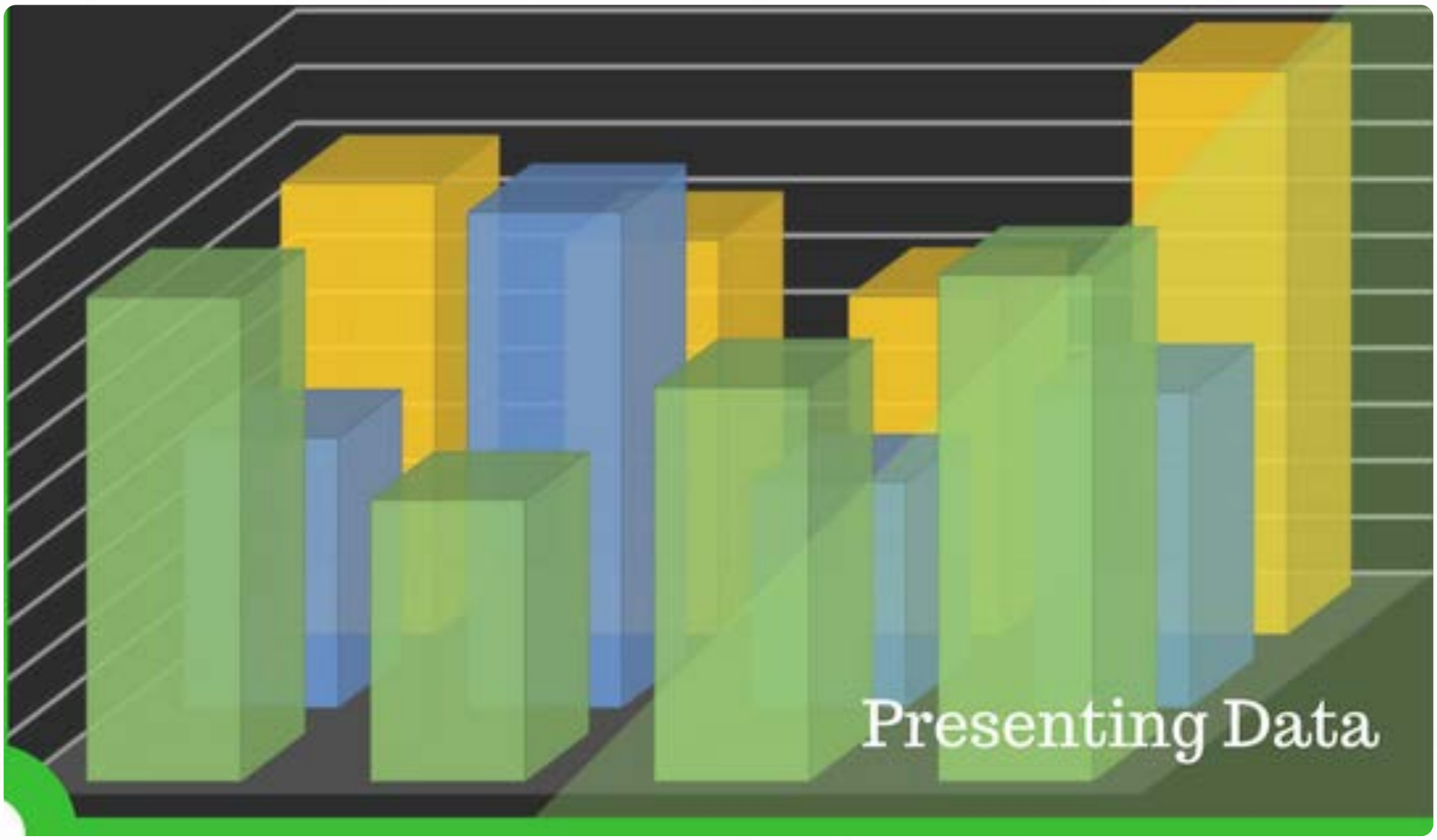
Research Writing

"The time will come when diligent research over long periods will bring to light things which now lie hidden. "

– Seneca, *Natural Questions*

17 Tips for Writing Effective Figure Titles and Legends



Pick up any journal and take a look at one of the articles.

Without reading the main text, examine one of the figures and ask yourself, "What can I conclude from this image?" Are you able to answer this question? Based on the figure, can you guess what the article's conclusions might be? Hopefully, yes!

Most people will agree that illustrations can greatly enhance reading comprehension. However, the problem we often face is how to create effective figures that best depict our data and conclusions. What's more, we often struggle with explaining the significance of these images to our readers.

Figures and tables aren't just supporting information; they should be able to stand alone. A reader should be able to look at the image, read its title and legend and grasp the takeaway message without having to rely on the main text. Indeed, people often look at the graphical elements in an article before they decide whether to read the rest of the article. Therefore, it is important to make your legends tell a clear story on their own.

In this section, we offer some key tips and reminders about writing effective legends for journal submissions. For ease of reference, we've sorted the information into five categories in the table below: overall legend structure; title; materials and methods; results; and definitions. When you draft captions for your figures, you should consider each of these elements.

Tips for Drafting Effective Figure Legend

Legend Aspect	Tip
Overall	✦ Keep the average length around 100-300 words. ✦ Use complete sentences to aid comprehension, but phrases are permissible. ✦ Use the same abbreviations, terminology and units as in the body of your article, particularly in Methods and Results. ✦ Always double-check your journal's Guide for Authors for specific instructions about figures and captions.
Title	✦ For each figure, make sure the title can adequately describe all of the panels of that figure. If it's not possible to create a single title that fits all, reconsider how you group the images. ✦ Use descriptive language to highlight the methods or type of analysis performed (e.g., "Structural comparison of peptide-activated XY receptors"). ✦ Use declarative language to emphasize a conclusion or major finding (e.g., "Compound ABC accelerates insulin production"). ✦ Use the active voice with strong verbs.
Materials and Methods	✦ Keep it brief. Only include information that is necessary to interpret the figure. The description might include details like the treatments and conditions applied or the models used. It should contain enough detail so the reader does not have to search the methods section for additional information. ✦ Confirm whether the journal wants you to include or exclude from legends, the details regarding the methods and materials used. ✦ Use past tense for verbs when discussing completed experiments.
Results	✦ Summarize the conclusion in one sentence. ✦ If you use a declarative title, consider whether you should restate the results in the body of the legend. ✦ Include sample size, p-values and number of replicates, if applicable. ✦ Use past tense for verbs.
Definitions	✦ In the figure (not the legend), define any symbols, abbreviations, colors, lines, scales, error bars, etc. Also, label any other aspect of your figure that might not be readily understood. ✦ Avoid naming conventions that are only used by your organization. Instead, use intuitive or standard names that outsiders can understand.

Tips on Writing the Methods Section of a Scientific Paper

We publish research to share new findings and increase our understanding of various subject matters. As we discussed in a prior article, when editors select an article to publish, one of the key factors they consider is your methodology. A research paper contains not only the results but also how you got the results and how you arrived at the conclusions you did. We include a Methods section in our papers so that others can reproduce our experiments and evaluate the validity of our results.

So, what does that mean for you? Your Methods section should be clear. It should explain both the actual procedures undertaken and the methodological choices made in designing your study. In other words,

readers should understand what you did, how you did it, and why you did it.

In theory, the Methods section is often drafted first because you would have written much of this during the initial stages of your research project. This section is also usually the last to be finalized once you have finished your research because you would need to adjust the descriptions to (1) reflect any adjustments you made while conducting your research and (2) incorporate feedback from co-authors and reviewers.

What information should I include?

Essentially, the Methods section should explain how you answered your research question. At a basic level,

you would need to describe how you chose the test subjects and variables, how you manipulated or observed those elements, how you collected data, and how you analyzed all of the preceding information.

Think about the traditional W-H questions (who, what, when, where, why and how) while drafting this section. However, remember that you're not cataloging every step you took. Rather, you want to give a comprehensive overview of key tasks that others would need to repeat your experiment.

How should I format the Methods section?

Each journal will have its specific requirements for how to format the Methods section, so please double-check your target journal's Guide for Authors. Generally speaking, however, you should have sections that roughly correspond to the following:

1. Study design. This part should describe how you planned to address the purpose of your research and how you intended to answer your research question, including any feasibility issues. Your aim is to address how well the study design you implemented was able to control random and systematic errors. By addressing these points, your readers will appreciate the validity and precision with which you arrived at your results.

2. Test subjects (selection criteria and methods). The purpose of discussing these elements is to address questions readers might have about the results you presented earlier in your paper.

3. Data collection (criteria and methods). Demonstrate the reliability of your methods. Did you adequately address bias and control any variables that could have impacted the results you presented in your paper?

4. Data analysis. By describing how you analyzed the data collected, you will address some of the concerns readers may have had about the conclusions you drew from that data.

➡ **TIP: Use subheadings to your advantage. They can help distinguish various steps taken in your study and identify the different procedure types or test subjects used. Typically, methods are organized chronologically or by procedure type, but you can organize them in any manner that will help you clarify your Methods section and make it logical for your reader.**

The following is a table summarizing some of the factors you may want to consider while drafting or revising your Methods section. We have organized the table based on the four general headings listed above. This list is not comprehensive but merely serves as a guide to help you reflect on aspects you might want to include in your Methods section, where applicable.

Factors to consider while drafting the Methods section

Subsection	Factors to consider or address
Study design (often an introductory paragraph)	✦ What do we currently know about the research topic? ✦ What type of study are you conducting (descriptive, analytical, comparative, interventional, observational, etc.)? ✦ What variables will you use, and which subjects will be exposed to which variables? ✦ How often and when will the data be collected? ✦ How can you control all the factors that might affect prediction models and outcomes? ✦ Do you have to adjust design because of some feasibility issues? If so, what factors?
Test subjects (selection criteria and methods)	✦ Ethical considerations (all animal or human studies must discuss factors like ethics committee approval of research protocol, informed consent of human subjects, etc. ✦ Study setting (time, place, etc.), where applicable. ✦ For living subjects (humans and animals): demographic and clinical conditions, gender, weight, species, age, special characteristics, living conditions, etc. ✦ Any preparations of subjects made before starting experiments. ✦ Sampling method, including target population, sampling frame, instruments used, and any stratification, clustering or weighting. ✦ Recruitment method and its effectiveness, including profiles of any subjects that refused (where applicable). ✦ For comparative studies: group allocation and randomization procedures. ✦ Follow-up procedures for longitudinal studies.

Subsection	Factors to consider or address
Data collection (criteria and methods)	✦ Variables measured (identify only the key predictors and all outcomes of those variables). ✦ Methods and instruments used to collect data (include information such as an instrument's manufacturer and model, calibration procedures, and other information necessary to allow others to reproduce your experimental results). ✦ Bias controls (e.g., blinding procedures).
Data analysis	✦ Descriptive statistics (e.g., means, medians, standard deviations, etc.). ✦ Inferential methods (include confidence intervals, hypothetical testing methods, and regression models or other modeling procedures used). ✦ Methods used to address confounding observational studies. ✦ Interim analysis methods. ✦ Adjustments made to sampling methods and weighting procedures. ✦ Missing data. ✦ Sample size. ✦ Power determination. ✦ Software used.

As you contemplate the above factors, also consider the following dos and don'ts when drafting the Methods section.

Dos and Don'ts

- ✦ Use past tense (you are writing about what you did, so that this makes sense).
- ✦ Don't mix results with procedures; only describe procedures in Methods.
- ✦ Exclude lengthy explanations and background information (they belong in the Discussions section).
- ✦ Only include essential information needed to reproduce your experiment. Strip your procedures to the bare minimum required. If you think you are leaving out an important point out, ask yourself, "If a reader followed my notes, would they definitively produce different results without the information I wanted to exclude?" If so, then include those details.
- ✦ Give precise measurements, including units, and disclose any errors of measurement.
- ✦ Don't repeat descriptions of already published methods. Instead, use numbered references to indicate the method was previously described elsewhere and only include information about any new additions or variations you made to the original method.

With these tips in mind, you will be well on your way to drafting a clear and meaningful Methods section.

Common Mistakes in Research Writing: the Results Section

In this part of our series on drafting a strong journal manuscript, we'll give you tips on how to write an effective Results section. As a preface, please note that some journals require you to have separate Results and Discussion sections, while other journals require you to combine the two into one. Please double-check your target journal's Guide for Authors to confirm its requirements.

What is the purpose of the Results section?

The Results portion of a manuscript presents the important data you acquired during your research. Yes, that sounds obvious, but there are a few common pitfalls to avoid while drafting this part of your scientific paper.

In this article, we'll cover some general rules for writing the Results section. Then, we'll explain how to navigate some of the drafting issues frequently encountered by research writers like you. As you write or edit your manuscript, keep these points in mind!

General tips

1. **Use the past tense**. Your Results section describes observations of events that have happened already, so the use of the past tense makes sense.

2. **Make sure that your data and numbers are consistent** throughout the manuscript. The last thing you want is someone going, "Wait a minute. Earlier, didn't you say...?"

3. **Number figures and tables consecutively** in the order in which you mention them. You want to avoid making readers hop back and forth. Wandering eyes lead to confusion!

4. Clearly (and appropriately) label all figures and other images. We provide 17 great tips on how to draft good titles and legends for figures in Chapter 2, Section 1.

Common mistakes in the Results section and how to avoid them

In the table below, we identify common mistakes people make drafting their Results section (the "Don'ts") and suggest ways to correct these problems (the "Dos").

Don’ts	Dos
Don't include all your data. (Obviously, you won't have enough room!)	Select only the information that is most relevant to the question you want to answer in your manuscript. Include information that may or may not support your hypothesis since you should let your readers know that you have carefully considered all the data relevant to your research question.
Don't use text to describe everything.	Some data might be better understood in a more visual format, like a table or figure. In theory, if you're able to capture the essence of most of your data by using clear graphs and illustrations, the text portion of the Results might be one of the shortest sections of your paper.
Don't repeat the data you include in figures, tables and legends.	Your data should complement the graphical information and vice versa. If you aren't able to describe information like controls, statistical analyses, actual p values, and key observations in your figure legends, then include it in the Results section.
Don't jump around by discussing different data in an unorganized fashion.	Organize your information in the order presented in the Methods section (usually chronological) or from most to least important. Regardless of how you arrange the overall structure of the Results section, within each paragraph, you should start with the most important information first.
Don't write long explanations.	Keep your descriptions concise. Eliminate phrases that establish passive-voice structures. When you use the active voice and choose strong verbs, your sentences will shrink, and your message will be clearer.
Don't use exact numbers that are meaningless out of context.	Where appropriate, consider describing the data's significance and magnitude using percentages and other comparison-oriented numbers. By doing so, you will better highlight relevant trends and help your readers digest your information. After all, what's more memorable? A series of random digits or percentages?

We hope that the above cheat sheet will help you as you draft or edit your journal manuscript. If you apply these ten tips, we are confident that your Results section will be clearer and more concise, thus making it easier to properly share your new discoveries with the world!

Drafting a Powerful Discussion Section

We've talked about several useful writing tips that authors should consider while drafting or editing their research papers. In particular, we've focused on figures and legends, Methods, and Results. Now that we've addressed the more technical portions of your journal manuscript, let's turn to the analytical segments of your research article. In this article, we'll provide tips on how to write a strong Discussion section that best portrays the significance of your research contributions.

What's the purpose of the Discussion section?

In a nutshell, your Discussion fulfills the promise you made to readers in your Introduction.

At the beginning of your paper, you tell us why we should care about your research. You then guide us through a series of intricate images and graphs that capture all the relevant data you collected during your research. We may be dazzled and impressed at first, but none of that matters if you deliver an anti-climactic conclusion in the Discussion section!

Are you feeling pressured? Don't worry. To be honest, you will edit the Discussion part of your manuscript numerous times. After all, in as little as one to two paragraphs (*Nature*'s suggestion based on their 3,000-word main body text limit [17]), you have to explain how your research moves us from point A (issues you raise in the Introduction) to point B (our new understanding of these matters). You must also recommend how we might get to point C (i.e., identify what you think is the next direction for research in this field). That's a lot to say in two paragraphs!

So, how do you do that? Let's take a closer look.

What should I include in the Discussion section?

As we stated above,

the goal of your Discussion section is to answer the questions you raise in your Introduction by using the results you collected during your research.

The content you include in the Discussions segment should reflect the following information:

1. Remind us why we should be interested in this research project.
    - ✦ Describe the nature of the knowledge gap you were trying to fill using the results of your study.
    - ✦ Don't repeat your Introduction. Instead, focus on why **this** particular study was needed to fill the gap you noticed and why that gap needed filling in the first place.
    - ✦ Mainly, you want to remind us of how your research will increase our knowledge base and inspire others to conduct further research.
2. Clearly tell us what that piece of missing knowledge was.
    - ✦ Answer each of the questions you asked in your Introduction and explain how your results support those conclusions.
    - ✦ Make sure to factor in all results relevant to the questions (even if those results were not statistically significant).
    - ✦ Focus on the significance of the most noteworthy results.
    - ✦ If conflicting inferences can be drawn from your results, evaluate the merits of all of them.
    - ✦ Don't rehash what you said earlier in the Results section. Rather, discuss your findings in the context of answering your hypothesis. Instead of making statements like "[The first result] was this...," say, "[The first result] suggests [conclusion]."
3. Do your conclusions line up with existing literature?
    - ✦ Discuss whether your findings agree with current knowledge and expectations.
    - ✦ Keep in mind good persuasive argument skills, such as explaining the strengths of your arguments and highlighting the weaknesses of contrary opinions.
    - ✦ If you discovered something unexpected, offer reasons. If your conclusions aren't aligned with current literature, explain.
4. Address any limitations of your study and how relevant they are to interpreting your results and validating your findings.
    - ✦ Make sure to acknowledge any weaknesses in your conclusions and suggest room for further research concerning that aspect of your analysis.
    - ✦ Make sure your suggestions aren't ones that should have been conducted during your research! Doing so might raise questions about your initial research design and protocols.
    - ✦ Similarly, maintain a critical but unapologetic tone. You want to instill confidence in your readers that you have thoroughly examined your results and have objectively assessed them in a way that would benefit the scientific community's desire to expand our knowledge base.
5. Recommend next steps.
    - ✦ Your suggestions should inspire other researchers to conduct follow-up studies to build upon the knowledge you have shared with them.
    - ✦ Keep the list short (no more than two).

How should I write the Discussion section?

Below, we provide some tips and general suggestions about the technical aspects of writing and organization that you might find useful as you draft or revise the contents we've outlined above.

Technical writing elements

1. Embrace active voice because it eliminates the awkward phrasing and wordiness that accompanies passive voice.

2. Use the present voice, which should also be employed in the Introduction.

3. Sprinkle with first person pronouns if needed, but generally, avoid it. We want to focus on your findings.

4. Maintain an objective and analytical tone.

Organization

1. Keep the same flow across the Results, Methods, and Discussion sections.

    - ✦ We develop a rhythm as we read and parallel structures facilitate our comprehension. When you organize information the same way in each of these related parts of your journal manuscript, we can quickly see how a certain result was interpreted and quickly verify the particular methods used to produce that result.

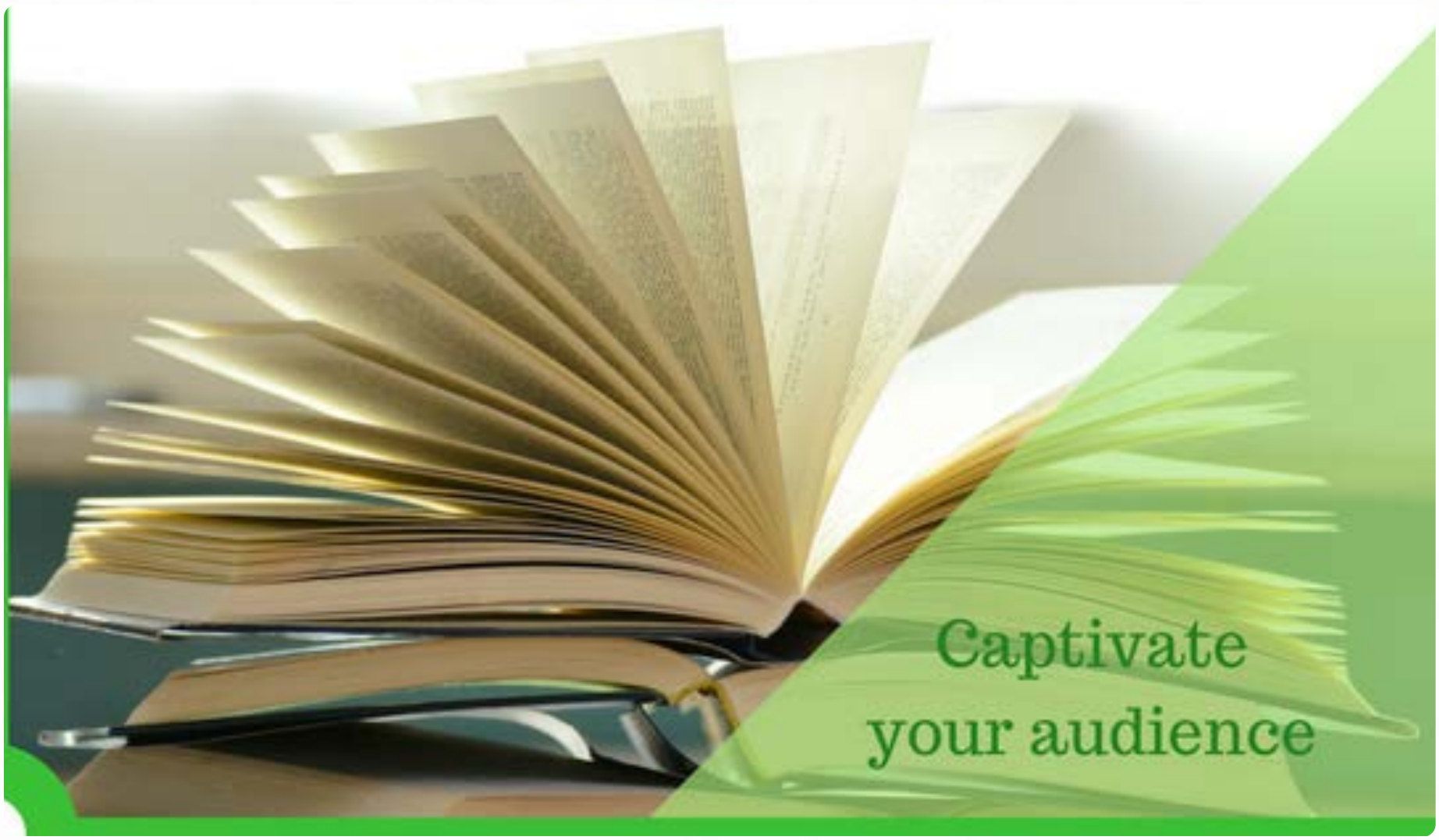
    - ✦ Notice how using parallel structure will eliminate extra narration in the Discussion part since we can anticipate the flow of your ideas based on what we read in the Results segment. Reducing wordiness is important when you only have a few paragraphs to devote to the Discussion section!

2. Within each subpart of a Discussion, the information should flow as follows: (A) conclusion first, (B) relevant results and how they relate to that conclusion and (C) relevant literature.

    - ✦ End with a concise summary explaining the big-picture impact of your study on our understanding of the subject matter. At the beginning of your Discussion section, you stated why **this** particular study was needed to fill the gap you noticed and why that gap needed filling in the first place. Now, it is time to end with "how your research filled that gap."

As you edit or draft your research manuscript, we hope that you implement these guidelines to produce a more effective Discussion section.

Crafting a Compelling Introduction



Thus far in our journal manuscript drafting series, we've covered the various sections of a scientific article according to the order in which we recommend you to write them (Figures, Methods, Results and Discussion). In this second-to-last installment, we'll talk about the Introduction and how to draft it in a way that intrigues your readers and makes them want to continue reading. After all, the journal publication industry is a business, so editors won't accept your article unless they're confident their readership will be interested.

What is the purpose of the Introduction?

After the Abstract (the final section of the paper you should draft) and the visual aids, like figures,

a reader's first true interaction with your work is the Introduction.

Thus, like any other story, you must set a compelling stage that invites your readers into your research world. Essentially, your Introduction will establish the foundation upon which your readers will approach your work. You lay down the rules of interpretation, and if your manuscript follows the tips we've given in this series, your readers should be able to logically apply those rules throughout all parts of your paper, including the conclusion in your Discussion section.

Before we examine what specifically belongs in this critical context-defining section of your manuscript, let's explore a practical point about writing the Introduction.

Why draft the Introduction as one of the final sections of the manuscript?

You may recall that we recommended a particular order for drafting your manuscript—an order that suggests the Introduction should be written second-to-last. You may also remember we talked about how the Discussion (or the Conclusion section for journals that separate the Discussion and Conclusion) should answer the questions raised in the Introduction. So which is it? Write the Introduction first or the Discussion? Honestly, the Introduction should come second-to-last because it is one of the harder sections of the manuscript to nail correctly. Therefore,

we recommend writing the Introduction in two stages.

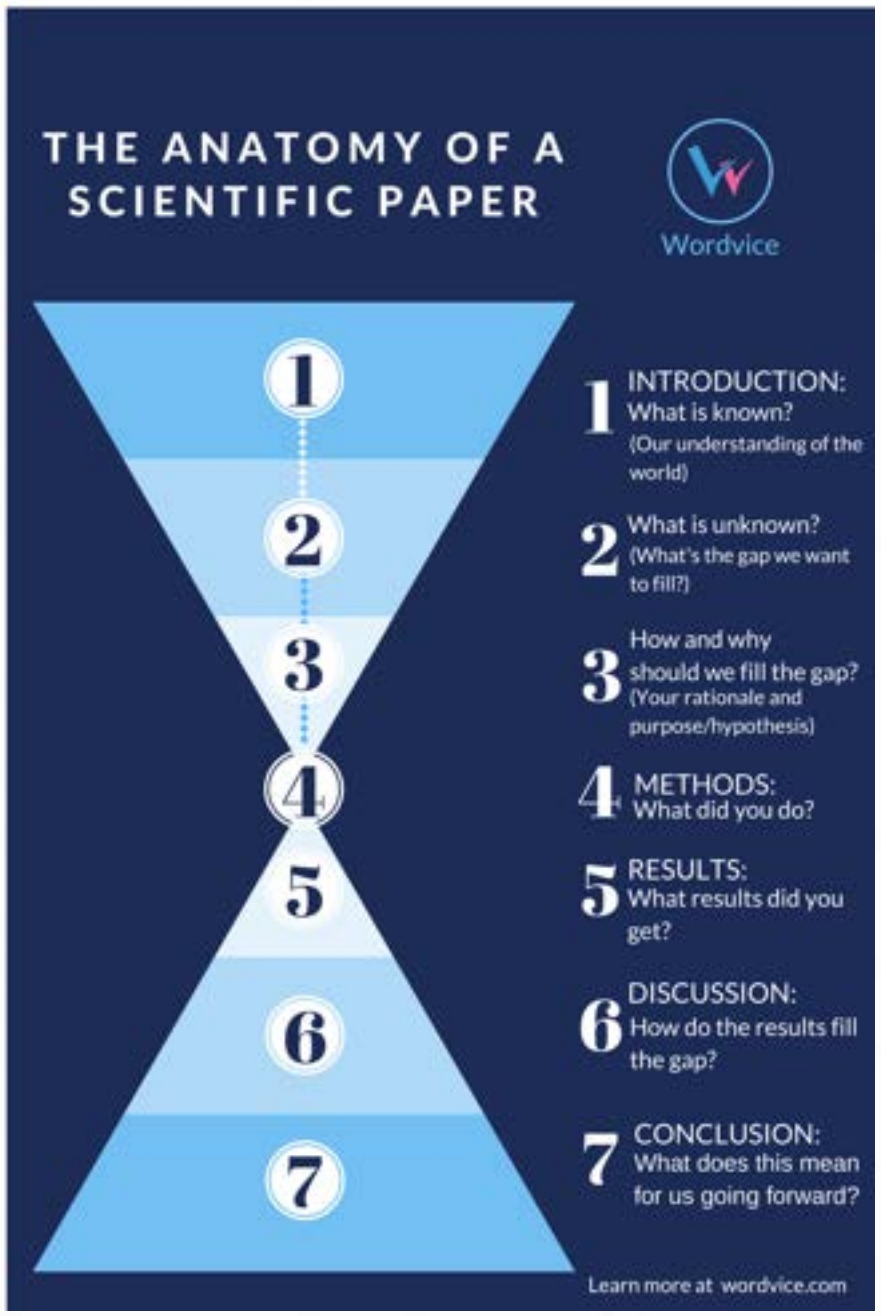
Start with a skeletal Introduction that clearly states the hypothesis (the question your research answers). Then proceed with fully drafting the remaining parts of your manuscript, including analyzing your results in the Discussion and drawing rough conclusions that you will later refine. Once you've finished the other parts, return to your Introduction and incorporate the information we outline further below under the heading "What should I include in the Introduction?" After, modify the Discussion's conclusion accordingly and polish the entire piece once again.

What should I include in the Introduction?

Your paper must read like a chronological story; it will begin with point A (the Introduction) and advance in time toward point B (the Discussion/Conclusion). If you recall from our prior article, the Discussion should answer the questions "why **this** particular study was needed to fill the gap in scientific knowledge we currently have and why that gap needed filling in the first place." The Introduction answers similar but distinct questions.

The context you establish in the Introduction must first identify that there is a knowledge gap and then explain how you intend to fill that gap and why.

Imagine that your paper is an hourglass like in the infographic below. Your Introduction holds the sand of knowledge that we currently have (the top bulb), and as the sand trickles through the neck (your research), it builds up a new base of knowledge (the bottom bulb). Thus your paper traces that journey from the top of the hourglass to the bottom, answering the questions in the infographic along the way. As a part of that journey, your Introduction is the starting point that answers the first three questions concisely.



As you can see from above, your Introduction should start broadly and narrow until it reaches your hypothesis. Now, let's examine how we can achieve this flow of ideas more closely.

What is known?

1. Start the Introduction with a strong statement that reflects your research subject area. **Use key words from**

your title to help you focus and avoid starting too broadly.

2. **Avoid stating too many obvious facts that your target readers would know.** You should be precise about the area of focus so that readers can properly orient themselves before diving into your paper.

    ✦ As a trick to help you combat too broad a start, write down your hypothesis or purpose first.

    ✦ Then work backward to think about what background information your reader needs to appreciate the significance of your study.

    ✦ Stop going back when you reach the point where your readers would be comfortable understanding the statements you make but might not be fully confident to explain all the aspects of those facts.

3. **Cite relevant, up-to-date primary literature to support your explanation of our current base of knowledge.** Make sure to include any significant works that might contradict your argument and address the flaws with that opposing line of thought. You want your readers to conclude that your approach is more plausible than alternative theories.

4. **Be sure to cite your sources.** Plagiarism is a serious offense in the academic community that will hurt your credibility (not to mention it is a violation of many copyright laws). Direct copying or a closely matched language should be avoided. Instead, be sure to use your own words to rephrase what you read in the literature and include references.

5. Remember that **the Introduction is not meant to be a comprehensive literature review**! Don't overwhelm your reader with a sea of citations. Instead, use key primary literature (i.e., journal articles) to quickly guide your reader from the general study area to more specific material covered by your hypothesis. In other words, the literature you cite should logically lead your reader to develop the same questions that prompted you to do your research project. Roughly a half page should suffice, but double-check with your target journal's information for authors.

What is the gap?

1. As you describe our understanding of the relevant subject matter, **highlight areas where too little information is available**. However, don't stop at saying "little is known about..." You must elaborate and tell your readers why we should care about unearthing additional information about this knowledge gap. See the subheading "How and why should we fill that gap?" for further details.

2. Alternatively, your Introduction should **identify what logical next steps can be developed based on existing research**. After all, the purpose of sharing research is to prompt other researchers to develop new inquiries and improve our comprehension of a particular issue. By showing you have examined current data and devised a method to find new applications and make new inferences, you're showing your peers that you are aware of the direction your field is moving in and confident in your decision to pursue the study contemplated by your paper.

How and why should we fill that gap?

1. **State your purpose/hypothesis clearly**. Surprisingly, many people actually forget to do so! If all else fails, a simple "The purpose of this study was to examine/study X" will suffice.

2. You are proposing a solution to a problem (the gap) you observed in our current knowledge base. As such, **your Introduction must convince your readers that this problem needs solving**.

    ✦ In particular, since we are writing with a particular journal's readership in mind (or, at least, you should be!), make sure to address how pertinent your project would be to the reader's interests.

    ✦ In other words, **if we fill this gap, what useful information will the readers gain?** The answer to that question is the promise you are delivering to your readers, and in the conclusion part of your Dis-

cussion, you will give final confirmation of your findings and elaborate more on what your readers can now do with the information your project has contributed to the research community.

3. **DON'T draw any conclusions or include any data from your study.** Those aspects belong in other parts of your paper.

4. Similarly, **DON'T talk about specific techniques in your Introduction because your readers ought to be familiar with most of them**. If you employed a novel technique in your study, and the development of that process is central to your study, then, by all means, include a brief overview.

How should I write the Introduction section?

To round out our guide to drafting the Introduction of your journal article, we provide some general tips about the technical aspects of writing the Introduction section below.

- ✦ Use the active voice.
- ✦ Be concise.
- ✦ Avoid nominalizations (converting phrases, including adjectives and verbs, into nouns). Instead, use the verb form where practical. When you eliminate nominalizations, your sentences will shorten, you'll maintain an active voice, and your sentences will flow more like natural speech.
- ✦ Do you see those uber long sentences in your draft? Revise them. Anything longer than three to four lines is absurd, and even sentences of that length should be rare. Shorter sentences are clearer, making it easier for your readers to follow your arguments. With that said, don't condense every sentence. Incorporate a variety of sentence structures and lengths.
- ✦ Similarly, drop the extended sentences with semicolons and serial clauses connected by commas. Again, the purpose of your paper is to provide a CLEAR explanation of your findings.
- ✦ Avoid overusing first-person pronouns. Use them rarely at the beginning of the section and sprinkle them toward the end when you discuss your hypothesis and the rationale behind your study.
- ✦ Organize your thoughts from broad to specific (as described in the section "What should I include in the Introduction" above).

BONUS TIP #1: Like any other type of writing, start your Introduction with an active hook.

➡ **Writing a summary of your findings shouldn't be boring. In fact, a dull start will make your readers stop long before they get to the good stuff—your results and discussion! So how do you make an exciting hook? Think about techniques in creative nonfiction like starting with a provoking anecdote, quote or striking piece of empirical data. You're telling a story, after all, so make it enjoyable!**

BONUS TIP #2: As one author, reviewer, and editor once stated, your Introduction should avoid using phrases like "novel," "first ever," and "paradigm-changing" [18].

➡ **Your project might not be paradigm-shifting (few studies truly are); however, if your idea isn't novel in the first instance, then should you be writing the paper now? If you don't feel like your research would make a meaningful contribution to current knowledge, then you might want to consider conducting further research before approaching the drafting table.**

Scientific Writing: a Verb Tense Review

On the following page is a quick cheat sheet highlighting the main verb tenses to use in each section of a scientific paper. We then provide further explanation about which tense to use in abstracts, given recent stylistic trends.

Which Tense Should Be Used in Abstracts: Past or Present?

Many of you had questions about seemingly conflicting rules about which tense to use in a research article abstract, so we wrote this article to clarify the issue.

When writing an abstract for a research article, several tenses can be used. In the chart on the previous page, we state that past tense is used to describe the results (i.e., observations) mentioned in abstracts. This statement remains true. However, tenses can be different in other contexts. We do see a rise in the use of present tense in abstracts, but let us explain why that is. (It's not because the grammar rules have changed!)

The tense you would use largely depends on the subject of your sentence. As a general rule:

- Any statements of general fact would be written using the present tense.
- Any discussion about prior research would be explained using the past tense.
- If the subject of your sentence is your study or the article you are writing (e.g. "Our study demonstrates…," or "Here, we show…"), then you should use the present tense.
- If you are stating a conclusion or an interpretation, use present tense.
- If the subject of your sentence is an actual result or observation (e.g. "Mice in Group B developed…"), you would use past tense.

In the case of the abstract, you were taught to use present tense because, stylistically, your professors wanted you to focus on sharing your interpretations in your abstract rather than simply stating what the results are. (And, in that regard, we agree!)

To further illustrate by example, let's take a look at the abstract from the article published in *Nature* as "Thermophilic archaea activate butane via alkyl-coenzyme M formation" [19].

- We see present tense for general facts ("The anaerobic formation and oxidation of methane involve…").
- We see present tense when the study/article is the subject or is the thing you are referring to ("Here [this article] we show that an anaerobic thermophilic enrichment culture …").
- However, when we talk about an actual observation, past tense is used ("Genes encoding 16S rRNA…were repeatedly retrieved from marine subsurface sediments…").

As you can see from the example we linked, most of this abstract is largely written in present tense, but this is because these abstracts focus on the authors' interpretations and not on specific observations and methods. We hope this addresses any questions you have about tense use. We know how complicated these grammar rules can be!

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