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TIPS FOR WRITING SCIENTIFIC JOURNAL ARTICLES

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SCIENTIFIC JOURNAL ARTICLES**

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Do not raise the bar unnecessarily by exaggerating requirements for successful publication, but rather encourage young researchers to try and experiment.

Researchers can raise their ambition level through gained experience.

PREFACE

In some cases, people raise the bar unnecessarily by exaggerating requirements for successful publication. This may be either an intentional attempt to bring the game to a higher level, or merely unintentional. Unfortunately, it is difficult to improve the level before understanding the publishing game in the first place. Writing scientific journal articles is learned through writing and publishing attempts when constructive feedback is available. It may occasionally be possible to enter the big league of very high-level journals directly, but only with adequate levels of support and feedback. In other cases, it is possible to publish in increasingly better journals once gaining experience through more moderate publication mediums. A researcher can raise their ambition level through gained experience.

Doctoral students have often requested concrete examples and guidelines from us. On the other hand, many guidebooks are at a more general level than the requested instruction. Ideally, adequate guidance would be conducted by a supervising professor, or a research group, but this is not always the case. This guidebook attempts to provide tangible tips that have been identified as beneficial for writing articles. Once someone tries to concretise the process of writing they are also easier to criticise. Learning to write journal articles is, however, not a black and white issue where there are absolute rights and wrongs. Being constructive is more important than seeking out flaws in the message. Young researchers should utilise several sources while building their know-how regarding scientific writing.

This guidebook on how to write scientific journal articles is mostly based on the authors' personal experiences and their own learning curve towards successful publication. This guidebook includes examples from over fifty journal publication attempts, most of which have eventually been successful. Aside from their own writing experience, the authors have also learned from various other people representing different fields through guiding them in the writing and publishing of journal articles. Currently, the authors provide hands-on guidance and disseminate knowledge and best practices relating to scientific writing through all the faculties in the University of Oulu, Finland. The work is financed by the University of Oulu Research Council. The authors hope that this document can support the University of Oulu graduate school in reaching its goals.

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We, the authors, have been in the grateful position of being able to support numerous doctoral students in their attempts to publish a scientific journal article. Through this experience, we have been able to deepen our own knowledge of how to write a scientific article. We would like to thank all the doctoral students we have guided for the chance to share in their learning.

We would also like to thank Dr Harry Anttila, the Director of the Language Centre of the University of Oulu, for constructive cooperation. We would especially like to thank the Language Centre Working Group for Scientific Writing, Dr Eva Braidwood, Ms Suzy McAnsh, Dr Riitta Sallinen and Dr Outi Toropainen, for giving permission to include their document *Language issues in writing a scientific journal article* as a separate chapter in this guidebook. This chapter provides valuable insights into language concerns relevant to writing scientific articles.

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INTRODUCTION

Being capable of publishing in peer-reviewed journals is commonly seen as an indicator of proper scientific research. It is the duty of a researcher to publish his results for the scientific community. Research can be seen as a product that must be sold to the target audience in the form of an article. In other words, research results do not exist before they are successfully published. The key people for getting one's article accepted for publication are the editor-in-chief, editor, and reviewers. After publication, a well-written article will attract readers, eventually resulting in a scientific impact defined by whether other scientists will cite the article.

Unfortunately, many researchers are far more comfortable conducting scientific experiments than they are reporting and publishing their findings. As a result, a considerable amount of research is not published in a way that adequately expresses its significance. (Spector, 1994) On the other hand, researchers who communicate well are successful in gaining recognition and support for themselves individually, but also for their institution (Yore et al., 2004). These are among the motivations as to why it is vital to achieve proficiency in writing scientific journal articles. It is vital for a new researcher to start writing articles as soon as possible. An early start will speed up the learning process. When you are writing, you are forced to think about your substance from different perspectives.

Often, researchers make the mistake of believing that writing an article is a separate phase to be done after completing the entire research. We recommend that researchers start writing much sooner. From the effectiveness perspective, it is not wise to wait for a moment when you feel that you know and understand "everything" needed for writing articles. It is more sensible to start learning to write piece-by-piece, better enabling the perception of what to do and when, and thus aiding the avoidance of unnecessary work. Understanding of the studied matter is enhanced while working on it. Starting the writing process early gradually lowers the threshold for publishing and through gained experience the chances of getting the work accepted for publication in better journals will improve.

As writing articles is learned best through gaining writing experience, it is worth initiating the learning process by making written notes of any ideas and documenting research processes and initial results. This way you will generate text that can potentially be utilised later for articles, or at least you will gain writing experience. In addition, by writing down thoughts, initial conclusions and suchlike, a researcher can better identify gaps in his thinking. It is beneficial to have publishing in mind already while conducting experiments. However, it is the results that will define the focus of the final article (Bem, 2003).

The process of writing an article is initiated by considering the significance of the future article, its importance and potential newness to the scientific community. It is also vital to identify those who might be interested in seeing your results, i.e. who is the target audience? In addition, it is beneficial to consider the practical implications of your research. A scientific article must be based on research that is conducted scientifically by using accepted methods. An article wraps up research by presenting it clearly and concisely to the scientific community.

A researcher may be under the illusion that his research will sell itself more or less automatically. On the contrary, it is the duty of an author to write an article so that an outsider can understand the main points and the reasoning logic with relative ease. Your article competes against other submitted article proposals. The decision on acceptance is not done based only on the article substance, but the readability of the article also matters. Consequently, an article must have a clear and logical structure combined with fluent story-telling. An article must be as appealing as possible for readers; no-one wants to read something that is laborious to understand. In addition, using unnecessary jargon makes the reading experience simply inconvenient. Do not attempt to invent new structural solutions, but follow the scientific format (see e.g., Suppe, 1998; Yarden, 2009). The purpose of the article and defining the research problem must be clearly stated in the introduction, thus giving a justification for the article. This is followed by a literature review, description of the research process and methods, results and discussion. The beginning and the end of an article **must match**, i.e. the stated problem or research questions must be addressed at the end. Any mismatch will severely diminish your article. The middle part of the article will describe the logic regarding how the results were obtained.

A scientific article must answer the following basic questions:

- What is the problem that is addressed?
- Why is it important?
- How did you study the problem?
- What are your results?
- What are the implications of the results?
- What do you recommend as further study for others?

Writing in a group

Articles are often written in small groups, which makes it possible to include the views of several people. Writing articles together with co-authors is a good way to obtain necessary feedback for your research. In addition, it is possible to have others to comment on your work, for example by offering favours in return. However, dynamic group work cannot afford freeloaders; everyone involved must have something to offer. Different types of capabilities and backgrounds can be a strength. Nevertheless, working for the same project does not mean your name will automatically appear among the authors of the article, as all the authors are required to provide a positive contribution to the realisation of an article. Also, note that some journals limit the number of authors (e.g. four). As a rule of thumb, it is beneficial to include your supervisor as a co-author, if you are a doctoral student. This way you show respect and acknowledge the help you receive as well as maintain the work relationship.

Seeking for feedback is vital for learning and putting together a good article. This is one of the main reasons why it is recommended for researchers to cooperate closely. This cooperation can mean either writing together, or commenting on the text written by others. From the perspective of effectiveness, it is important to ask for feedback on *small increments* and as frequently as possible. This way the feedback is more precise and easier to utilise. You should start seeking for comments already at the stage when you only have an initial idea for an article. This can be done, for example, by using PowerPoint slides. Your colleagues, or a supervisor, can comment on your slides, providing valuable feedback very early.

Target journal

It is beneficial to decide on a target journal during the very early stages of writing an article, rather than first preparing an article and then considering where to send it. Analyse potential journals and choose one. Write your article with your target journal in mind. This is useful because different journals have different perceptions of science as well as differing opinions on how articles ought to be written. By writing directly for your target journal, you will ensure the right type of approach and speed up your writing process. If you wish to be even wiser, you may also choose a secondary target journal for the case that your primary option fails.

The number of scientific journals is vast and is growing steadily, which means that there are plenty of publishing opportunities. The fundamental reason behind the growing number of journals is the increasing number of researchers globally. Quite often you can hear researchers complaining that there are no scientific journals for their specific narrow research field. Most often this is not true. Journals exist for wide and varying topical fields. Should you find it difficult to find a suitable one, try considering potential applications for your results. Consequently, think who might benefit of your results and how. It may also be possible to publish your results in an applied journal instead of what you initially thought as your own field.

Noteworthy is that different publication mediums are valued differently within the scientific community. Also, universities are ranked based on the number and level of publications. Journal articles are commonly recognised above conference papers, even if many of the conference publications use peer review practices. It is recommended that a researcher, even at early stages, should start the learning process of writing for journals. Once experience is gained, one should raise his ambition level step-by-step and aim towards publishing in increasingly better journals. The impact factor is one way to measure the level of journals (see e.g., Seglen, 1997; Garfield, 2006; Althouse et al., 2008). Note that this is not an absolute measure and there are differences among different fields of science. A researcher should see conferences as an additional medium for networking and as an avenue to obtain more face-to-face feedback. However, the ultimate goal should be eventually publishing the work in a journal. A researcher should consider his ambition level and assess the level of his own research when choosing the publication medium.

When selecting your target journal it is beneficial to conduct an analysis of the purpose and mission of the journal, and examine what type of articles they typically publish. Pay special attention on the topics, the structure and the research methods. Conduct a deeper analysis on about five recent articles in the target journal. If the journal does not seem suitable, choose another one and conduct a similar analysis. Browse through the editorial board and previous authors and pay attention to their nationalities. For a European author, it may be beneficial if some of the authors and editorial board members are European. As an example, a pure US board may in some cases prefer American authors.

Especially a starting researcher, or a PhD student, ought to pay attention to the journal's turnaround time. Turnaround time means the time from submission to receiving feedback from reviewers. The shorter the turnaround time, the quicker the learning process is for the author. Slow turnaround, in the worst case, may postpone obtaining one's doctoral degree, which typically depends on the "accepted status" of the articles constituting a compilation dissertation.

One can find out the turnaround time by:

1. checking articles published in the journal. Some journals print the essential dates of the articles, enabling interpreting the turnaround.
2. checking the web pages of journals.
3. sending a polite e-mail to the editor-in-chief.

RECOMMENDED ORDER OF WRITING

According to our experience the different elements of an article should not be written in the same order as the final layout of the article. The list below presents a recommended order of writing that is proven most efficient, avoiding unnecessary iterations. The two grey lines in the beginning signal the preparatory work, while the bullets in bold represent the recommended order for actual writing.

- Initial outlining of introduction (research questions)
- Initial outlining of theory
- **Writing experimental elements**
 - **results**
 - **analyses**
- **Research process**
- **Finalising theory**
- **Introduction**
- **Conclusions**
- **Abstract**
- **Title**
- **Final revision**

The order of writing presented here highlights the importance of your results for defining the focus of your article. You should define the focus of your article based on the evidence you have. This way you can set the focus of your article relatively early and avoid unnecessary re-working when writing up the theory and other elements of the text.

It is sensible to start writing an article by outlining the subject matter and content by a few bullet points or key words. This phase will act later as an aid in writing the introduction.

After outlining the initial ideas, you can try to find a suitable target journal. Once selecting a potential target journal, outline the initial theory for your article. After this, you will need to concentrate on the core: the “heart and soul” of your article and write the results and analysis of your research. Once you have these elements, it may be worth reviewing your target journal selection. If there are any reasons to change, pay attention to the potentially different format and other requirements, such as the recommended article length that your new target journal may have. Once you have the core substance ready, you can concentrate on elements critical for acceptance; the introduction, the discussion and the abstract.

Writing one’s first journal article usually takes several months of intensive work, but later, through experience, the process will speed up significantly. Novice authors should especially bear in mind the importance of multiple iterations. Once you have written a paragraph, do not believe it is the final version. When you have written the other sections to your article, you will most likely have to return to this previously written paragraph, re-analyse its content, consider its place and even the justification for its very existence in the final article.

ARTICLE ELEMENTS

An article typically constitutes the following sections and elements:

- Title
- Abstract
- Introduction
- Theory/Literature review
- Research method/ process
- Results (sometimes divided into results & analysis)
- Conclusions

There are a lot of writing guides available which provide advice on the structure of proposed articles. One example is the commonly known IMRAD (Introduction, Method, Results and Discussion) structure (see e.g., Swales, 1990, Sharp, 2002; Freeman, 2000). The terminology may differ somewhat, as for example in the IMRAD scheme the literature review is integrated into the Introduction section, however, the above list presents the literature review separately. Also, discussion, which D stands for in IMRAD, is the same as conclusions in the above list. Discussion in the above list covers the interpretation of the result by the researcher. This again slightly differs from the IMRAD model. To sum up, there is no commonly accepted right structure and terminology. The differences between journals are, however, marginal, once you have understood the essence of the key elements. The best solution for a researcher is to follow the structure and terminology of their target journal.

The following will provide tips for each individual section.

Title

When considering a title for your article, do familiarise yourself with the types of titles in the target journal, analyse whether they are more general or very specific. The editors-in-chief may want the article titles to sell and gain clicks. This is why in some cases a more general title is better than an overly specific one. Avoid abbreviations in the title as well as unnecessary “and” words. Fundamentally, a very long title is not good as the reader may have difficulties in perceiving the content. Again, there are some journal and field specific differences in the types of titles, and following the practices of your target journal is the best approach. The suitable title length depends on whether your target journal favours indicative or informative titles. Journals favouring short indicative titles may, for example prefer titles with less than eight words. On the other hand, other journals may prefer long informative titles. However, researchers ought to attempt simplifying their titles even when longer ones are allowed.

Abstract

The Abstract is one of the most central elements of your article, luring other people to read it and may also influence the acceptance of your article. An abstract must describe the purpose of your article. Moreover, it must describe how you have realised your research and provide few key findings and any practical implications. You can build your abstract by answering the following questions with one or two sentences for each one:

- What is the bigger, more general field your article relates to?
- What is the purpose of your article?
- What methodology did you use?
- What are the key results?
- What are the practical implications of your research (how can the results be utilised by e.g. practitioners, society or companies)?

Your target journal may have some specific requirements related to formulating the abstract, such as word count. Should your target journal require a structured abstract, please follow their instructions. In addition to a conventional written abstract, some journals also use graphical abstracts, i.e. the authors include an illustration to accompany the text.

The Abstract is typically followed by key words. Follow the practices of your target journal when defining the key words.

Introduction

The Introduction justifies the significance of the subject matter and connects your work to previous research. This chapter can also include a definition of the key terms, if necessary. In reality it is better to use a limited number of terms and be consistent in their use. One rarely needs to invent completely new terms even when discussing something totally new. It is essential for the author to understand the true meaning of the terms used and be able to communicate them clearly.

It is sensible to write the introduction in a form of a logical *funnel*, where more general aspects are told first and sentence-by-sentence, paragraph-by-paragraph the text should proceed onto narrower detail (see also Bem, 2003). The purpose of the article is expressed last in the introduction by describing the research problem. Please note that in most journals the introduction chapter does not include any results. As the abstract already includes the key results in a condensed form, the Introduction can be started in a more general manner. In our experience, a logical funnel is a practical way to build up a functioning introduction.

Start the Introduction with sentences that are adequately general, and simple enough to understand even for those who are not experts in exactly the same topic as you. This way different type of readers can position your article into previous research more easily. Aim to motivate the reader and help them understand why your research topic is important. Utilise published journal articles, preferably recent ones, to point out the importance of your research by highlighting how it relates to them. This will please editors who want the scientific discussion to occur in their own medium.

The research problem the article aims to address must be described at the end of the introduction. One recommended way to deepen the description is to use research questions or hypotheses. Research questions help the reader to perceive the content of your article and the author to structure his thoughts and writing. The reader may also use the research questions to reflect the reasoning while reading through the article. When using research questions, the author must remember that the questions can be changed or adjusted during the writing process. It is also imperative that the research questions and later results match in the final version of the article.

Theory / Literature review

One can start writing the literature review by finding a few good articles, of which some are from the target journal, and maybe a few good books discussing your topic. Later on use these articles as a base and expand your literature review. Typically, finding one good article relevant to your research starts a chain reaction as some of the references in that article may also be relevant to your work. Write a summary of a few pages based on these articles and books. This will help in obtaining a relevant understanding of your research topic and will act later as a frame for the theoretical part of your article.

Write the theory to support the storyline of your article. Note that it is not customary to describe the development of your own understanding in an article, but describe what others have studied that is relevant to your topic. The purpose of a literature review is not to present all possible references, but to concentrate on those that are relevant for the focus of your article. The literature review will position your research in relation to previous literature; therefore cite articles on which your research is based. Aim to depict the state of research relevant to your article before your study. You can reflect your results against the previous literature in the discussion section of your article. Minimise self citations; only cite your own previous work if absolutely necessary.

When looking for references, do not chase terms but aim to understand what the true meaning of these articles are. It is important that you refer to some gurus in your field to show that you know the relevant scientific research. Additionally, it is important to refer to new journal articles to ensure the timeliness of your article. Minimise references that are not in English as reviewers cannot verify them.

It is wise to finalise the theory only after writing up the results of your article. This way you can once more search for related studies and can thus better focus the literature review to match your results.

Research method / process

The article must describe your research, the set-up and research methods precisely. This way the reviewers can assess the scientific basis of your research and the justification of your results. In principle, the research method/process should be described so that another researcher can repeat the study. You must prove that the methodology you have chosen is robust and applicable for your study. Should you use research methods that are established in your field, it is enough to cite the methods and there is no need to describe these aspects in detail.

It is important to describe clearly how the research is done. If needed, you can visualise the research process. In addition, you can include more justification as appendices, if necessary (for example, in qualitative research the interview questions). In some fields, it is customary to discuss the reliability and validity of the research in the research method section.

Results and discussion

Having completed the experimental research and having analysed the results, it is time to write up and summarise the results as well as the analysis. The experimental section of a journal article must concentrate on the actual *analysis* of the material, not on documenting

the data. Note that this differs from writing for other purposes, such as writing a research report.

While analysing your results, think what the focus of your article will be. However, do not fix the focus of the article too early, but be flexible and open minded. If you realise that your results do not match your original idea, be prepared to re-focus. Let your key results define the article focus. In some cases you may even have a happy problem; you may end up having material for two separate articles.

Consider what the key results of your research are and present them clearly. Build the Results section of your article around these key results. Present your results in such an order that their logic is as easy for an outsider to understand as possible. Should you not have any better way to decide the order of presentation, use the funnel principle; from more general to more specific points. Remember to highlight the key results by using visual elements, such as lists, illustrations and tables. This way, anyone who quickly riffles through the article will focus on the key results and will automatically get a level of conception of your results.

You may include a Discussion section at the end of your results section to explain and contemplate the results. The discussion can either be a part of the Results section or a separate section of its own, whichever is in line with the practices of your target journal. Please note that the reader must be able to separate easily the research facts from the researcher's own thinking.

Conclusions

The Conclusions section, alongside the Abstract and Introduction, is one of the core elements of a journal article. The Conclusions section can be written up by using the following structure (one paragraph each):

- Introduction
- Results (one paragraph for each research question)
- Significance of the research/practical implications, for example for the society, or business companies
- Limitations
- Recommended topics for further study

By using this type of structure, you can make it easier for readers to follow your thinking and enable understanding the core content without reading the entire article. It is important to include the practical implications of your research in the Conclusions chapter; discussing what the implications are for practitioners, companies, etc. Novice researchers tend to concentrate purely on the results and forget about the implications.

The Conclusions must be in line with the previous sections and should not present totally new results. The implications should, however, be discussed.

Visual elements

By leafing through your article, a reader should be able to spot the main findings easily, as well as figure out how the research was conducted and locate any crucial definitions needed to understand your results.

Therefore it is vital that you highlight **central aspects of your work** by using visual elements. Visual aspects mean anything that differ from the basic text, i.e. figures, tables, listings. The purpose of using visual elements is to direct the readers' attention to key aspects. One should, however, be conservative in using visual elements excessively as their use may cause unwanted confusion. Also, the use of overly complex illustrations that are difficult for an outsider to perceive should be well justified.

Aim to highlight your own work, not others' work. The illustrations you use must be your own and should not have been published before. Try to distribute the visual elements evenly along your article. In an optimal situation these elements form a unified whole, just like a comic strip.

When using figures, tables and equations, you must introduce and discuss them in the main text. Aim also to name the figures, tables and equations in a descriptive manner so that the reader can understand them by reading the caption.

SUBMISSION AND REVIEW

Polishing the article

Too often authors ignore the importance of adequate internal reviewing and polishing of an article among colleagues before submitting it to a journal. Authors may believe that a reviewer, appointed by the journal, will see the excellence of their research, and they fail to understand that the article may contain ambiguities and explanatory gaps. These gaps are caused by the author knowing more than what is said in the text, which enables them to understand the omitted bits. Unfortunately, an outsider does not have exactly the same knowledge; it is only the aspects that are visible for a reader that exist. Consequently, careful review before submission is of great importance. A good co-author will help you in finalising the article.

Remember to follow precisely the format instructions of your target journal. There is no point in irritating the editors or reviewers with lousy finishing. Publishing is not a lucrative business, therefore, publishers are not keen to spend a lot of time and money for editing your article; it is your job!

Make sure your article has a solid storyline and is written in good English. Including fresh brains to read through the article just before submission can help in removing any unnecessary flaws. Remember to return the favour.

Do pay attention to transitions between sentences in order for the reader to easily understand the positioning of different sentences. It must be clear whether sentences are parallel, opposed, or have a logical continuum. Consequently, words such as *in addition*, *also*, *however*, *nevertheless*, or *consequently* can be used for this purpose. Having to pay attention to transitions may, however, not be an issue for native English speakers.

What do reviewers look for?

Before submitting your article, it is wise to a) make sure you have selected a fitting target journal, b) you have carefully met your target journal's requirements for submission. It is also crucial c) to understand what the reviewer might be looking for when going through your article. Also, by screening out silly mistakes, you can increase your article's chances for publication.

In order to better understand the reviewers' perspective, you can think about the way you read an article that you have never seen before. At first, you may not proceed in a linear way. Instead, you probably scan the article for results and look around for an explanation. In addition, you may also start thinking about the meaning of terms that you do not recognise or cannot guess. All in all, one does not like hunting for the information.

A reviewer may be looking for an intellectual logical continuum or a plot-line by quickly browsing through your article. Typically, a reviewer will soon have an opinion whether the article is good enough. Therefore, your article should be constructed to be so clear that one can get a level of understanding without reading it word-for-word, even by browsing through the visual elements.

A reviewer may look whether it is easy to see what the researcher/s wished to find out, and whether these questions are well justified. Also, a reviewer may have a look to see whether the stated problem/s and research questions are actually answered.

Only if the beginning and the end match adequately, it is worthwhile for the reviewer to see if the research literature used presents convincing support arguments, and whether the literature cited is suitable.

Reviewers also pay attention to the section where you describe the utilised methods, and whether the methods are fitting and justified for your research. Also, the reviewer may be interested whether you understand the limitations of your research and have stated them clearly.

The quality of your text is also important: not only the grammar and punctuation, but how the story is told, which is ideally suitably straightforward and unambiguous without unnecessary jargon. The storyline should be built so that a reader can get something out of the text, even if they are not exactly specialists of the same field.

A good review is supportive, constructive and fair. A good reviewer identifies both the strengths and weaknesses of the article, and offers concrete suggestions for improvement. A good reviewer justifies the review conclusions.

Reacting to reviewers' comments

Scientific journal articles undergo a peer-review, which means that they are independently reviewed by two or more experts. These experts make a recommendation to the journal editor on acceptance or rejection. Quite often, even if later accepted for publication, some changes may be required, which can be minor or even major. In order to promote unbiased critique, typically peer-reviews are independent and blind, which means that the reviewers know neither the authors' identity, nor each other.

Typically, articles are not accepted for publication exactly in the same state as they are initially submitted, but reviewers require some changes. Obtaining critical comments is a good thing, which means that you have a chance for publication — this is the **time for work and analysis!** The feedback may initially seem harsh, however, do not get depressed. Be analytical and start working. It may be sensible to ask colleagues to join analysing the critique. You may be closer to acceptance than you first think. If you have chosen the right journal, you have good chances for publication, once you take the effort and react to the given feedback.

It is important to carefully analyse what the feedback really means. Any requirements that initially seem extensive may in practice require relatively small changes to the article. Often you only need to adjust the way the “story” is told.

Do react swiftly to the given feedback and acknowledge all the criticism. Should you wish not to change something, regardless of the critique, do justify this decision in the covering notes. Do provide a *point-to-point response* acknowledging all the reviewers' comments indicating all the changes to the article, and justify if you did not change something. The purpose of the point-to-point response is to avoid the reviewers being forced to read the entire article again when checking your changes. Even though reviewers' comments may be provided as 1-2 pages of A4 text, try to see what the issues they criticise are and separate them by using numbering or some other means. Also, if there are more than one reviewer, separate their comments. This will make it easier to manage your own responses. Look at the example below where a few examples are given on how to address

the reviewer's comments. Please note that the "point-to-point response" below is not from a single review, but is a collection from different types of articles.

1. Description of research process criticised:

A descriptive paragraph has been added to the research process section (3.1) to clarify how the research was conducted. Also, a new figure (Figure 3) has been included.

2. Page 6, line 126: which amount of adsorbent did you actually use? It is very important.

The amount of adsorbent used in the isotherm experiments varied from 25 mg/l to 100 mg/l. The text has been modified to better highlight this (p.7, line 137).

3. Better description of the interviewed companies

A minor revision has been made in Chapter 3 to better describe the interviewed companies. However, as the studied companies unfortunately wish to maintain a level of secrecy for business reasons, we have not been able to obtain the permission to reveal their real identities.

4. There are different mistakes during the presentation of equation formulae or data. For instance, CO₂ Nm³ or in paragraph 2.7 "100 00"....

In paragraph 4.1 Results of the comparison for steam energy for figure 3, a line is used for NG, whereas for Figure 4 and Figure 5 a different one is used. It would be important to have homogeneity in the presentation in order to avoid confusion.

The above described mistakes have been rectified:

- CO₂ has been changed to CO₂ throughout the article
- 100 00 has been corrected to 100 000, see chapter 2.1.2 of the revised version
- NG lines have been homogenized in Figures 2, 3 and 4

5. It would be better if the paper described the world-wide market of formic acid and its main use. It is not necessary to add a paragraph but a short description.

A new description has been added in section 2.1 to better describe the world-wide market of formic acid and its main uses.

6. It would be better to separate the discussion from the conclusion.

A new Conclusions section has been included into the article

7. The figures should be homogeneous concerning the style, otherwise the reader may get confused.

The figures have been corrected.

8. Sometimes it is confusing/unclear how the author(s) have chosen the wording of different concepts/terms. For example, the distinction in "tactic" and "strategic" seems a little fuzzy to me.

The terms "tactical" and "strategic" have been replaced by "non-adaptive" and "adaptive" respectively. The terms used are explained in Table 1.

9. Figure 3. The label does not indicate to which commercial antibody each set of data corresponds.

We have now included the information in the caption to the Figure to indicate the correspondence. In addition, the manufacturers are listed in the Methods part.

10. The criticised statement in section 4 "it is logical..."

The criticised statement has been revised.

11. Comma missing in reference Anderson 2004 on page 4

A comma has been added to the reference (Anderson, 2004).

LANGUAGE ISSUES IN WRITING A SCIENTIFIC JOURNAL ARTICLE

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“Communication lies at the heart of research. It is as vital for research as the actual investigation itself, for research cannot properly claim that name until it has been scrutinized and accepted by colleagues.” (Meadows, 1998)

Introduction

While getting your article published may be your primary aim, there are other aspects of writing a scientific paper to keep in mind. Writing a scientific paper is an act of participation in a research community. This means that you are presenting your own contribution to science for the scrutiny of your colleagues, using the medium of language to try to convince them of the significance of your work and expecting your fellow researchers to respond.

In this chapter, we shall point out that different research paradigms may require different approaches to writing a paper, discuss the role of genre knowledge as a persuasive device and outline the language skills that writers need. We also give advice about the actual process of writing and mention some readily available tools which can help you to polish your text.

Effect of research approach on writing

Research approaches and the practices of communication may differ from one discipline to another. The main divide between the so-called hard and soft sciences can best be seen in the differences of research approaches and subsequently in the conventions of scientific and academic writing. (Creswell, 2003.) In the hard sciences, the quantitative approach, based on verifiable data and objectivity, seems to be more frequently used. In contrast, certain soft sciences take a qualitative approach, which allows subjective interpretation with supporting argumentation (Bazerman, 1981). In between these polarities, social sciences have developed a special mix of the above two approaches. All these types of scientific enquiry have produced their own varieties of research articles with distinctive language features, differing from other kinds to a certain extent.

When you have chosen the appropriate research approach, you should be aware of its implications for the typical organisation and content structure of your text. In addition, you need to bear in mind that the research approach may also determine linguistic choices related to the degree of formality, active or passive verbs, and the use of various rhetorical devices (metaphor, rhetorical questions and paraphrase).

Journal articles as persuasive narratives

When you set out to write an article on your study or experiment, two distinct purposes should guide your effort. First, you need to reconstruct the study procedure to tell the readers the story of your research. However, you must also aim to convince the readers of your knowledge and skills as a researcher, of the soundness of the research procedure, and of the validity of the findings. This means that a research report can be defined in text-linguistic terms as **a persuasive narrative**. This narrative makes use of a kit of conventionalised means of persuasion.

Genre knowledge to enhance persuasion: structure and language choices

To master the above two skills of narration and persuasion in the context of research reporting, you need to be aware of the distinctive features of research articles, in general, and of the specific research-reporting conventions of your discipline, in particular. This is known as genre knowledge, which implies a familiarity with the widely accepted characteristics of the content, structure and style of a text from a particular genre.

As a researcher, you can gain credibility by following the genre rules of written communication in your discipline. The basics of such genre knowledge related to research reporting include the following:

- organising the contents of your article into sections using the IMRaD pattern or its disciplinary variant (N.B. the IMRaD structure, while widely accepted as a model, certainly has a variety of modified forms in different fields and disciplines),
- keeping to the conventional information content and sequence of the individual sections (e.g. the *Introduction* presents the i) background of the study, ii) references to previous literature, iii) relevance of the study, iv) research question or purpose of the study),
- discipline-specific use of titles (complete sentences, noun phrases or compound titles)
- discipline-specific use of references (types of in-text referencing and list of references),
- the types of illustrative devices (tables, graphs, figures) used, and how these are integrated into the body of the text [*Figure 3 below indicates some interesting divergence from the previous experiment...*],
- the style of language used in research articles
 - formal written language
 - discipline-specific terminology
 - general scientific idiom: appropriate word choices, word forms and combinations [*get results ==> obtain results; do a test ==> carry out a test; the variables are, for example, ==> the variables include...*] (see <http://sana.tkk.fi/awe/style/vocabulary/index.html>)
 - grammatical choices typical for the type of article you are writing, including use of articles, typical usage of verb tenses in different sections of the article, preference for active or passive voice,
 - use of punctuation, capitals, abbreviations, etc.

The best way of exploring the disciplinary conventions of your field is perhaps to analyse articles in your field, paying particular attention to the above features and to familiarise yourself with the requirements and instructions for publication in target journals (see section on '*Target Journal*' on page 9).

Genre knowledge to enhance persuasion: content and arguing your position

Genre knowledge also involves understanding that the persuasive effect of your text arises from such content-related conventions in the various sections of a journal article as

- reviewing the relevant literature in the Introduction and thereby demonstrating your thorough knowledge of the field (Törrönen, 2007),
- supporting your claims and quotations by references to previous literature throughout the article (Hyland, 2004),
- presenting the research procedure in the Methods section in a transparent way, which allows replicability,
- referring to the very experiment, test or analysis that produced your finding in the discussion of that finding; this in fact provides evidence for your claim [*“Our results show that...”*],
- comparing current findings with the findings of other similar studies in the Discussion [*“These findings were also corroborated by Andersen (2009), who...”*],
- arguing for and explaining your own claims in the Discussion in order to anticipate possible criticism [*“Although our findings differ to some extent from those in the studies mentioned above, they can be explained by...”*],
- using appropriately hedged language to avoid later criticism or to signal caution (often called *downtoning*), or to stress the significance of your study or findings (often called *boosting*) throughout the text [*“the findings suggest”* instead of *“the findings demonstrate”*; or the other way round for boosting].

These devices help you win credibility as a researcher and can be used for strategic effect.

Cultural differences in scientific writing

Some differences have been observed in the writing in English of Finnish and native-speaker writers. One difference has been noted in the use of phrases which help guide the reader through the article and make the text easier to follow (Mauranen, 1993a, 1993b). The possibly more frequent use of such phrases in English texts reflects what is referred to as “writer-responsible orientation” (Hinds, 1987), where the writer leads the reader explicitly through the text, as opposed to a “reader-responsible orientation”, where the writer relies on the reader’s ability to make sense of the message. Anglo-American readers tend to expect that writers take responsibility for making their message clear to readers, guiding them to notice what the writer deems to be important and convincing the readers to accept the writer’s claims. These phrases may take the form, for example, of

- previews of what is to follow later in a text,
- explanations of what topics the text will **not** cover,
- summaries of significant topics that have already been discussed,
- signals of the writer’s commitment or caution towards a claim
- explicit instructions about where readers can find illustrations or data presented in tables or figures.

The use of such devices, however, varies from one discipline to another and from one part of a journal article to another.

Another area of difference can be noted in the approach to argumentation. For example, it has been observed that, when reporting the main results of a study, Anglo-American writers have a tendency to **begin** with the results, followed by supporting explanation.

Finnish writers, however, tend to prefer an “end-weight” strategy, presenting the results as a **conclusion** to an argument. (Mauranen, 1993a.)

Necessary skills for constructing a text

You also need to know how to construct logical, smoothly flowing text that both keeps the current topic in the spotlight and allows the text to develop from one aspect of the topic to another. This means placing familiar content before new information in a sentence, constructing paragraphs with a clear focus on one main idea (most commonly an overview followed by further details) and using various typical patterns of paragraph organisation which are suitable for your purpose.

However, to introduce new topics as the “story” unfolds, you must also apply a good knowledge of “signposts”, phrases that indicate how ideas are connected within a sentence or from one sentence to another. These devices make the article easier to read as they signal cause-effect relationships, contrasts or similarities, or the existence of additional evidence to support scientific claims (for example, *moreover, in addition, however, nevertheless, consequently*) (for more examples see also <http://sana.tkk.fi/awe/cohesion/signposts/index.html>). In addition, you should know that English prefers the “action” to occur close to the start of a sentence. This means that you must be able to manipulate long, complex concepts into a position after the verb, thus making the sentence easier to process (Compare “*In this paper, the advantages and limitations of each of the above-mentioned techniques for chemical sensing is discussed.*” with “*This paper discusses the advantages and limitations of each of the above-mentioned techniques for chemical sensing.*”).

The process of writing

Creating a text involves the scrutinising and summarising of knowledge, but also includes the actual process of writing. Even among experienced writers, few are able to produce a final version of a text in the first draft. Writers can certainly benefit from experience, but there is a danger that habitualisation can result in an over-reliance on tired formulae. While writing requires know-how and knowledge of language and genre conventions, the act of writing is also creative cognitive activity. (Hyvärinen, 2007; Väliverronen, 2007; Hirsjärvi, et al., 2000; Flower & Hayes, 1981.)

There are many ways of stimulating the act of writing and getting the process started. One such tried and trusted method is to chart your thoughts on a mind map. With the help of a mind map, you can organise (construct) the knowledge you possess. In this way, you can create for yourself a representation of your own thoughts and the relationships between them before you start to write. Used well, a mind map can clarify the boundary between essential and non-essential knowledge. Mind maps are particularly helpful for writing which is goal-oriented and situated in a specific context, a characteristic of the writing of scientific journal articles. (Grabe & Kaplan, 1996; Kristiansen, 2004.). There are several free mindmapping tools available online (for example, FreeMind, CmapTools and XMind).

The larger and more complex your research study, the greater the challenge of reporting your reading and communicating new knowledge. In this, we can make a distinction between the **reiteration** and the **reworking** of knowledge. The reiteration of knowledge is the reporting of knowledge published by other authors in your own articles, in order, for example, to provide a theoretical frame of reference for your research. The reworking of knowledge is essentially connected to the shaping of new knowledge from your own

research. Through references to the literature, scientific text is characterised by intertextuality, which can be described as a discussion between texts. These dialogues stimulate your thinking, help you to develop your stance and formulate your own unique contribution to the discipline. (Luukka, 2007; Kniivilä, Lindblom-Ylänne & Mäntynen, 2007.)

Scientific articles are limited to a certain length, which means that you are faced with a concrete challenge of meeting this limitation. You have to be able to recognise the essential aspects of a study and publicise these in accordance with the conventions of the discipline and the journal in question. The main focus of scientific text can be considered to be new knowledge (research findings) rather than reiterated knowledge (received knowledge). To separate essential from non-essential knowledge, you may need to be aware of when you are writing for yourself and when you are writing for others. While writing for yourself is informal, even creative, activity, writing for others relies on the communication of knowledge using formal conventions. (Väliverroinen, 2007.) These two dimensions are a fundamental part of the process of writing scientific articles. You can lessen the anguish of creation by permitting yourself to write for yourself. In the process of writing, the creation and revision of text go hand in hand, in parallel with writing for oneself and writing for others.

An indispensable part of the writing process is the procurement of feedback. Ideally, a draft should be read by several readers so that the feedback includes a variety of perspectives. It is important that you also request positive and supportive feedback. As the feedback is received, the revision continues and lasts until the publication of the text.

Tools for writing

The University Library provides a wealth of resources in the form of books and electronic databases, such as guides for scientific writing in different disciplines, dictionaries, style guides (for example, APA, PMLA, Harvard). The staff are willing to help you find specific resources to meet your needs and provide training in, for example, the use of databases and programs such as RefWorks, a tool for online research management. In addition, through the Internet you now have access to a wide range of means of support for scientific writing. It can be helpful to study the genre conventions of your own discipline by building up small corpora of articles from your own field (Paltridge, 2001; Lee & Swales, 2006). This is now easy to achieve as a result of the availability of electronic versions of scientific journals, from which articles can be downloaded and electronically searched for particular phenomena or uses of language. To do this efficiently, you can make use of a readily available and reasonably priced concordancing program (for example, WordSmith Tools). With such a program, you can quickly examine your own selected corpus articles for such language features as likely vocabulary combinations (collocations) or broader contexts in which certain words are likely to occur. The free online web site, Just the Word, can also assist you in finding a word appropriate for a particular context. Numerous other tools exist online, and a select few of these are described below:

- Thesaurus.com: This free tool suggests synonyms for search items.
- Visual Thesaurus: This reasonably priced tool maps out relationships between words in a visual mind map.
- Word Neighbors: This free online resource provides examples of how words are used in context.
- Grammarly: This reasonably priced tool checks the grammar of a text and provides explanations, as well as detecting text taken from other sources and suggesting appropriate word choices.

- Academic Writing in English: These resources comprise online handouts and interactive exercises specifically designed for writers of academic and scientific texts.
- Multimedia dictionaries, such as the Longman Dictionary of Contemporary English with DVD-Rom.
- Roget's Thesaurus: The paper version of the thesaurus may still be even more useful than online tools for finding synonyms and antonyms, and clarifying shades of meaning.
- Google / Google scholar: These sites can help you search for discipline-specific phrases and words, such as nouns and verbs, which tend to occur together. However, you must always be aware that these Internet sources may not always be the most reliable of models.

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