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WRITING A SCIENTIFIC ARTICLE

2009

1. Texts
2. Checklists
3. Theory
4. Exercises
5. Notes

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Checklist Academic Writing 1/2

When revising and editing your research article, ask yourself whether you have delivered the message clearly and whether you have used the appropriate language. The checklist below provides you with topics you should consider when revising and editing your text.

DELIVERING THE MESSAGE	TOPICS	Syllabus	<input checked="" type="checkbox"/> / <input type="checkbox"/>
Structure and Coherence: text level	<ul style="list-style-type: none"> • Journal requirements • IMRAD structure • Abstract • End notes/references 	Ch. 1: 1.2 Ch. 2: 2.2 Ch. 5: 5.2	
Structure and Coherence: paragraph level	<ul style="list-style-type: none"> • Topic/elaborating/concluding sentences • Linking words and phrases • Grammatical parallelism • Repetition of key words 	Ch. 3: 3.1 Ch. 3: 3.2 Ch. 3: 3.2 Ch. 3: 3.2	
Presentation of Arguments	<ul style="list-style-type: none"> • Argumentation patterns • Logical fallacies • Effective use of evidence: referring and quoting 	Ch. 3: 3.5 Ch. 3: 3.5 Ch. 3: 3.5 & Ch. 5: 5.2, 5.3	
Tentativeness	<ul style="list-style-type: none"> • Hedging and modality 	Ch. 3: 3.3	
Style sheet	<ul style="list-style-type: none"> • APA/AMA/MLA/journal style sheet used consistently 		

General remarks:

Checklist Academic Writing 2/2

LANGUAGE		Syllabus	<input checked="" type="checkbox"/> / <input type="checkbox"/>
Academic Register	<ul style="list-style-type: none"> • (Formal) academic style • Appropriate vocabulary / jargon • Presentatives / (It-/pseudo-) clefts 	Ch. 4 (4.2.5)	
Vocabulary	<ul style="list-style-type: none"> • Fixed word combinations (e.g. to resolve the difficulty) • Phrasal verbs (e.g. to rule out, put forward) • Wordiness avoided 		
Grammar	<ul style="list-style-type: none"> • Word order • Tenses • Adjectives and adverbs • Prepositions • Relative clauses: correct distinction between restrictive and non-restrictive clauses • Passives • Articles (the, a, an) • Subject-verb agreement • Inversion • Absence of frontally overloaded sentences • Absence of dangling modifiers • If/when 	Ch 4 (4.1 & 4.2)	
Sentence structure	<ul style="list-style-type: none"> • Simple/complex – effective mixture • Choppy style • Techniques of clause combining • Techniques of giving prominence to sentence elements (end-focus & end-weight, object-adverb switching, presentatives, clefts) • Appropriate use of linking words and phrases 	Ch 4 (4.2) Ch 4 (4.2) Ch 4 (4.2) Ch 4 (4.2) Ch 4 (4.2)	
Punctuation	<ul style="list-style-type: none"> • MLA/APA/Chicago/other style sheets, consistency 	Ch. 4 (4.3)	
Spelling	<ul style="list-style-type: none"> • Consistency, BrE / AmE 	Ch. 4 (4.4)	

General remarks:

Checklist for writing a scientific article

Below you find the most important aspects that play a role in writing a good scientific article.
Use the checklist to assist in constructing and revising your scientific article.

A. Audience, purpose, tone, research question, outline

- I have carefully considered my audience: I know who they are, what their needs and expectations are
- I have clearly stated the purpose of the text
- The tone is consistent with my purpose
- My research question is clearly and specifically worded
- The research question predicts the article's direction, emphasis and scope
- I have made a clear outline of the structure of my research paper
- I have logically structured my outline; that is, I have presented my ideas into a logical sequence
- My outline is sufficiently detailed
 - I have structured the introduction and conclusion
 - I have drafted paragraph themes
 - I have generated content for the different sections and paragraphs

B. Text structure

Title

- My title is comprehensible for readers outside my field
- My title is clear, meaningful and brief
- I have not included specialist abbreviations which can be left out
- The title reflects the contents of the article
- I have avoided a full sentence in the title
- I have punctuated the title correctly
- I capitalised the principal words, but not the articles, prepositions and conjunctions

Abstract

- I have not exceeded the maximum number of words (often 250 words, but check journal requirements)
- My abstract is clear and complete: it provides background information, states the objectives, explains the methods, presents the results, and draws conclusions
- The abstract is sufficiently informative, yet concise
- I have avoided abbreviations, trade names, acronyms and symbols in my abstract which can be left out
- The abstract consists of a single paragraph
- I have included a list of keywords (*optional*)

Introduction

- I have outlined the problem and why it is worth tackling
- I have reviewed the literature, recording briefly the main contributors and summarising the status of the field when I started my research
- I have clearly stated what I will do that has not been done before (new experimental approach / new data / new model / new interpretation)
- I have announced my main purpose
- I have announced my research question in clear and concise words
- Hypotheses are explicitly stated
- I have given an outline of the structure of my research paper
- I have started the Introduction with a good first sentence (e.g. a new fact, new idea or a revealing comparison)

Body

- It is possible for a reader to scan the text and glean enough logical information from the headings and subheadings of the body to understand, albeit it in a superficial way, what the body is all about

Methods

- I have told my readers in detail what I did to answer my research question
- I have clearly specified all the relevant materials and/or data from other sources I used
- I have clearly specified the actions I carried out (usually in chronological order)
- I have clearly specified how I analysed the data to obtain results (experimental design, variables, statistical treatment)
- I have used subheadings to help organise the Methods section
- The experimental design has been sufficiently described so that the study can be evaluated and replicated

Results

- I have clearly presented the findings/results without opinion or interpretation
- I have integrated tables and figures clearly and at relevant points in my text
- I have numbered all tables and figures

Discussion

- The Discussion section answers my research question and shows how my results support that answer
- I have presented the most significant conclusions first and developed subsidiary conclusions after that
- All key results are interpreted and discussed in light of whether they did or did not support the hypotheses
- Key results are compared and contrasted with results from other studies
- I have carefully and clearly worded the interpretation of the findings
- I have discussed the limitations and implications of my methods and findings
- I have indicated what further research would be necessary to answer the questions raised by my research

Conclusion

- The conclusion restates the focus of my research with reference to the formulation I gave in the Introduction
- The conclusion explains (with reasons) the extent to which my original research question has been answered
- The conclusion states the implications of my results for specific issues or the discipline as a whole
- The conclusion follows logically from the analysis and discussion in the paper
- The conclusion makes suggestions for further research or action

Whole composition

- The reader gets a clear understanding of what I wish to convey
- Clear transitions between paragraphs and sections allow my readers to follow the composition's structure
- The headings of the sections and sub-sections are clear and well chosen
- I have not included irrelevant details
- I have not included unnecessary repetitions

- The introductory paragraph of each section arouses the reader's interest and prepares the reader for what is to come
 - The concluding paragraph of each section sums up the main points of that section
 - The paragraphs are of roughly equal length and weight
 - There is a logical presentation and progression of information/ideas, and so paragraphs and/or sections do not need re-ordering
 - I have created a reader-friendly text
- B. Paragraph structure and coherence**
- Each paragraph contains only one main point which is a clearly identifiable and unambiguous topic sentence
 - Each paragraph develops one central idea that supports the research question (All topic sentences are logically related to my research question)
 - Each paragraph contains sufficient discussion (and illustration)
 - Argumentation contains no contradictions or logical falacies
 - Supporting ideas are fully developed
 - Sentences within paragraphs are logically linked with transitions
 - There are adequate transitions between paragraphs
 - I have used a variety of techniques to write coherent paragraphs
 - I have avoided one-sentence paragraphs
- C. Sentence style**
- I have used correct sentence structure
 - I have varied sentence structure
 - I have avoided overloading sentences with too many clauses
 - I have used emphatic word order
 - I have adopted an active style, using passives only when they serve a particular purpose
 - I have reformulated sentences that were difficult to process and comprehend
 - I have avoided wordiness: I have replaced wordy and woolly constructions by clear, forceful and shorter constructions
 - I have avoided orders and exclamations
 - I have applied the principles of end focus and end weight
- D. Word choice**
- I have chosen words that are specific, concrete and unambiguous
 - I have avoided weak qualifiers (e.g. 'very', 'rather', 'somewhat', 'quite')
 - I have replaced wordy expressions by more concise expressions (e.g. 'if' instead of 'if it should happen that')
 - I have varied my vocabulary
 - I have used fixed word combinations and phrasal verbs common in academic English
 - I have eliminated nonessential words and needless repetitions
 - I have used a variety of words and phrases ('hedges') to express possibility and tentativeness
- E. Grammar, punctuation and spelling**
- I have used the correct tenses for the various sections
 - Pronoun references are clear and unambiguous
 - Adjectives and adverbs are used correctly
 - Subjects and verbs agree
 - I have avoided dangling modifiers
 - I have avoided frontally overloaded sentences
 - My sentences are grammatically correct
 - I have used the correct prepositions
 - I have avoided contractions (e.g. 'isn't', 'don't', 'we'd')
 - All punctuation marks are used correctly

- All words are spelled correctly
- I have consistently used British English or American English spelling
- I have used the correct article (a/an/the/no article) for each noun
- Numerals and spelled-out numbers are used appropriately

F. Source reference

- I have acknowledged all sources and given clear bibliographical details
- My summaries accurately reflect the source: I have not included any of my own ideas or opinion.
- My paraphrases are really my own words and style of writing
- I have only quoted when something vital would be lost otherwise
- There is a clear distinction between my ideas and words and those of the authors I've read and cited
- I have used APA/AMA/MLA/journal style sheet consistently

- The introductory paragraph of each section arouses the reader's interest and prepares the reader for what is to come
- The concluding paragraph of each section sums up the main points of that section
- The paragraphs are of roughly equal length and weight
- There is a logical presentation and progression of information/ideas, and so paragraphs and/or sections do not need re-ordering
- I have created a reader-friendly text

B. Paragraph structure and coherence

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- My sentences are grammatically correct
- I have used the correct prepositions
- I have avoided contractions (e.g. 'isn't', 'don't', 'we'd')
- All punctuation marks are used correctly

Peer-feedback checklist

Below you find the most important aspects that play a role in writing a good scientific article.
Use the checklist to assist your colleague in revising (parts of) his/her scientific article.

A. Audience, purpose, tone, research question

- The audience has been considered carefully: their needs and expectations have been met
- The purpose of the text has been clearly stated
- The tone is consistent with the purpose of the text
- The research question has been clearly and specifically worded
- The research question predicts the article's direction, emphasis and scope

B. Text structure

Title

- The title is comprehensible for readers outside the field
- The title is clear, meaningful and brief
- No specialist abbreviations have been included which could have been left out
- The title reflects the contents of the article
- The title is not a full sentence
- The title has been punctuated correctly
- The principal words have been capitalised, but not the articles, prepositions and conjunctions

Abstract

- The maximum number of words has not been exceeded (often 250 words, but check journal requirements)
- The abstract is clear and complete: it provides background information, states the objectives, explains the methods, presents the results, and draws conclusions
- The abstract is sufficiently informative, yet concise
- The abstract does not contain abbreviations, trade names, acronyms and symbols which could have been left out
- The abstract consists of a single paragraph
- A list of keywords has been included (*optional*)

Introduction

- The problem and why it is worth tackling has been outlined
- The literature has been reviewed clearly and concisely (i.e. the author has briefly recorded the main contributors and summarised the status of the field when he/she started his/her research)
- It has been clearly stated what the author will do that has not been done before (new experimental approach / new data / new model / new interpretation)
- The main purpose has been announced
- The research question has been announced in clear and concise words
- Hypotheses are explicitly stated
- An outline of the structure of the research paper has been given
- The Introduction starts with a good first sentence (e.g. a new fact, new idea or a revealing comparison)

Body

- It is possible for a reader to scan the text and glean enough logical information from the headings and subheadings of the body to understand, albeit it in a superficial way, what the body is all about

Methods

- The readers have been told in detail what the author has done to answer his/her research question
- The author has clearly specified all the relevant materials and/or data from other sources he/she used
- The author has clearly specified the actions he/she carried out (usually in chronological order)
- The author has clearly specified how he/she analysed the data to obtain results (experimental design, variables, statistical treatment)
- The author has used subheadings to help organise the Methods section
- The experimental design has been sufficiently described so that the study can be evaluated and replicated

Results

- The findings/results have been clearly presented without opinion or interpretation
- Tables and figures have been integrated clearly and at relevant points in the text
- All tables and figures have been numbered

Discussion

- The Discussion section answers the research question(s) and shows how the results support that answer
- The most significant conclusions have been presented first and subsidiary conclusions have been developed after that
- All key results are interpreted and discussed in light of whether they did or did not support the hypotheses
- Key results are compared and contrasted with results from other studies
- The interpretation of the findings has been carefully and clearly worded
- The limitations and implications of the methods and findings have been discussed
- It has been indicated what further research will be necessary to answer the questions raised by the study

Conclusion

- The conclusion restates the focus of the study with reference to the formulation the author gave in the Introduction
- The conclusion explains (with reasons) the extent to which the original research question has been answered
- The conclusion states the implications of the results for specific issues or the discipline as a whole
- The conclusion follows logically from the analysis and discussion in the paper
- The conclusion makes suggestions for further research or action

Whole composition

- The reader gets a clear understanding of what the author wish to convey
- Clear transitions between paragraphs and sections allow the readers to follow the composition's structure

- The headings of the sections and sub-sections are clear and well chosen
 - The text does not contain irrelevant details
 - The text does not contain unnecessary repetitions
 - The introductory paragraph of each section arouses the reader's interest and prepares the reader for what is to come
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 - There is a logical presentation and progression of information/ideas, and so paragraphs and/or sections do not need re-ordering
 - The author has created a reader-friendly text
- C. Paragraph structure and coherence**
- Each paragraph contains only one main point which is a clearly identifiable and unambiguous topic sentence
 - Each paragraph develops one central idea that supports the research question (All topic sentences are logically related to the research question)
 - Each paragraph contains sufficient discussion (and illustration)
 - Argumentation contains no contradictions or logical falacies
 - Supporting ideas are fully developed
 - Sentences within paragraphs are logically linked with transitions
 - There are adequate transitions between paragraphs
 - Several techniques been used to write coherent paragraphs (for instance, the use of linking words and phrases and the repetitions of key words)
 - There are no one-sentence paragraphs
- D. Sentence style**
- Correct sentence structure has been used
 - Sentence structure has been varied
 - Sentences have not been overloaded with too many clauses
 - The author has used emphatic word order
 - An active style has been adopted: passives have only been used when they serve a particular purpose
 - The text does not contain sentences that are difficult to process and comprehend
 - There are no wordy and woolly constructions (instead, sentences are clear, concise and forceful)
 - Orders and exclamations have been avoided
 - The principles of end focus and end weight have been applied
- E. Word choice**
- The words in the text are specific, concrete and unambiguous
 - There are no weak qualifiers (e.g. 'very', 'rather', 'somewhat', 'quite')
 - There are no wordy expressions (e.g. 'if' instead of 'if it should happen that')
 - The vocabulary is varied
 - Fixed word combinations and phrasal verbs common in academic English have been used
 - The text does not contain nonessential words and needless repetitions
 - A variety of words and phrases ('hedges') have been used to express possibility and tentativeness
- F. Grammar, punctuation and spelling**
- The correct tenses for the various sections have been used
 - Pronoun references are clear and unambiguous
 - Adjectives and adverbs are used correctly
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 - All sentences are grammatically correct
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 - All punctuation marks are used correctly
 - All words are spelled correctly
 - British English or American English spelling has been used consistently
 - Articles (a, an, the) have been used correctly
 - Numerals and spelled-out numbers are used appropriately
- G. *Source reference*
- All sources have been acknowledged and clear bibliographical details have been given
 - The author has only quoted when something vital would be lost otherwise
 - There is a clear distinction between the author's ideas and words and those of the authors that have been cited
 - The APA/AMA/MLA/journal style sheet has been applied consistently

General remarks:

- The headings of the sections and sub-sections are clear and well chosen
- The text does not contain irrelevant details
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- Fixed word combinations and phrasal verbs common in academic English have been used
- The text does not contain nonessential words and needless repetitions
- A variety of words and phrases ('hedges') have been used to express possibility and tentativeness

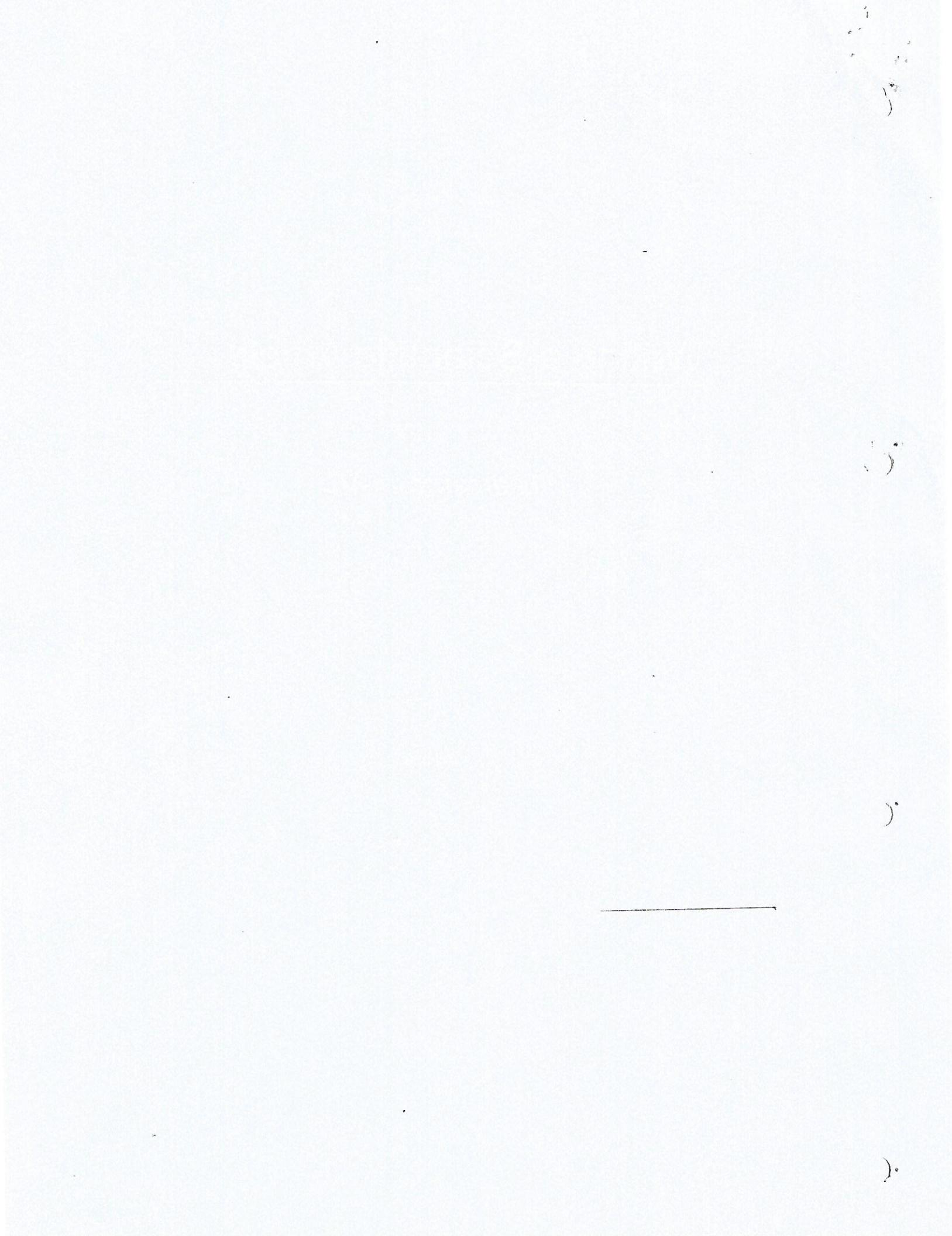
F. Grammar, punctuation and spelling

- The correct tenses for the various sections have been used
- Pronoun references are clear and unambiguous
- Adjectives and adverbs are used correctly
- Subjects and verbs agree
- All sentences are grammatically correct
- There are no dangling modifiers

Writing a Scientific Article

Taalcentrum-VU

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Writing a Scientific Article: contents

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1 Get started

1.1 Research question, hypothesis and audience

Writing can be seen as a problem-solving process. After the initial research and planning activities, you have to think the subject matter through till you know the rough outline of your message. You need not bother about the detailed formulation of the text at this stage. That will come later, after you have identified the intended reader.

We will assume for the moment that you want to write a research paper rather than, for example, a review of the literature. The structure of this paper will reflect that of the actual research, which should follow a systematic approach that can be divided into four stages. First, you ask a clear and straightforward question, your research question. Then you use that question as a basis for formulation of your hypothesis. Thirdly, you test your hypothesis with the aid of an experiment. And finally, you draw conclusions about the hypothesis on the basis of the results of the experiment.

Let us consider the first two stages. A **research question** typically begins with *why, who, where, when, how or what*. It links the experiment with the initial objectives of the research.

RESEARCH QUESTION

Why do plants change colour in the autumn?

<http://biology.plosjournals.org/perlerv/?request=getdocument&doi=10.1371/journal.pbio.0050187>

The best way to start formulating your **research question** is by asking yourself:

- What have other people written about the subject?
- What are the gaps in current research?
- Are there any contradictions in what researchers have said about the subject?
- What is the benefit of answering your research question?

Chapter 1 - Get started

- Who will benefit from this answer?

The answers to all these questions will provide a starting point for careful formulation of a focused **research question**, which will lead directly to your **hypothesis**.

A **hypothesis** is what we might call “an educated guess”. It is a specific, yet tentative, prediction of exactly what you expect to happen in your experiment. A **hypothesis** says something about the relationship between two factors or variables.

HYPOTHESIS

Olfactory cues may play an important role in coordinating foraging activity in honeybees.

FACTOR 1

Olfactory cues

FACTOR 2

Coordinating foraging activity

<http://biology.plosjournals.org/perlServ/?request=getDocument&doi=10.1371/journal.pbio.0050249.90>

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You have to make sure that your hypothesis is formulated in such a way that its validity can be tested in an experiment. For a statement to become a scientific **hypothesis**, it must meet two very important requirements:

1. It must be testable

When you carry out scientific research, basically what you do is test the relationship between two variables. The difference between a speculation and a **hypothesis** is that a **hypothesis** is testable by conducting scientific research. If it is not possible for a scientist to prove or disprove a statement, it is not a **hypothesis**. In other words, a **hypothesis** predicts the outcome of an experiment.

2. It must be falsifiable

It is important to realize that the aim of scientific research is not to prove a **hypothesis** but simply to test it. For a **hypothesis** to be scientific it must be falsifiable, in other words it must be possible to prove it wrong. A good example of a non-falsifiable statement is: “green swans exist” (source: Wikipedia). The correctness of this statement can easily be proven by

producing a green swan. It is, however, impossible to prove that the statement is incorrect. Not being able to find a green swan does not mean it does not exist since there might be one hiding away in some unexplored lake.

Once research is under way, it is time to think about the writing task that is ahead and to ask yourself who will be most interested in your message or, put differently, who your audience will be. Writing can be such a solitary activity that it is easy to forget about your **audience**. However, it is important to think about your **audience** before you start writing since having a specific **audience** in mind will give your paper the necessary direction. Your intended **audience** may, for example, influence your choice of arguments, tone and style. You should thus always consider the following questions:

- Who will read your paper?
- What do they already know about the subject?
- Why would they want to read the paper?

1.2 Structure your thoughts and your text

In very general terms, research papers do not differ structurally from most other planned texts of an academic or other nature. They have a beginning, a middle and an end. In the first part, you tell the reader what you are going to say; in the body of the paper, you say it; and in the final part you sum up and consider the broader implications of your research.

In more specific terms, scientific research papers may be expected to follow a conventional format that includes a **title**, an **abstract**, a **reference section**, **appendices** and the components of the so-called **IMRAD-structure**, the dominant structure used for research articles across disciplines:

Chapter 1 - Get started

Introduction	answers <i>what</i> question/problem was studied and <i>why</i> : review of the literature, aim of the paper, research question, hypotheses
Methods	answers <i>how</i> the problem was studied (experimental design): materials, sample, procedure and analysis techniques (statistical treatment)
Results	answers <i>what</i> the findings were: presentation of tables, highlighting of significant features
And Discussion	answers <i>what</i> these findings mean: hypotheses confirmed or disproved, theoretical or practical implications of results, alternative interpretations, possible discussion of future research

The Discussion in the **IMRAD structure** often contains the conclusions, though these may also be given separately in the Conclusion section. To cover this eventuality, we deal with the Discussion and Conclusion separately in this course.

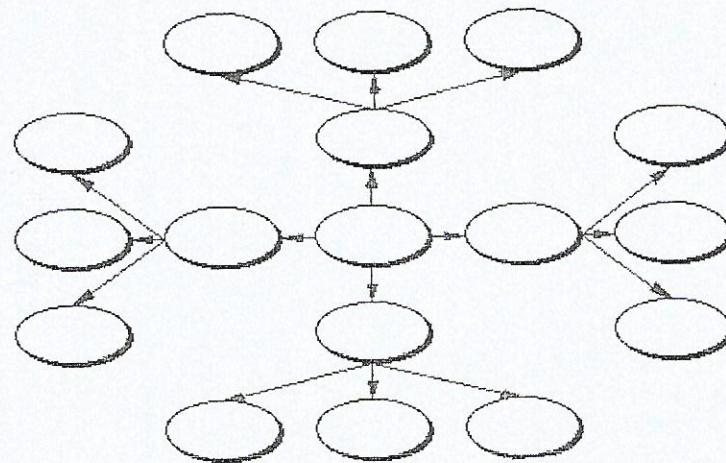
It is important at this early stage to make sure that the presentation of your paper complies with the house style of the journal where you hope to publish it; your research supervisors may also have very definite ideas about such matters as the layout of tables and the use of footnotes.

Drafting an **outline** will help you structure both your research paper and the underlying research itself. You can start preparing an outline while you are doing your research. Put down your first broad ideas. Use your main theme to hang your research on. The idea behind the outline will help you to shape your own ideas logically and to put them down on paper in a form that the reader can readily follow.

Think of a working title: This does not have to be your final title but it will give you a 'peg' on which to hang your article. Then write down the main ideas about your subject – e.g. by **brainstorming** and **clustering**.

Brainstorming: Write down everything that comes to mind about your subject. Don't consider whether your ideas are suitable or not at this stage. Evaluate what you have written, select the good ideas, and then set them down in a list.

Clustering: Write down the paper's main subject in the middle of the page and circle it. Think of ways of sub-dividing the subject, jot down these subtopics around the hub and circle them. Connect them with arrows. Write down other topics in the same way. Discuss your ideas with other people.



WRITING TIPS

Flower (1981) discusses four strategies you can apply to help you overcome the various problems you may experience in actually producing text. These are:

1. **Brainstorming:**
Write down ideas that come to mind and work on those, instead of trying to produce perfect sentences.
2. **Using the WIRMI technique:**
Make a concise statement of the point you are trying to make by saying to yourself 'What I Really Mean Is ...'
3. **Using notation techniques:**
Visualize your ideas by transforming them into drawings. Use arrows, boxes, tree structures etc.
4. **Accepting imperfect writing:**
Don't look for the best expression. Try again when you start revising.

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2 Write the article

2.1 Create a title

The title is the most important single phrase in your paper, so make sure it is effective. The function of your title is to:

- identify the field of study
- distinguish your paper from all others in the field.

WRITING TIP

It is important to realize that on average, the reader will only absorb three salient details from your title. So keep it as short and as simple as possible.

When considering the title for your paper, think about what the readers know and what they don't know. If readers don't understand the title, they may switch off and not read the rest of the document. The message here – and it applies equally to any other part of the document (or presentation) in question – is *keep it crisp or they won't listen*. Some academics hate the idea of a title followed by a subtitle, but this approach can be very effective: a short, snappy title can attract the reader's attention while a subtitle can add vital information. If you opt for this combination, you can use a colon to separate the two halves of the title:

Stratus Not Altocumulus: A New View of the Yeast Protein Interaction Network

<http://biology.plosjournals.org/perlServ/?request=getDocument&doi=10.1371/journal.pbio.0040317>

In short, your title should be specific to the project yet concise. It should also be comprehensible to readers outside your field and should therefore, if possible, not include specialist abbreviations. Titles often have to be presented in title case; that is, all words except prepositions, articles and conjunctions should be capitalized.

2.2 Write your abstract

All academic papers should begin with an abstract, which appears before the main body of the text. Abstracts are entered into databases and on search engines and must provide a concise summary of the objectives, methodology, key findings, and major conclusions of the study.

The object of an abstract is to provide a highly condensed version of your article, highlighting its major points only. It is thus essential that your abstract is concise and complete. You must first establish the topic of your research and state your research question. Then you briefly explain the methodology used, present the main results and finally give the main conclusions. In short, the abstract should address the following questions:

- why have you done what you are writing about? **BACKGROUND**
- what did you try to do? **OBJECTIVES**
- how did you go about doing it? **METHODS**
- what did you find? **RESULTS**
- what does this mean? **CONCLUSIONS**

Before you start writing the abstract you must first find out how long it should be. An abstract for publication in an academic journal should usually not exceed 250 words (check journal requirements). You must realize that the maximum word limit is not just a recommendation: the stated maximum number of words must never be exceeded. Abstracts that are too long are often rejected, since they do not meet the requirements of the database used to store them.

WRITING TIPS

Always take the following considerations into account when writing your abstract:

- The abstract is often read without the rest of the paper, so make it clear and make it complete.
- The abstract will be read together with the title, so don't repeat the wording of the title in the abstract.
- Try not to use the first person (I / we) in the abstract. (You should also consider carefully whether it is appropriate to use this style in the *body* of the paper).
- Do not use abbreviations, trade names, acronyms and symbols in your abstract.

Your abstract should be written in complete sentences, either with or without explicit subheadings (different journals have different conventions on this matter). And remember: the purpose of the abstract is not only to introduce your research question, but to summarize the whole of your research.

WRITING TIPS

- If you are unsure about what to put in your abstract and what to omit, you can delay writing it until you have finished the rest of the paper.
- The structure and the language you have chosen for your article will help you write a well-structured, concise and complete abstract.
- The abstract generally includes a list of keywords. Put in all the keywords applicable to your research you can think of, as this increases the chance that your paper will be picked up by computer search engines and cited).

2.3 Write your Introduction

A good, well-structured Introduction is indispensable to the success of your research paper. The Introduction is your chance of getting your reader interested in what you have to say. In most cases, busy researchers will only

Chapter 2 - Write the article

skim through the title, the abstract and the Introduction of a research paper: they will not read further unless your Introduction suggests that the rest of the paper contains something they need to know.

Introductions to academic articles are mostly written in a 'MOVE-Step' pattern. The model presented below is adapted from Swales (1990).

MOVE 1: Establish a territory

- Step 1 Claiming centrality and/or
- Step 2 Making topic generalizations and/or
- Step 3 Reviewing items of previous research

MOVE 2: Establish a niche

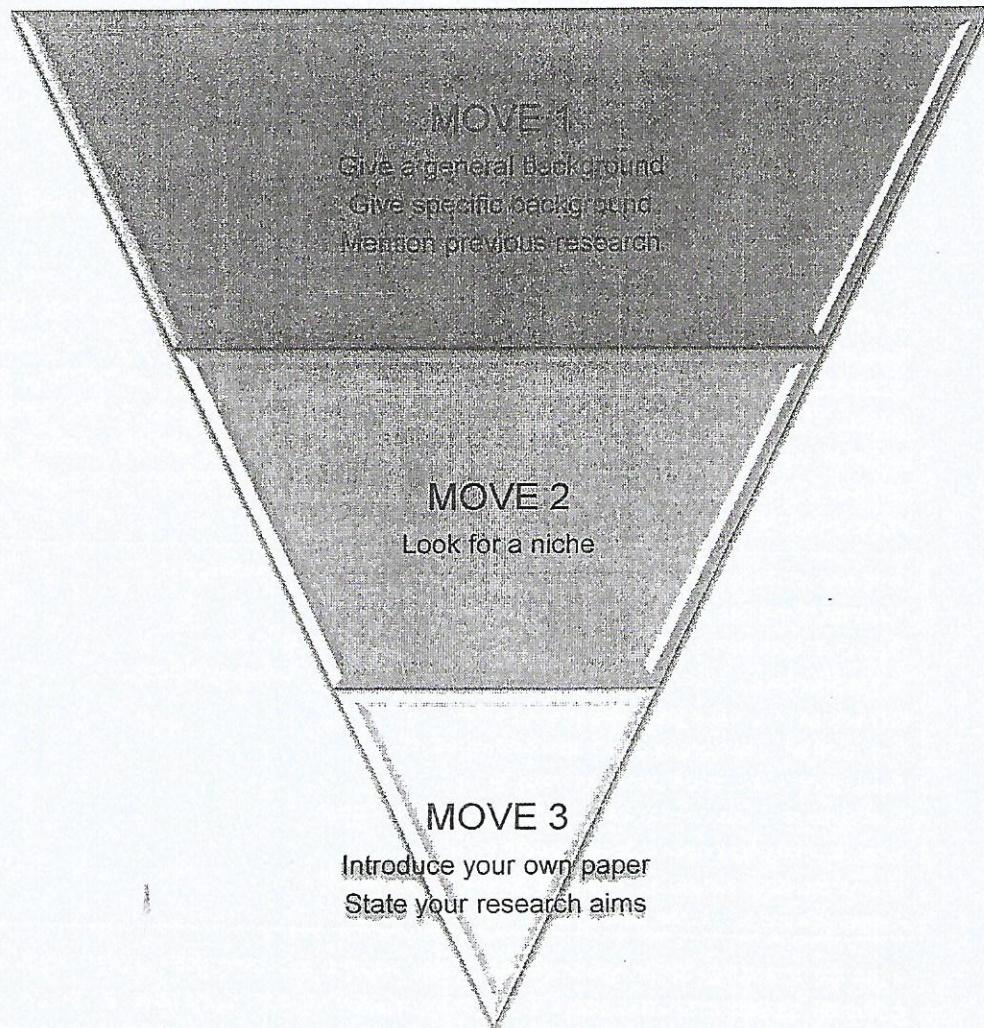
- Step 1a Counter-claiming or
- Step 1b Indicating a gap or
- Step 1c Question-raising or
- Step 1d Continuing a tradition

MOVE 3: Occupy the niche

- Step 1a Outlining purposes or
- Step 1b Announcing present research
- Step 2 Announcing main findings
- Step 3 Indicating structure of paper

The MOVE-Step model is well known in academic writing. It might look very complex and daunting, but it is essentially the same as the inverted pyramid pictured below. Both models are based on the same principles.

Introduction as Inverted Pyramid



2.3.1 Establish a territory

In the first part of your Introduction (MOVE 1) you need to give as much background information as the reader needs to place your argument, main issue, or problem, in a larger context. In this part you:

- state the area in which you are working,
- define key terms that you wish to use in your argument,
- persuade your reader that your research is fundamentally sound,
- can make topic generalisations: what is happening NOW in this field,
- can review previous research.

Centrality claims (Step 1) are appeals to the reader to accept that the research about to be reported is part of a lively, significant or well-established research area. These centrality claims may take a number of forms: you can focus on the interesting nature or importance of the issue addressed; you can point out that it is a long-established, widely studied or central topic of research; or you can mention that many other investigators are currently active in this field.

In recent years, applied researchers have become increasingly interested in ...

Recently, there has been wide interest in ...

The explication of the relationship between ... is a classic problem of ...

The well-known ... phenomena ... have been favourite topics for analysis both in...

Knowledge of ... has a great importance for ...

The study of ... has become an important aspect of ...

The theory that ... has led to the hope that ...

The effect of ... has been studied extensively in recent years.

Many investigators have recently turned to ...

The relationship between ... has been studied by many authors.

A central issue in ... is the validity of ...

Step 2, **making topic generalizations**, represents a more neutral kind of general statement than step 1. Topic generalizations can take a variety of forms. They can express in general terms the current state of the art or they can refer to certain key phenomena:

The aetiology and pathology of ... are well known.
There is now much evidence to support the hypothesis that ...
The ... properties of ... are still not completely understood.
A standard procedure for assessing ... has been ...
Education core courses are often criticized for ...
... is a common finding in patients with ...
An elaborate system of ... is found in the ...
English is rich in related words exhibiting 'stress shifts'.
There are many situations where ...

The third step in establishing a territory is the **review of one or more items of previous research** that are relevant to your study. By using reporting verbs such as *show*, *demonstrate*, *establish*, *propose*, *examine*, and *suggest*, you can tell the reader *what has been found* (or claimed) and *who has found it* (or claimed it).

2.3.2 Establish a niche

In the second part of the Introduction (MOVE 2), you indicate the presence of a niche or raise some questions about previous research by questioning or challenging existing claims to knowledge. You may imply, for example, 'these authors' experimental techniques were excellent, but their results raise some questions' or 'this investigation suffers from some limitations'.

For this purpose, you can use contrast words, such as '*however*', '*unfortunately*', '*nevertheless*', '*yet*', and '*but*'. Niches can also be signalled by verbs (*suffer*; *is limited to*), adjectives or adjectival phrases (*time-consuming*; *expensive*; *not sufficiently accurate*) or negation (*cannot treat*).

However, little information is available about...
However, little attention has been devoted to...
Few reports have discussed...
Few discussions have addressed...
Few articles have focused on...
Few studies have investigated...
The first group cannot treat.... and is limited to....
Both ... suffer from the dependency on ...
The method upon which the present study is based eliminates many of these limitations by..... but it can treat only.....

Chapter 2 - Write the article

The differences need to be analysed.....
It is desirable to perform test calculations.....
It is of interest to compare.....
A key problem is.....

2.3.3 Occupy the niche

After giving background information (MOVE 1) and identifying the main problem (MOVE 2), you occupy the niche you announced by stating your research aims (MOVE 3). In other words, MOVE 3 is where your own work comes in.

Step 1 (outlining objectives or describing structure of research) is an obligatory element of MOVE 3. It can take one of two forms:

- Step 1a you indicate your main purpose or purposes; *or*
- Step 1b you describe what you consider to be the main lines of your investigation.

The main purpose of the experiment reported here was to ...
The aim of the present paper is to give ...
This study was designed to evaluate ...
This paper reports on the results obtained from ...
In this paper we give preliminary results of ...
The present work extends the use of the last model to ...
We now report the interaction of ...

In some disciplines, authors **announce their principal findings** (step 2) in the Introduction, the reason being that they do not want to keep their readers in suspense about the outcome of their research until the conclusion. In most disciplines it is common practice to give an outline of the **structure of the study** in the Introduction so that readers will have a clear idea of what to expect from the rest of your paper.

WRITING TIPS

Write your Introduction after you have written the rest of your paper. You will then have a clearer picture of your main objectives and will have already developed the arguments needed to support your claims. Establishing the context in which your paper should be read and announcing what you will be doing is much easier now.

It might also be a good idea to ask someone who is not a specialist in your field to read the Introduction and to comment on it. Does it cover all the relevant points? Is it easy to follow? Does it make the reader want to read the rest of the paper?

WRITING TIP

You can start your Introduction with a literary device that helps to make it more gripping, for example:

- a quotation,
- a concession: mention opinions that are different from your own,
- a paradox or other striking statement: "Before 1960, Baker's theory of ... was regarded as absurd. Nowadays, however ...";
- a short narrative or anecdote,
- an interesting fact or statistic,
- a question or questions that will be answered in the paper,
- a definition that is important for your study.

2.3.4 How to announce your research aims

- (1) In the following discussion, the most prominent research in this field will be described and illustrated.
- (2) The purpose of the present investigation was to compare the sealing ability of the Obtura system with that of the traditional system.
- (3) This study examines the impact of different kinds of stressful marital situations on individual levels of distress.
- (4) The objective of the present study was to determine whether a second strain of *S. mutans* was cariogenic in mono-infected rats and

Chapter 2 - Write the article

to observe the response of the pulp to mechanical exposure in the same rats.

- (5) **The present report describes** the management of root resorption in a group of patients who had undergone treatment.
- (6) **This very limited investigation ventures to demonstrate how** intonational differences occurring in the expressions of politeness in English and Japanese can be related to the two language communities' socio-cultural expectations of and attitudes towards male and female speech.
- (7) **This investigation concentrates on** this second aspect of pitch.
- (8) **In the following pages I have confined myself to** those problems of philosophy in regard to which I thought it possible to say something positive and constructive.
- (9) **The question arises as to whether** such an extension demands a modification of the model.
- (10) **This issue will not be pursued here.**
- (11) **A review of research and theory relating to this phenomenon is obviously beyond the scope of this study.**
- (12) **This paper reports a preliminary investigation into** the pitch correlates of politeness formulae.
- (13) **What we are mainly concerned with here** is the use of 'well' in situations of repair.
- (14) **Let us see if there is any real substance in this claim.**
- (15) **A series of experiments was designed to investigate this problem.**
- (16) **This study attempts to give a partial answer to the question posed at the beginning of this chapter:** why.....
- (17) More specifically, it addresses the facilitating and inhibiting effect of context and assimilation on word recognition.
- (18) **To develop these claims it will be useful to begin by sketching** some of the relevant dimensions of this theory.

- (19) In this paper I want to look at a deviant tradition in nineteenth century liberalism.
- (20) Here I want to suggest that it is advantageous, rather than damaging, for Socrates to practice a certain kind of toleration.
- (21) This paper presents a solution to this problem.
- (22) The two major aims of the current study are.....
- (23) This research note sets out to evaluate Gove's sex-role theory.
- (24) In the present study we compared energy expenditure of both groups.
- (25) Our objective was to determine whether the effect of nicotine observed during rest was also present during activity.
- (26) The present study was designed to allow a distinction between these two possibilities by measuring tissue adenosine after hypoperfusion in the presence of *d*-propranolol.
- (27) To determine whether such an *in vitro* / *in vivo* disease oriented screening programme is feasible, we have examined a number of technical questions which are fundamental to *in vitro* assay systems.

2.3.5 How to review the literature

Reporting verbs used in academic writing				
acknowledge	carry out	explain	propose	specify
address	challenge	express	publish	state
admit	deny	indicate	question	suggest
advise	describe	inform	quote	teach
announce	determine	mention	recommend	urge
appeal	discuss	note	remark	warn
argue	emphasize	offer	report	write
call (for)	encourage	point out	respond	

From: Hinkel, Eli. *Teaching Academic ESL Writing: Practical Techniques in Vocabulary and Grammar*. Mahwah: Lawrence Erlbaum Associates, 2004 (p.186).

How to refer to others: general references to other research

Here are some general references to other research:

- (1) While **researchers might acknowledge** that attainment occurs within specific structures, **critics have charged** that this body of work ignores the **dependence** of attainment processes on the structure of positional inequality.
- (2) **Many investigators have maintained** that structure is more important than individual attainment.
- (3) **In recent years, empirical research has sought** to redress the imbalance.
- (4) **Much of this research purports to show** that individual achievement is a function of structural factors such as class and authority.
- (5) **Writers have provided plausible theoretical explanations but, to date, the empirical tests have proved equivocal.**
- (6) **Such studies have shown** that various crime indices are sensitive to lagged unemployment rates.
- (7) A number of exogenous factors **cited by earlier researchers** are for all practical purposes held constant.
- (8) The social science theoretical traditions **are to be found** primarily in economics and sociology.
- (9) **From the economists we obtain** a perspective on how choices are made.
- (10) **Sociological theory provides us with** an understanding of employment variables.
- (11) **Some sociologists have made contributions** to the study of utilitarian perspectives on crime.
- (12) **Studies of the unemployed have documented** the deleterious effects of unemployment on self-esteem and morale.
- (13) **These briefly outlined theoretical considerations provide** the background for the construction of a testable model.

- (14) The study of mass communication in modern culture **has often been regarded as peripheral** to the core concerns of sociology and social theory.
- (15) Within sociology **it has commonly been assumed** that the study of mass communication can be relegated to specialists.
- (16) **Social theorists have also tended to neglect the role of mass communication in modern media.**
- (17) Social theorists **have tended to view** the role of mass communication in a one-sided and overly negative way.
- (18) Mass communication **is treated by some social theorists** as an agency of social cohesion.
- (19) This orientation **is sometimes given** a critical slant: mass communication is **also seen** as a medium of ideology.
- (20) There is a **tendency among some social theorists to view** mass communication as part of 'the culture industry' which numbs the masses into a state of subservience.
- (21) There is also a **tendency** to treat mass communication as an 'ideological apparatus' which serves to reproduce the social order.
- (22) When social theorists **have sought to analyse** the role of mass communication, **they have generally approached the relevant issues in a restricted way.**
- (23) Anthropologists **have linked the study of culture** to the analysis of symbols and symbolic action.
- (24) This approach **provides a framework** for considering the impact of mass communication on modern culture.
- (25) I do not want to suggest that **the many other methods which have been used in the history of media research** are without interest.
- (26) The effects of selected nutrients on SNS activity **have been examined in several clinical studies.** 15-19
- (27) **Renewed interest in** the effect of coronary perfusion pressure on myocardial oxygen consumption (mVO₂) **dates back to** the observation of Gregg (13).

Chapter 2 - Write the article

- (28) **Although it is widely accepted that** the net energy expenditure of the heart is tightly linked to the rate of metabolism and to oxygen consumption the

How to refer to others: specific references to other studies

- (1) Research **indicates that** the group brainstorming process may be suspect in its effectiveness as an idea-generating procedure (Bouchard, 1969; Bouchard and Haire, 1970; Bouchard et al., 1974).
- (2) A complete description of the survey **is found** in Featherman and Hauser (1978).
- (3) For a review of early treatments the reader is **referred to** James (2001).
- (4) A more extensive discussion of each study **is available in** Shadish (1998).
- (5) This is essentially the argument **advanced by** Marshall (1997).
- (6) Some of the assumptions of the modernity school can be **seen in the work of** Cohen and Till (1977) and Armer and Schnaiberg (1972; 1975; 1977).
- (7) This conclusion **has been widely quoted and paraphrased in textbooks and** other publications. However, the data **reported by** Glenn et al. (1974) (and in the other publications cited above) do not adequately support that conclusion.
- (8) This finding **is consistent with** that of Hofstetter et al., (1987) who found no difference in the basal metabolic rate of smokers.
- (9) As Kendell **notes** (1975:39-41), reliability is just a means to an end.
- (10) It **has been noted in the literature that** the same holds for the other variables (Schneiberg, 1976; Edelsky, 1981).
- (11) A clearly different position **is taken by** Simpson (1998).
- (12) There **has been a considerable amount of work done on...** (Marshall 2007).

- (13) As I have demonstrated elsewhere (Tieken, 1987:206), Elphinston's linguistic observations with regard to the auxiliary do are not always accurate.
- (14) The same point has been argued for elsewhere, notably in Jesperson (1993).
- (15) The methodology of the survey has been described in detail elsewhere (Australian Bureau of Statistics, 1979; Braithwaite and Biles, in press).
- (16) For an interesting experiment in establishing native speaker reactions to specific pronunciation errors in the English of Dutch learners, see Koet (1976).
- (17) The main difference between his analysis and Koster's will then be the requirement that topics be NPs - but see Bernsan and Grimshaw (1978, fn.4) for data that any analysis must take into account.
- (18) Sociologists (e.g. Labov, 1972b; Hymes, 1972; Ervin-Tripp, 1972) have shown that communication systems are heterogeneous and multilayered.
- (19) Also cf. Seward's comments (1978:11) that 'Japanese men emphasize the masculinity of their speech by adopting a deep-voiced, gutteral mode of speaking'.
- (20) It should be recognized from the outset that our approach differs somewhat from that taken in much of the recent literature.
- (21) This issue is not pursued in the present paper but is at the heart of a study in which I am at present engaged (Dines 1999).
- (22) Following the suggestion of Stack and others (2005), my measure of income inequality focuses on both ends of the income distribution.

2.4 Describe your Methods

The body of your article contains a detailed description of the work you did – both how you did it and the results you obtained. The description of the

Chapter 2 - Write the article

method is dealt with in the present section, while the description of your results is dealt with in section 2.5.

If these two parts of the article contain a great deal of information, you might consider dividing them into sections and sub-sections with the appropriate **headings**. It should be possible for a reader to scan through the article and glean enough logical information from the headings and subheadings to understand, albeit in a superficial way, the main line of your message.

In the Methods section of your article, you:

- state what happened
- state how it happened

Or, to put it in another way, you:

- give an overview of the experiment
- describe and explain the steps you followed in conducting your study (i.e. specify what was done and why)
- describe the sample (including human test subjects and experimental animals)
- describe the sample restrictions/limiting conditions
- describe the sampling technique
- describe the materials you used
- describe the dependent measures that were used to assess the dependent variables (i.e. explain how the dependent variables were operationalised)
- describe the procedure
- describe the statistical treatment (but do not discuss the results: they come in the next section)

Note that the elements included in the Methods section and the order in which they are presented are not fixed and vary according to discipline. However, the above-mentioned list is quite conventional and provides you with a good model.

WRITING TIP

The main question your reader should be able to answer after reading your Methods section is: "How was the problem studied?"

Following the IMRAD-structure, we include 'materials' in the Methods section of a research article. Some researchers, however, prefer to refer to the second major section of a research article as 'Materials and method' rather than 'Methods'. This combined title indicates that researchers generally describe these two aspects together when they report on their study. Whichever heading you use, what is important to remember is that 'materials' refers to any items you used to carry out an experiment. They may fall into any of the following categories: (1) all sorts of materials (e.g. natural, fabricated or structural materials, chemicals), (2) the treatments you used (e.g. drugs, nutrition, chemical reactions), and (3) the instruments employed (including laboratory or field equipment, surveys, questionnaires, tests, computer models and mathematical models). Human or animal test subjects may also be classified as 'materials', but they are often presented as a separate category.

If you make use of specialized chemicals, biological materials, and any equipment or supplies that are not commonly found in laboratories, make sure you provide all the relevant details. If you are using common measuring equipment such as a spectrophotometer or pH meter, you should mention at least the make and type number. If you have measuring equipment specially made for the purposes of your investigation, you must of course describe that in much greater detail. On the other hand, you do not need to mention supplies such as test tubes, pipettes, beakers or any other standard lab equipment.

As mentioned briefly above, the Methods section also includes a full description of the statistical methods used in processing the raw data – though again, where standard statistical methods or software packages are used it will be sufficient to refer to them by name.

The key criteria you must bear in mind while writing this section are *replicability* and *validity*. The information you give in this section should allow your readers, if they so wish, to replicate your experiments and thus test the credibility of your experimental results. It is therefore crucial to include all essential information, while omitting irrelevant details.

Chapter 2 - Write the article

To conclude this section, let's have a look at the Methods section of a study from the field of bilingual education. Notice the elements that have been included.

EXAMPLE

Use of a Writing Web-Site by Pre-Master Students on an English for Academic Purposes Course

A.J. Gillett, University of Hertfordshire

Method

Two groups of international students on a one-year Pre-Master English for Academic Purposes course, each comprising 50 students were taught academic writing by different methods and compared (**Overview of the experiment**). In each group there were 50 students from five different academic departments – computer science, business, engineering, life sciences and law (**Sample**). The subjects were selected from the second semester – Semester B – of the University of Hertfordshire International Bridging Programme in the 2004-2005 academic year (**Sample restriction**). This programme accepts only students from a narrow English Proficiency band (IELTS 5.00 – 5.5) (**Sample restriction**). Thus comparable language level among the test subjects was insured (**Sample restriction**).

The subjects were selected from the 250 students in the International Bridging Programme on the basis of performance at a satisfactory level in the Semester A examination (**Sampling technique**). Students who had performed below the minimum level of the semester A examination were excluded (**Sample restriction**). This criterion was employed to ensure competent understanding of the task and adequate motivation (**Sample restriction**).

One group – Group A – studied English writing in the traditional way in a class with a teacher (**Procedure**). This class met for 2 hours each week in a classroom for 12 weeks and was supplemented with written homework assignments given by the teacher each week (**Procedure**). The second group – Group B – met together in a class with a teacher for one hour per week for 12 weeks and were assigned a homework task of spending one hour per week doing exercises from the UEFAP web-site (Gillett, 2005) (**Procedure**).

The test instrument employed in this study was a revised version of the University of Hertfordshire English Language Writing Test (Roberts, 1997), which permits the assessment of academic written language performance (**Materials**). It consists of an academic reading text and comprehension questions, followed by a discursive essay on the subject of the reading text (**Materials**).

Both groups A and B were given the same written examination at the end of the semester. The students took the examination under standard university examination conditions as part of their end of semester examination (**Procedure**). The tests were marked using the following categories: task achievement; communicative quality; organization; ideas, content and relevance; and grammar and vocabulary, by two experienced writing examiners and moderated in the standard way to ensure reliability (**Procedure**). In this way it was possible to see the relationship between the students' main academic subjects, and the improvement in their writing ability depending on the teaching method (**Variable**).

A 3×5 analysis of variance was used to test for academic department, method of teaching and language achievement differences (**Statistical treatment**).

IMPORTANT

The Methods section should be written in the PAST TENSE (see section 4.1 below)

2.4.1 How to describe a process

- (1) Before one begins to **test causal hypotheses** one has to make sure that the **data collected** are in conformity with the conceptual structure axiomatized in advance.
- (2) In the **experiment** we **designed** the central concepts were proficiency level, speech recognition and contextual constraint.
- (3) **Responses were gathered** and given a score, which varied from 0 to 5.
- (4) There is a method of **analysing the data** that can answer both these questions.
- (5) The **subjects** were **instructed** to fill in the sheets while listening to the tape.
- (6) The **experimenter verified** whether the subjects had filled in the sheets in accordance with his instructions.
- (7) A statistical analysis was **performed** on the complete set of 30 items.
- (8) These **data were subjected to** a three-way analysis of variance.

Simple past tenses

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- (9) The following **information was recorded**: date of referral, age at time of transplantation, sex, date of operation and date resorption first noted.
- (10) An **experiment was carried out** in order to test the validity of our hypothesis.
- (11) Cultures were **set up and tested** for their antibacterial activity.
- (12) We **estimate this figure** by taking the proportion of endorsement after the data have been examined and interpreted.

2.5 State your Results

In this section you:

- show results
- explain where they came from

If appropriate, you can use tables and figures (graphs, charts diagrams, photographs and drawings) here. These can be a very effective means of allowing the reader to grasp the main lines of your results at a glance. You must, however, also summarize your main findings in the text. First, you must decide on a logical structure for your presentation. For example, you may:

- present your results from most to least important or
- go from simple results to complex ones or
- present data in chronological order, paralleling the way methods were applied

WRITING TIP

The main question your reader should be able to answer after reading your Results section is: "What were the findings?"

While describing your results, you should point the reader to the most relevant findings. It may help to repeat your research question here, to provide a conceptual framework. However, do NOT discuss or interpret the results at this stage; that is done in the Discussion section.

Tables and figures can be a powerful aid to presenting results. Many readers look at them in a paper first, to see whether the rest of the text is worth reading. Tables and figures can be used to:

- Summarize and emphasize key points,
- reduce narrative length,
- simplify information,
- improve the conciseness and clarity of the text,
- add visual appeal to a text.

Examples of tables

Table 1

Method	Parameter	AcrB/1108_19
Data collection	Space group	P2 ₁ 2 ₁ 2 ₁
	Unit cell parameters (Å)	a = 146.18, b = 157.41, c = 246.04
	Resolution (Å)	35.00–2.54 (2.70–2.54) ^a
	Completeness (%)	95.0 (79.9)
	R _{merge} ^b	0.081 (0.321)
	I/σ(I)	20.75 (6.1)
Refinement	Resolution	25.00–2.54 (2.70–2.54)
	Number of reflections	177,557
	R/R _{free} (%) ^c	22.9/27.0
	RMS deviations	
	Bond lengths (Å)	0.008
	Bond angles (°)	1.3
	Ramachandran plot (%)	
	Most favored	88.4
	Allowed	10.8

^aValues in parentheses are for the highest resolution shell.

^bR_{merge} = $\sum_h \sum_l |I_h - \langle I_h \rangle| / \sum_h \sum_l I_h$, where $\langle I_h \rangle$ is the mean intensity of symmetry-equivalent reflections.

^cR = $\sum |F_{\text{obs}} - F_{\text{cal}}| / \sum F_{\text{obs}}$. The formula for R_{free} is the same as that for R, except it is calculated with a portion of the structure factors that had not been used for refinement.
doi:10.1371/journal.pbio.0050007.t001

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Table 5 Example layout of a 3*2*2 factorial design used to optimize a protocol for screening in drug development (for details see text)

Group	Event time (hr)	Age	Treatment
1	0 (-)	Old (+)	Treat (+)
2	0 (-)	Old (+)	Control (-)
3	0 (-)	Young (-)	Treat (+)
4	0 (-)	Young (-)	Control (-)
5	2 (0)	Old (+)	Treat (+)
6	2 (0)	Old (+)	Control (-)
7	2 (0)	Young (-)	Treat (+)
8	2 (0)	Young (-)	Control (-)
9	4 (+)	Old (+)	Treat (+)
10	4 (+)	Old (+)	Control (-)
11	4 (+)	Young (-)	Treat (+)
12	4 (+)	Young (-)	Control (-)

Examples of figures

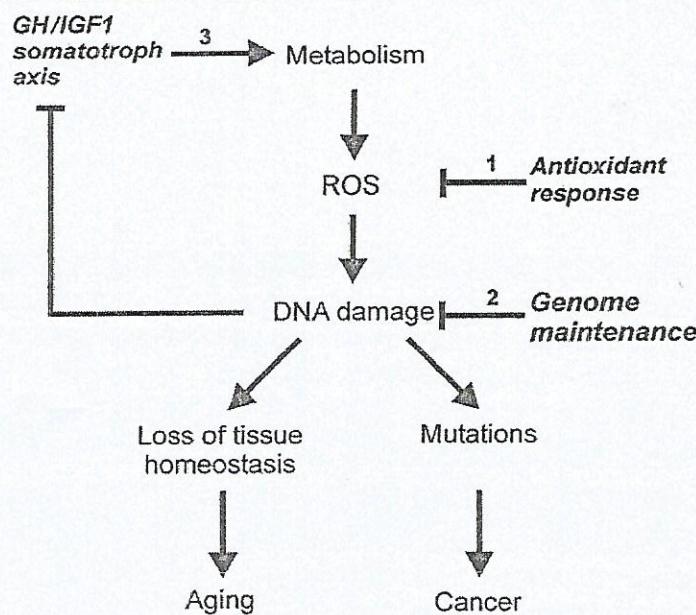


Figure 1. The Proposed Link between DNA Damage and the Decline of the GH/IGF1 Somatotroph Axis

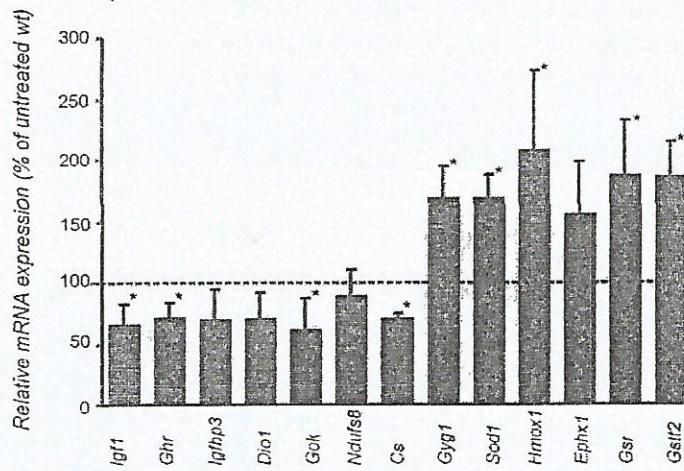


Figure 2. Expression Levels of Genes Associated with the GH/IGF1 Axis, Oxidative Metabolism, and Antioxidant Defense in DEHP-Treated wt Mice

WRITING TIP

Always take the following considerations into account before deciding to use a table or figure:

- Is an illustration necessary?
- Does this illustration fit the purpose?
- Does it meet the requirements of the journal where you wish to publish the paper?
- Can each illustration be understood independently, while still fitting clearly into the context provided by the text?

Any figure or table you decide to include should not contain raw data or intermediate calculations. Instead, tables and figures should summarize clearly and concisely any primary and relevant research findings. Your text should complement any figures and/or tables, and should not repeat the same information.

As regards the placement of figures and/or tables in your research paper, you can either:

- incorporate figures and tables within the text itself or
- include them at the end of the report.

Regardless of where you choose to place your figures and/or tables, they must always be titled (titles are usually positioned below a figure and above a table) and numbered successively. When you refer to tables and figures in the running text, make sure these words are capitalized (e.g. "Figure 1 (or Fig. 1) and "Table 2").

IMPORTANT

The Results section should be written in the PAST TENSE (see section 4.1)

2.5.1 How to refer to tables and figures

- (1) These data are presented in Table 1.
- (2) Table 1 shows.....
- (3) As shown in Figure 3,

- (4) As can be seen from Table 2,
- (5) Figure 3 illustrates the correlation.
- (6) Figure 2 provides the data necessary for these inquiries.
- (7) The predictions and the relative errors per grade are given in Tables 6a and 7.
- (8) The observed flow data are shown in Figure 1a. Figure 2b takes these flow data and reinterprets them as a vacancy-driven process.
- (9) Comparison of Figures 1 and 2 shows that
- (10) Table 1 also relates intra and interpersonal situations and elements of the triad.
- (11) Energy expenditure was greater for smokers receiving nicotine than for smokers receiving a placebo during both the activity and the rest sessions (Table 2 and Fig.1).
- (12) These data were subjected to a three-way analysis of variance: A (a, b) x B (c,d,e) x C (f,g). The results are shown in Table 1.
- (13) There was a significant A effect ($F(5,486) = 8.5, p<.001$), which did not interact with any other factor, despite (or because of) the considerable variability evident in Fig. 1.

2.5.2 How to report on statistical findings?

- (1) Analyses of variance performed on the data revealed a significant effect of A, $F(3,72)=4.15, p<.001$.
- (2) In an analysis of variance, this was reflected in a highly significant interaction between the effects of A (proactive vs. retroactive) and B [$F(4,32)=21.1, p<.001$].
- (3) An ANOVA showed that ... was significant. More importantly, however, the A condition by B interaction was not significant ($F<1$), indicating that ...
- (4) The interaction between A and B was marginally significant ($p<.10$).

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- (5) Neither the difference between groups (Mann-Whitney U, $p>.05$) nor the difference between low and high A (Sign test, $p>.05$) was significant.
- (6) No other effects even approached significance.
- (7) Averaging over the two groups, subjects detected 83% of the mispronunciations in condition A and 80% of the mispronunciations in condition B, a nonsignificant difference [$F(1,38)<1$].
- (8) Post hoc Newman-Keuls tests revealed one significant effect of the first consonant stop (/d/ shorter than /b/, $p<.05$) and two significant effects of the second stop (/g/ shorter than /b/ and /d/, both $p<.01$), out of three comparisons in each case.

Describing change

There are many set expressions used in academic publications to describe change. An overview of such expressions is given below:

(1) Expressions for referring to figures/ tables in your text		
As can be seen from...	the chart	
According to...	the diagram	
As is shown in...	the table	
	the graph...	
	Table 1...	shows
	Figure 2...	indicates
	Chart 3...	illustrates
		demonstrates
(2) Degrees of change		
small/slow:	negligible marginal(ly) fractional(ly) slight(ly) gradual(ly) slow(ly) steady(ly)	 rise increase decrease decline reduction fall drop
big/fast	considerable(bly) substantial(ly) sharp(ly) dramatic(ally) marked(ly) sudden(ly) rapid(ly)	
stability:	stable steady(ily) constant(ly)	

2.6 Write your Discussion

In the Discussion section, you interpret your results and explain your findings to the reader. This will involve most or all of the following actions:

- make clear how your results relate to the original research question,

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- state whether and how the data support your hypothesis,
- explain what is new in your work and why it is important,
- explain whether your results are consistent with what other researchers have reported,
- show how your results fit into the big picture,
- account for results that differ from your expectations,
- discuss the limitations and implications of your methods and findings,
- explore other ways of interpreting your results,
- indicate what further research would be necessary to answer the questions raised by your research.

WRITING TIP

The main question your reader should be able to answer after reading your Discussion is: "What do the findings mean?"

While the Discussion should draw attention to your most significant results, you must take care not to repeat what you have written in the Results section. One of the biggest mistakes made by budding researchers is to present a superficial analysis in the Discussion that more or less re-states the content of the Results section. What you need to do is interpret your results, i.e. explain to the reader what you think they *mean*.

IMPORTANT

The Discussion should be written in the PRESENT TENSE (See section 4.1).

2.7 Write your Conclusion

Together with the Introduction, the Conclusion of a research paper is often the most difficult part to write. By the time you get down to this point, you may feel that you have already exhausted everything there is to say on this

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topic. But remember that the Conclusion is probably the last thing your readers will read, so you want to leave them with something meaningful and memorable.

The Introduction and the Conclusion of your research paper frame the body of your text and form a bridge between your thoughts and your reader. Use the Introduction to make a good first impression on your readers and encourage them to keep on reading. An effective Conclusion will leave the reader with a lasting impression of the quality of your research and the cogency of your analysis of the experimental results.

In the Conclusion, you draw together what you have said in the Introduction and the body of the text, for instance, by:

- restating the focus of your research (research aim and research question)
- summarizing the results of individual sections (if the paper is long enough to make this necessary)
- explaining (with reasons) the extent to which your original research question has been answered
- stating the implications of your results for specific issues or the discipline as a whole
- explaining the need for further research, and specify the areas in which this is required

In general, the Conclusion can be divided into three parts: **Firstly, you restate the focus of your research with reference to the formulation you gave in the Introduction.**

This study began with the premise that.....

Secondly, you show how your experimental results tie in with the research question. This act of synthesis is very different from summarizing: do not simply repeat what you said in the Introduction or the body of the paper, but show the reader the organic link between your research question, the experimental results, your arguments and conclusions.

In conclusion.....

I am led to the conclusion that....

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The results of this study both support and contradict my hypothesis.
I can be brief in drawing my conclusions.
In summary then.....
Apparently, my initial assumption is empirically validated by this study.
This study has uncovered several important factors that are associated with...

Thirdly, you make suggestions for further research or action. Go beyond the boundaries of the present paper and help the reader to appreciate the broader implications of your research by raising questions to be addressed in further investigations, recommending a course of action or proposing a solution to a given problem.

This issue deserves further empirical study.
This study cannot of course be viewed as conclusive.
Studies of this sort, no matter how suggestive, must be hedged with caveats.
Additional research is needed.
Another promising line of research would be....
These results have implications for further studies.

Finally, you get to your concluding sentence. Try to be clear in your mind about the effect you want to achieve with this sentence.

Before closing I wish to reiterate one point.
If interest and effort continue we may soon have a good understanding of

WRITING TIP

An increasing number of academic journals require submitted papers to combine the discussion and the conclusion under the heading Discussion.

Always check the format requirements of the journal to you which you intend to submit your paper before finalizing the text. This can save you a lot of time and effort.

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2.7.1 Use of language in summaries and conclusions

Anticipating a fuller discussion of the use of tenses in English (section 4.1), we may mention here that general summarizing statements and focus repetition (e.g. 'we have seen that' or 'it has been proposed that') will be in the **present perfect** tense (the *have* form). The tense used in statements about individual sections, however, will vary with the position of such statements in the text: they will be in the **simple past** ('we saw') if they occur right at the end of the entire paper but in the **present perfect** tense ('we have seen') at the end of the section referred to. The distinction between the present perfect and the simple past is not easy for the non-native speaker to grasp, but is important if you want to write good (scientific) English. In brief, the present perfect is used to describe actions that occurred at an unspecified time in the past – which extend right up to the present and possibly beyond it – while the simple past refers to actions that started and were completed at a specific time in the past. It may be useful to consult a guide to English usage for a more detailed explanation and examples of the way these two tenses are used. Googling 'present perfect' and 'simple past' can also turn up useful information.

A list of expressions that can be used to signal a conclusion is given below. A word of caution in this connection: while 'in conclusion' is appropriate as a means of signalling a conclusion, you should not use 'conclusively' for this purpose. This word is not synonymous with 'in conclusion', as you might think, but means 'beyond a doubt'. (See example 19 below for a sentence in which 'conclusive' is used correctly.)

to draw conclusions
to be brief
in short, the results confirm our hypothesis
this leads us to the conclusion that X
this may indicate/suggest that
It appears that X
the results support the assumption
our results also suggest an explanation for
the explanation is consistent with
to summarize,
in summary

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it has been proposed that
the evidence we have examined suggests that X
to deserve/require further study
additional research is needed

- (1) **In sum, it appears that** indicators of job-related stress and strain are primarily affected by job-related sources of support.
- (2) **The conclusion as to** the effect of context on word recognition, **then**, is that one cannot make generalizing statements such as: non-native listeners make more use of context than native ones.
- (3) I can be brief in **drawing my conclusions**.
- (4) **In conclusion**, it appears that male-female differences may result more from differential opportunity (status and norms) than from ability.
- (5) **We are led to the conclusion** that CS is a constant factor.
- (6) Some **summarization** of the above may now be possible.
- (7) **In summary, then**, all these examples involve reinterpretation in a structure containing an empty category of one kind or another.
- (8) **To round off my comments about** the work under discussion, let me again express my opinion that it is an excellent book.
- (9) **In short**, the results of this study both support and contradict our hypotheses.
- (10) **This study has uncovered several important factors** that are associated with membership in mature groups in the classroom. First, Second, Third,
- (11) **This study developed** a comprehensive and utilitarian instrument for measuring group consensus.
- (12) **Apparently** this assumption is **empirically validated** by this study.
- (13) **Evidently**, perceived freedom to participate in decision making does indeed lead to stronger support for the group decision.
- (14) **We have seen that** an 'abstract' approach is perfectly capable of being phonetically sophisticated.

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- (15) **The evidence we have examined suggests that** knowledge of reliability and validity is essential to an understanding of these effects.
- (16) Generalizing this procedure, **we can best summarize it by saying**
.....
- (17) **This issue deserves further empirical study.**
- (18) **It is true that in this paper I have not made a point-by-point analysis** of GMLE. This would be the subject of an entire worthwhile research project.
- (19) This study, of course, **cannot be viewed**, nor is it presented, as conclusive.
- (20) **Additional research is needed** to specify more precisely the conditions under which the relationship between life change and mental health is linear or curvilinear.
- (21) **Another promising line of research would be** to carry out the same analysis on left-branch languages.
- (22) **A challenging task for further research is** the specification of conditions under which these roles occur.
- (23) These results have **implications for future studies.**
- (24) **The results of this pilot study point to a compelling need to test** the instrument both with a larger sample and with a variety of groups.
- (25) **Further research should provide** the evidence necessary for confidently accepting or rejecting the instrument tested and defended in this article.
- (26) Whatever its shortcomings, and there are many, **the measurement approach described in this research is offered as an alternative for** the coping process.
- (27) If this interest and effort continue we may soon have a good understanding of sex differentiation in language.
- (28) **Before closing we wish to reiterate one point.**
- (29) **It is hoped that some of the findings presented here will reach** the authors of English-language textbooks, so that they may be included.