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C. Sterken & C. Aerts

Advice on Writing a Scientific Paper

Chris Sterken

Vrije Universiteit Brussel, Pleinlaan 2, B-1050 Brussels, Belgium

Abstract. What makes one author a good communicator and another a poor one? What turns out one manuscript a swift editorial task, and another an editorial nightmare? Based on direct experience from the manuscripts of the lectures and papers presented during this school, advice is given on what to do and on what to avoid when writing a scientific paper. Some feedback recommendation is also provided on how to prepare manuscripts, handle copyright and permissions to reproduce, how to anticipate plagiarism, how to deal with editors and referees, and how to avoid common errors. A few illustrations of English grammar and style for the foreign author are given.

Preamble

This meeting is very special in the sense that less than a dozen scientific talks were delivered by senior scientists, whereas 75% of the papers in this book were presented by PhD students. As the sample of students was expected to show wide variance in research experience, writing skills and capabilities of communication, all students were requested to submit a first version of their 4-page research paper (or a 2-page poster) about three months before the start of the workshop. All these manuscripts were then proofread and annotated by the Editor, and these marked pages were then scanned and made available to the students as sets of `jpeg` image files. With these guidelines, combined with additional personal feedback during the meeting, students were expected to submit the final version of their manuscripts within two weeks after conclusion of the workshop.

Students were asked from the very beginning to strictly follow the ASP *Instructions to Authors*, and an additional set of instructions issued by the Editors of these Proceedings. These additional instructions only regulated the naming scheme for the files to be submitted, and an additional, though explicit, condition that *every* co-author – and the thesis supervisor in the first place – should have read the manuscript well before its first submission.

About 70 student papers were received, a good 80% of which were submitted on time. The spread in submission time was quite large, with a rather long tail towards late submissions. About 10 announced manuscripts were not submitted at all, though some of them surfaced by the final deadline (and thus skipped the first round of internal editorial reviewing). Less than 30% of the leading authors followed and respected our first rule (Editor and Publisher instructions), whereas we were unable to find out how many authors did follow the second rule (proofreading by supervisor): it appeared that several papers had not been read by any one else but the first author.

Students could also display a poster paper, and anticipate publication as a two-page manuscript. Half of these posters either had an unacceptable overlap with the main paper, or were simply duplicates of papers already submitted or presented elsewhere.

This paper is written in the first and second person singular – a not very common approach in scientific communication – but since we deal with somewhat personal advice and experience, this strategy is much more direct and persuasive than the use of the third person. The reader is thus addressed in the second person, the target audience being the young researcher at the beginning of her or his life as an author (though more senior researchers may occasionally take profit of the advice presented here).

Some of the workshop participants will readily recognise their own mistakes in the examples quoted hereafter, so at this stage I wish to stress one very important point: *do not feel offended; all reported errors are normal for beginners and my remarks are only made to help you writing a better paper.* As I will state more than once in the subsequent Sections, the best way to learn is to learn from each other.

The following Sections expose some general aspects of scientific writing (types of papers, the writing process, etc.) and then deal with the most common errors encountered during the reviewing process.

1. Printed Paper *versus* Oral Talk

The foregoing paper *Advice on Giving a Scientific Talk* by Don Kurtz gives good advice on how to present scientific results to an audience. Beware that there are fundamental differences between a talk and a written paper, such as:

- a printed text has no provision for any kind of intentional or inadvertent body language,
- a written paper calls for careful wording in order not to be misunderstood, or in order to avoid being cited out of context (see also Sect. 7.3.),
- a printed article allows the author to present a very different degree of detail in the description of the research procedures and results,
- the printed message is not instantaneous: whereas the spoken word is a direct address to an audience, the printing and distribution process takes weeks, even months of time,
- published phrases remain forever, spoken words often persist only a very short time,
- whereas sitting through a bad lecture may possibly yield a minor dividend (for example, when the lecturer uses very well-designed powerpoint slides), a poorly written paper has no value whatsoever since it *always* conveys the message that "*what is poorly written is also of doubtful scientific value*",
- a lecture – an invited lecture above all – is a social event, with a pre-arranged relationship between speaker and audience, and with emphasis on the pedagogic form. Studying a text is a more solitary experience.

A published paper is quite often the written record of a talk (like the papers in this book). Whereas one just cannot publish a *verbatim* record of the lecture, the written article normally corresponds to the talk (at least in content). In the present case, however, I deliberately deviate from this rule as I elaborate here a more general structure suitable for a wider audience, and I include some elements which were not stressed during the talk because of lack or time, or for other reasons (see, more specifically, the last Section of this paper).

2. Why do we Publish?

Scientific research is a collective undertaking, and requires the distribution of knowledge and the sharing of results. This dissemination, using rigid rules and standards of scientific reporting, is the prime reason for publishing. Evidently, we do not always and only publish with this motive in mind; in real practice there are several gradations in the incentive for writing.

Because I want to report new scientific results and get credit. Besides the wish and need to communicate results, it is very important to publish as soon as the results and discoveries are considered solid. Credit is usually (but not always) attributed to the person who first makes the result public. Early publication allows the startup of another necessary process: experimental verification of the observations or theories – and possibly falsification.

Because I am at this meeting and this is the only way to cover my travel costs. This is unfortunate but realistic: many conference attendees get their expenses covered only if they present a paper (in practice, a poster is displayed most of the time).

Because I need a job, a promotion, or a grant. Any application for a job or a research grant requires evidence of scientific creativity and productivity. This proof indirectly emanates from the publication record. A colleague once wrote me that he sought a contract renewal and, therefore, needed to produce "*a paper, quick and dirty*". The resulting quick paper may have been effective in his pursue of a job but, needless to say, the paper cannot have been on a high standard of creativity if the job hunt was the only motive for writing it.

Because I want to achieve social climbing by being visible in ADS. This ambition to gain esteem by fellow astronomers is somehow related to the previous one, in fact to the complete mechanism of "measuring" scientific stature by "counting" a person's papers and citations through uncalibrated bibliometric tools like ADS[1].

There are two bibliometric parameters which are used (in combination): the Citation Index (CI) and the Journal Impact Factor (IF).

- A CI keeps track of which articles in scientific journals cite which other articles. A most widely-used citation index is the Web of Science published

[1]The NASA Astrophysics Data System, `http://www.adsabs.harvard.edu/`

by the Institute for Scientific Information (ISI)[2]. Note that a CI does not necessarily give a true measure of an author's value as a scientist: there certainly is a correlation, but it is not a tight one. In fact, a CI can somehow be compared to television viewing figures, and we all know too well how easily these figures are influenced by adding a flavor of adventure, a zest of erotics, or a dose of sports to an otherwise dull performance.

- The IF is a measure of the frequency with which the "average article" in a journal has been cited in a particular year or period. The impact factor of a journal is the annual rate of citation of its average article (mostly calculated over the previous two years). Bibliometric studies have revealed that the IF is severely affected by a small number of papers (*Nature* 2005, Vol. 435 p. 1003), and the inflated status and limited metric value of the IF is very well known. IF also favors journals that publish rapidly.

Young scientists should be warned that CI combined with IF are tools developed *by and for the scientific administration* for *statistical* assessment of the outcome of scientific projects and funding schemes. These tools should be used with cautious restraint, and are not fit for evaluating your colleague's or your supervisor's scientific weight. These parameters are not even calibrated over a modest range of disciplines inside one science (CIs in theoretical stellar physics, for example, are not in step with citation counts in certain branches of observational astronomy), not to speak of comparing CI-values in mathematics, physics and chemistry. Moreover, 75% of all papers are never cited. I dare say:

> *You should never ever attempt to measure your own scientific value by the outcome of a citation count: you will either end up with overwhelming unhappiness, or with a misleading sense of self-importance.*

3. Types of Scientific Papers

There are many types of papers that a scientist deals with. This Section lists the most common types, and roughly ranks them by importance.

Research paper in a refereed journal. Submission of a paper to a refereed journal mostly implies that it is the result of original research *not previously published, nor submitted for publication elsewhere, nor considered for later reproduction without the consent of the copyright holder.* Most refereed journals require manuscripts be submitted in double-spacing so that the referee can make annotations. Note that these days some refereed journals will not even submit to the referee a paper on, for example, an unremarkable binary together with a standard interpretation of its light curve (Bertout & Schneider 2004). It is thus advisable to check the editorial policies of a journal by verifying what types of papers are published.

[2] `http://www.isinet.com/`

Letter to the Editor. A Letter is a research paper (or a short opinion paper) that requires rapid publication. Some types of Letters are esteemed higher than regular refereed papers, others have a lower reputation.

Information bulletins and telegrams. A bulletin is a brief news item intended for immediate publication. An example of a bulletin journal in astronomy is the *Information Bulletin on Variable Stars*[3] (IBVS) published by Konkoly Observatory in Hungary. IBVS publishes short but significant news on variable-star astronomy. One telegram journal is issued by the *Central Bureau for Astronomical Telegrams*[4] (CBAT) which is responsible for the dissemination of information on transient astronomical events via the International Astronomical Union Circulars (IAUCs), a series of postcard-sized announcements issued at irregular intervals. The basic difference between these two communication media is the publication speed (IAUCs being faster) and the publication cost (IBVS not imposing page charges). Telegrams get some editorial attention, but are not necessarily refereed: the degree of refereeing in such short papers depends on the editorial policies of the journal.

Review paper. A review paper is a wide retrospective survey of a specific field including a critical evaluation of the scientific subdiscipline dealt with. A straightforward compilation of literature sources or catalogued data is by no means a review paper – especially not in our times when web compilations can so easily be performed.

Essays. This form of paper is an interpretative work usually dealing with its subject from a personal point of view of the author.

Data paper. Standard journals require concise reporting, and few journals can accomodate large volumes of experimental data. Some major journals have (or had) associated supplement series, where results of experiments (theoretical or observational) are published. Most data are nowadays published in machine-readable form. Note that there is a large difference between a *data paper* and a *data archive*. The latter is merely a set of tabulated information, the former usually also explains why the data were obtained, how the data were acquired, includes a discussion of the accuracy, and possibly gives some illustrations of results already published elsewhere.

Instrument and software manuals. These publications belong to a somehow similar category as the data papers, have a quite short life time and tend to get buried in the archives of observatory libraries.

Invited talk in conference. Mostly on invitation, such papers give a review of one of the themes of the meeting. Good meetings often have several such landmark papers, which are quite often very informative, and certainly are recommended literature for every beginner in the field.

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[3] `http://www.konkoly.hu/IBVS/IBVS.html`

[4] `http://cfa-www.harvard.edu/iau/cbat.html`

Contributed paper in a conference. Such papers, as a rule, are short, and quite often bring a preview of new results that are not yet published. In principle, every conference paper should be able to pass mild refereeing, but in practice, as one can easily verify in these Proceedings, such papers are of widely variable quality and some would never pass a strict refereeing test.

Conference poster. Poster sessions were created to allow participants to present their results, even if the meeting format only allows invited talks and reviews. The advantage of posters is that participants can view and discuss the material at their own pace, in an atmosphere that encourages direct discussion.

Ticket papers. The term "ticket paper" is slang for a conference paper that only serves to get your travel covered. University administrations often require participants to give a talk when they apply for travel support. As such, a short paper is often given for the sole purpose of acquiring the travel subsidy.

Publicity papers. Some papers do communicate results, though only for the purpose of bringing to public attention some achievements of a large team or a scientific consortium. Such papers are typically published in annual reports of institutes, or in observatory magazines.

Salami papers. The term refers to the not so uncommon habit of reporting results from a single study in slices, i.e. instead of presenting all results in one cohesive single paper, the work is partitioned in multiple papers and submitted to different journals. This technique, for sure, increases your visibility in a bibliographic database, but the dilution takes its toll at the moment when a peer-review body asks your *"three most important papers of the last three years"*.

Hoax articles. A scientific hoax is a fabrication. If the intention of the author is to dupe the reader, we speak of a fraud (see also Sect. 7.). There is a very special type of hoax or parody which leads to exposure of corrupt research practices or customs. A most interesting example is Alan Sokal's "*Transgressing the Boundaries: Toward a Transformative Hermeneutics of Quantum Gravity*" (Sokal 1996).

Free-lance writing for newspapers, amateur journals and public outreach. This kind of publication serves to increase the scientific literacy of the non-scientist, even to address the scientific-illiterate politician. Though such writing is very important (see also Zoltán Kolláth's paper in this book), some specialists look at such publications with some disdain.

Karaoke papers. Karaoke, from japanese *kara* (empty) and ōke (orchestra) refers to the (sometimes *verbatim*) reproduction or duplication of (mainly) posters at meetings. Needless to say, such duplicates have no value in a curriculum and such duplication should be avoided (see also Sec. 7.). After all, why would you map a paper onto itself if you can come up with other interesting aspects of your research? Do not forget that papers that are not refereed are discounted for promotions and job applications.

4. The Editorial Process

From dealing with the various submissions, it became apparent that a number of students do not have a clear view of the editorial process they are being subjected to. When you submit a document for publication to the Scientific Editor, you may not be aware of the very strict contractual limits within which the Editor operates. The Scientific Editor first of all judges scientfic interest and the originality of the papers, and checks whether the paper is not an unnecessary duplication of work published elsewhere, in order to prevent violation of the copyrights, see Sect. 5. Then, every paper is proofread, corrected and compiled to verify whether each of the manuscripts compiles well as a stand-alone paper. When all manuscripts have thus been corrected, they are merged into one master LaTeX file for compilation, and after several interactive sessions, the complete volume is ready for constructing the Author, Subject and Object Indexes. At this stage, there is no more room for modifications that involve changes in page numbering. Once this stage is completed, a volume number is assigned, and the digital manuscript is sent to the Production Manager Enid Livingston at the ASP Conference Series Publisher. She is the copy-editor and does the technical checkup of the complete manuscript. Several weeks later, she returns a list of errors to the Scientific Editor, and waits for the submission of a set of files that swiftly compile to an immaculate book. The Publisher then delivers a digital proof in the form of a `pdf` file to the Editor, and requests permission to print. At that stage there is still room for minor changes, but not at zero expense as any intervention causes extra costs. Once such interventions have been taken care of, no more modifications can be made, and the book is printed and shipped. Manuscript preparation by the Scientific Editor typically takes 4–6 months, the printing and distribution process another 3–6 months. Needless to say, any unforeseen complication in the process slows down production and delivery time.

4.1. Problems with the Editorial Process

Publisher instructions. The first set of rules is described in detail in the ASP instructions for authors[5] as prepared by Terry Mahoney, the ASP LaTeX Computer Consultant. Respecting these "house style" instructions is just mandatory. I now list some of the most common violations of the ASP conventions.

1. No other matter may appear in the preamble, and any author's macro will be removed by the volume editors. Hence, any author-defined macros become inoperative, and the use of personal macros will, inevitably, produce scrambled characters.

2. One of the major mishaps occurs because of poor understanding of the system of references, in particular the `thebibliography` environment. Though the use of this environment allows most versatile handling of citations and references, many authors do not realise that formatting errors in the reference list can propagate through the complete book and,

[5] `http://www.astrosociety.org/pubs/cs/macros/author/aspauthor2005.pdf`

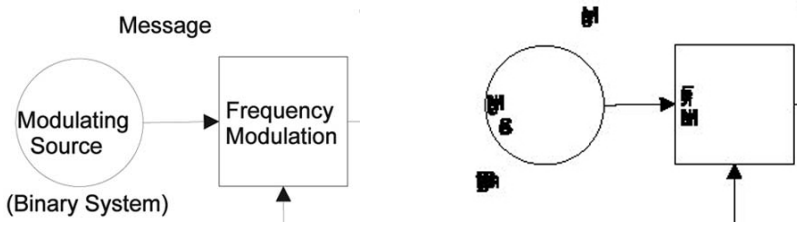

Figure 1. Example of a disastrous transformation. *Left*: part of an original illustration delivered by the author in encapsulated postscript format. *Right:* the result after a passage via `pdf` format.

consequently, destroy the coherence of the bibliographic citations. Even a manuscript that correctly compiles as a stand-alone paper, may render another paper's citations useless. I quote Mahoney (personal communication 2005): *"Some of your authors just aren't reading the author instructions with due care and have messed up their bibliographical lists"*.

3. Not respecting margins, especially with overflowing running titles, Figures and Tables.

4. The selection of fonts may introduce problems, especially since encapsulated postscript sometimes includes non-standard postscript fonts. One example is the classical and popular typeface Helvetica. A modified version of Helvetica became a Windows font called Arial, a non-standard postscript font that may cause problems with specific `dvi` viewers. Beware that fixed-resolution bitmap fonts do not print or display very well on some devices, hence always use scalable fonts. Figure 1 illustrates one example of what can happen when transforming a postscript file (after Publisher-processing) to a `pdf` format.

5. Image resolution (the sharpness and clarity of an image): most graphics render very well, but sometimes `eps` files are made from online images of very low resolution. Remember that sending 75 dpi fonts to a 600 dpi printer produces output no better than that of a 75 dpi printer.

Editor instructions. At least two versions of all LaTeX files were processed several months apart, and this calls for a very systematic and tight working procedure.

1. As we were dealing with over 100 LaTeX files and about 250 postscript graphic files, authors were asked to label their files in a systematic way using `surname.tex` and `lastname-fig1.eps, lastname-fig2.eps`, etc. Still, several `firstname.tex` files were received – an impossible task considering the presence of three Zoltáns and two Andreas in the audience.

2. The confusion between Encapsulated Postscript (EPS) and Postscript (PS) formats. EPS is a standard format for importing and exporting PostScript language files in all environments. It must include a header comment

(`%!PS-Adobe-3.0 EPSF-3.0`), and a `%%BoundingBox` comment that describes the bounds of the illustration. The EPS file can contain any combination of text, graphics, and images. An EPS file is the same as any other PostScript language page description, with some restrictions, and is usually a single page. The entire file is ASCII (American Standard Code for Information Interchange).

Some authors label their Figure files with the `ps` extension. While not basically wrong, it creates confusion as this extension is generally used for multipage documents (for example, an author's complete paper). Mixing `eps` and `ps` extensions for one-page documents to be inserted in a `tex` manuscript certainly does not help editors and computer consultants keeping a tidy job.

3. We received several files labeled `fig1.eps`, even files named `w4b.ps.eps`: all these had to be renamed in order to create a workable and efficient structure.

4. Though the page limit was set to 4 pages, several manuscripts exceeded that limit by about 10–20%. In practice, allowing a half-page overshooting unavoidably results in 6 printed pages, as every paper starts on an odd page. Though not a real problem in the present case, authors should be aware that editors also have page limits, in the sense that extra pages must be paid for by their budget.

5. Some authors submitted 4 to 5 different versions of their LaTeX file after their first submission had already undergone considerable editorial labour. It is just not possible to track down such changes, nor is sending back a source file to the author a workable option, since the editor may lose all control over the changes made previously.

6. Late (or no) submission, one of the most irritant problems as it has a direct impact on the editorial planning. Some excuses are really universal: *"I had a disk crash, my laptop broke down, my office needs painting..."*. The worst justification I received was *"I am waiting for the permission to include one more illustration"*. The most pleasant statement was *"I apologize for the delay in sending the files (for which there is no real excuse)"*. There is very little an editor can do, except refuse the paper if it comes after the deadline.

Let it be clear that publisher instructions always override editor's guidelines, and that these conventions are not just a publisher fad or an editor craze to take the fun out of your work, but are given to ensure cost-effective streamlining of the publication process towards a coherent and handsome book in the house style of the publisher. Publishing has changed dramatically in the past decade: simply compare a conference book of the 1980s to a modern one. Many of the older books have a mixture of fonts and font sizes, variable line spacing and margins, and a most heterogeneous collection of references. Modern proceedings books are esthetically more pleasing, and more efficiently organised, in the first place because of these instructions. After all, accurate rules also prevail in electronic banking (accuracy of amounts and accounts), observing proposals (coherence and deadline), and grant applications (deadlines, structure and logic).

5. Copyrights

Copyright deals with the exclusive legal right to reproduce and publish, and is usually transferred to the Publisher through the *Copyright Assignment*. Most scientific authors – young and old – just blindly sign this contract. Many a participant was rather surprised when confronted with the content of the form:

> "*... because you desire to have this paper so published, you grant and assign the entire copyright for this paper exclusively to the ASP. The copyright consists of all rights protected by the original copyright laws of the United States and of all foreign countries, in all languages and forms of communication. ...*"

which means that you transfer your entire copyright to ASP, and you get in return the permission to reproduce your work elsewhere provided you give appropriate credit[6]. Beware that you cannot legally sign two Copyright Assignments and submit the same manuscript to two copyright-demanding publishers.

Many students asked me whether they must get permission to reproduce complete sentences. In fact no, because of the so-called *"Principle of Fair Use"*. This principle is a privilege that allows users to copy without permission for non-commercial purposes of criticism, research and teaching. Thus, when citing one or a few sentences, provided you give due credit, no permission is needed. But the principle is vague and when in doubt, it is better to ask for permission.

All book publishers take over your copyrights, and very few journals leave copyrights to you. A very special situation occurs with PhD thesis works: when reproducing your papers in your thesis book, simply ask for permission; it will be granted.

Evidently, the financial consequences increase with the commercial interests of the material you copy; just be prepared for the financial complications if you breach copyrights with a well-established publisher, museum, or library. Let me give you one practical example. In Sterken (2005), I reproduce three graphics: two colour reproductions on the cover, and one black-and-white reproduction of a comic strip on page 178. Permission to reproduce the portrait of Ole Rømer was granted free of charge by the Rundetårn Museum in Copenhagen: hence I reproduced it on page 182 (in black-and-white), and also on the cover of the book (in colour). Permission to reproduce the portrait of Giovanni Domenico Cassini was granted by Observatoire de Paris for a fee of less than 50 Euro per reproduction, hence I reproduced it on the cover only. Permission for a single black-and-white reproduction of the comic strip was granted for a fee of almost ten Cassinis, and several additional restrictions were imposed (no modifications of text balloons, for example).

6. Writing a Research Paper

Writing a paper is a *process*, a chain of gradual steps that lead to an acceptable and pleasing end product. The best procedure is to start drafting a paper while

[6]Note that some copyright assignments leave you with much less liberty than this one.

the work is still in progress, recording first the preliminary structure and then completing those parts which are rather easy to handle: description of the methods, observations, references, Figure captions, etc. One advantage of starting early is that you become familiar with the journal's house style and almost immediately can see some of the fruits of your labour in typeset format, and that you avoid staring at blank pages or sloppy notes. Another, more important, bonus is that this approach may also lead you to follow possible sidelines, even to a spin-off paper derived from your main work. Such by-product paper is an excellent item to present at a meeting as a poster showing new findings in the context of the core work without unnecessary duplication of material that has already been published elsewhere. In other words: *you can make publicity for your core work, without violating copyright rules nor creating empty compositions*. As writing is a process, it takes time to acquire the necessary writing skills. There are four indispensable basic requirements for producing a good paper:

1. write clearly,
2. write accurately,
3. be brief (avoid verbose and pompous styles),
4. build a logical structure: the train of thought should be logical, avoiding a winding and repetitive course in the suite of ideas.

Besides these basic requirements, there are a number of issues to absolutely avoid, see Sect. 9. The subsequent paragraphs discuss the general structure of a research paper.

6.1. Title and Running Title

The title should be specific and as brief as possible, at the same time it should be attractive. If a title is long, then the author should provide an abbreviated "running title" for page headers. Avoid neutral titles (beginning with "A study of ..."), refrain from excess words, do not use abbreviations (unless they are very well known, like LMC), and prevent grammatical errors and typos in the title. Finalize the title when you finish the paper.

I recently received a paper entitled *"On BH's and GW's"*. It took me a moment to realize that the compilation was about black holes and gravity waves, especially because the plural of BH should be written as BHs – without accent (which expresses a relationship through the genitive). Such a title, though brief, is not a clear one, as the reader needs reflection to understand it.

6.2. Authors

The order of author names is something many young (but also some not so young) writers struggle with. There are no general rules, except the expectation that the order of names is morally upright and correct, i.e. that there is a *progression with delivered effort or labour*. Remember that the first author, in general, bears responsibility for the work. A solution I applied quite some time in my early postdoc years, was to decide the author sequence at the very end,

just before submission. But that ideal turned out to work only when no more than two or three authors are involved, and does not fit every team.

One should always discuss authorship in an open way: if you think you should be the first author, start a dialogue with the others and give your arguments. **Never** change author sequence on your own initiative only: dialogue is the only solution if you do not wish to permanently damage your relationship with colleagues with whom you collaborate.

Avoid inclusion of gratuitous co-authors that were not really involved in the work – including yourself. Small teams do sometimes work with a kind of reciprocity, i.e. scratching each other's backs with mutual exchange of participation in each other's papers. This is a bad habit to be avoided because you will end up disappointed (reciprocity is not always guaranteed and is often forgotten), and you will even be blamed for grave errors. Never omit names of people who did contribute to the work. For some more details on related issues, I refer to Sterken (1988).

Though it may sound far-fetched, typos in author names do happen! Such errors most frequently occur in names with character accents, in composite names (the many ways of combining *van* and *de*, or the difference between Pierre Olivier and Pierre-Olivier), and in names transliterated from Cyrillic (Russian and a number of other languages of eastern Europe and Asia). Special attention is required when publishing with Chinese and Japanese co-authors, where traditionally the family name is listed first, followed by the given name (which is frequently a composite name). These days the matter is standardized in the sense that Asian authors publishing in English use the westernized format of family name followed by given name or initials.

6.3. Abstract

The abstract should provide maximum information with minimum words and cover the following elements:

1. *WHY* was this research undertaken, and what is the objective of this study
2. *HOW* did you do the research (observations, theory, calculations)
3. *WHAT* are the new results, and what do these new results mean

and should be comprehensible without reading the paper. The abstract is not part of the paper and should not make reference to it. It is preferably written in the third person (see abstract of this paper) and draws attention to all new facts in the paper.

Avoid using abbreviations and acronyms, or listing references in the abstract. Again, grammatical errors and typos in the abstract are not allowed, and any kind of review matter is out of place here. We received a couple of Proceedings papers with a much too long abstract (up to 25% of the length of the paper) containing too much review and excessively detailed methodology.

Remember that the abstract is the first thing someone reads after reading the title (especially when consulting ADS, where reading the paper involves downloading permissions). Don Kurtz (these Proceedings) says *"...you have made eye contact and verbal contact with the audience. Now you need "the hook". Your words and first science slide tell why your talk is important..."* In

a written paper the title is the "eye contact", so to speak, and the abstract is "the hook". And, at the same time, it is the most important part of the paper.

6.4. Introduction

This is the place to mention if preliminary results or related conference papers of yours were already submitted or published. Give a clear statement of the problem you study, and draw the outline of your work. Make a brief literature review giving the most relevant papers related to your work, but avoid irrelevant citations (especially of the very few people you know personally). Only give references to papers that you have really read, or at least have seen, and never cite a reference because the paper or software manual you read also cites that paper! Wild citing changes the citation history of a work, and this helps no one. If you refer to someone, refer to a specific and important paper, not just to a minor poster.

In the introduction, but also throughout the rest of the paper, a proper paragraph structure should be maintained. A paragraph is a topic sentence where one and only one main point or idea is handled. It also includes directly-related sentences with details and information that support the paragraph topic.

Finalize the introduction after finishing the discussion and conclusions. I personally consider it as a capital error to spoil space for presenting a list of Section headings at the end of the introduction.

6.5. Methods, Observations, Computations and Theory

Here you describe your methods in such a way that the description gives all elements needed to allow experimental reproduction of your work. Do this in a concise way, list observing logs in a Table, and do not repeat such descriptions for every object discussed.

6.6. Results

Point out how the data look (trends, new effects, frequencies, ...), but do not give interpretation of the results at this stage: the data only state the bare facts, without making inferences. Give experimental errors, and state the accuracy of the results (but avoid tabular and graphical redundancy since Tables and Figures illustrating the same results are mostly not accepted by journals). Do not overplay what you found.

6.7. Analysis, Discussion and Conclusions

Here comes the interpretation (analysis) of the results reported in the previous Section. It is very important to keep this Section separate from the foregoing: just as good food can be ruined during its preparation, so can good numbers be spoiled in analysis. Compare your results with previously published work, and point out limitations and uncertainties of your work. Always translate the observational and computational accuracy to error budgets *in the physical domain*. Give suggestions for improving your results. Your stark conclusions must absolutely stand out in this Section.

6.8. Acknowledgements and Dedications

Always give credit and acknowledge the help of others: it is a matter of scholarly courtesy. It is also a matter of honesty and fairness towards your supervisor, a colleague, or the referee. Thank the provider of the equipment you used (library, telescope, computer facilities), but do not feel obliged to add all directers and associate directors of the place to the list of authors. Explicit mentioning of research and travel grants is mandatory (some agencies require standard expressions and contract numbers). But do not exaggerate, and certainly avoid phrasing it like *"The author wishes to acknowledge the work of Dr. B.L. towards formulating the concepts and writing the first draft of the manuscript"*[7], which may very well be interpreted as mockery. When mentioning people, give their complete names (Jim, John and Jane will appreciate if their family names are included).

A dedication is mostly a tribute to one or more persons and is seldomly used in scientific reports. But it is quite often included in a PhD thesis manuscript (*"in memory of ..."* or "*to my parents*"). Never dedicate your PhD thesis to your beloved pet.

6.9. References and Citations

There exist two main systems for citing and referencing: the *Harvard system*, with author names and year in the text and references in alphabetic order at the end (like in all papers of this book), and numbers in the text with references in footnotes or numbered at the end. ASP uses the Harvard system.

6.10. Postscript and Appendix

A postscript is a note or series of notes appended to a completed letter, article, or book. It is reserved for a very special remark or statement. An appendix contains supplementary technical matter in tabular form, usually attached at the end of a paper or book, not to confuse with the postscript described previously.

7. Plagiarism and Dishonesty

Charles Babbage was a mathematician now widely known for his early conceptualization of a mechanical computer. In 1830 he discussed the problem of dishonesty in science (Babbage 1830), listing three types of dishonesty: forging, trimming and doctoring of data. But much more goes wrong in the reporting of science.

7.1. Plagiarism

Plagiarism is the use of ideas or words of another as your own (without crediting the source). A very special form of plagiarism is "self-plagiarism" – that is, reusing sentences and complete paragraphs – even redundant duplicate publication from your own published works.

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[7]This is a quote taken from a real book, not a tongue-in-cheek statement.

There is some controversy over the question if such duplication is acceptable, whether or not the source – yourself – is cited. I would say that plain unnecessary duplication should be avoided, but sometimes mild repetition may be useful from the educational point of view.

Scientific writing is a commitment to intellectual honesty. That means that you are supposed to be honest with the data, report honestly, and cultivate a honest attitude of citing the sources you use. Fortunately, we may expect dark times ahead for poachers of texts and ideas, since academic institutions now develop powerful software for cross-correlation of published material in search for identical passages: internet, the point of origin of much plagiarism, is quickly becoming the plagiarist's toughest adversary. Note also that some journals provide the referee with the submitted TEX files, and the structure of these files often gives a very clear insight in the way the file was built up: when many paragraphs (and references) are flagged out, there is a great probability that the paper has already been submitted elsewhere. Especially the format of citations and references, and their ordering, can tell the reviewer where the paper was published before. It is sad to say that even these Proceedings contain a handful of papers where such methods were used.

That hard-core plagiarism does happen is illustrated by the following story. In 2001 I was asked to referee a paper that criticised a work by the late Dan Popper. To my surprise, I found that 80% of the Abstract and the Conclusions were copied *verbatim* from Popper (1998), and several other paragraphs were literal copies as well. Even Popper's Table 1 was copied to an unacceptable degree, including the typos that the typesetter had made in 1998 (omission of greek letters in Bayer star names). My conclusion as a referee was "*The scientific content of this paper does not correspond to the level of quality expected by this Journal. Publication of this paper will lead to legal problems with the copyright holder*". Needless to say, the paper was refused.

Always mention the original source of Figures, never reproduce a copy published by someone else, and never ever refer to one of your former published copies as the original source of such graphical information.

A milder form of deceit is presenting a compilation of data or references as if it were your own work, whereas the list was simply copied or downloaded from another source. As a rule, *you should only list the references you have actually consulted*, not copy lists from other places. Not only because it is not fair, but because this form of copying perpetuates and propagates bibliographic transcription errors which are always present in such lists.

7.2. Dishonesty

Another form of dishonesty is to submit a paper co-authored by one or more senior scholars without their knowledge: this is what happened in another case I refereed, and where the manuscript and the science were of such low level that letting it pass would have blown a direct insult to these senior "co-authors". Why do people do such things? I can only guess, but I think they must assume that the referee might be a befriended colleague of the ignorant senior co-authors.

In fact, such behaviour could lead to legal prosecution, especially when you include someone else's name in an application for a grant or an observing pro-

posal, and it is very unpleasant if not humiliating for the duped to find out to have been unwittingly dragged before a peer-review panel.

This brings me to the absolutely worst form of research misconduct: plagiarism during the review process of grants, or while refereeing manuscripts. This is the fourth type of violation of the standard of honesty and is now formally part of the definition of FPP (Fabrication, Falsification and Plagiarism, see Kaiser 2004), and certainly a fraud that is not as easily detectable by an alert referee as catching a dual submission.

7.3. Misquoting

Misquoting is to repeat something someone has said in a way that is not accurate: deliberate misquoting is a frequently-used tool in politics, even by the media, and contributes to inaccurate reporting and the rewriting of history. It also occurs in scientific papers, and it is either intentional or inadvertent. Misquoting of the first kind is a perversion that makes the misquoter a complice in the offense. There are basically two situations where inadvertent misquoting may occur: citing out of context can easily happen when you only read the abstracts, and quote from this limited information. A second source of misquoting occurs when quoting in translation: it is, therefore, good practice to include the original quote (in a footnote) together with your translation. For an example, see Sect. 9.12.

And if a quote includes an error of spelling or grammar, you are expected to copy the quote exactly as it was printed, though you may add the Latin [*sic*] (which means "as it is written here") after the quoted material.

8. Referee and Editor

From previous experience, and from discussions with students at the Pécs school, I have the impression that students are not really familiar with the role of the referee, and the referee is quite often confused with the editor. A scientific referee is a person who reviews a paper and recommends that it should or should not be published, and so helps separating the chaff from the wheat. One extreme view is to see the referee as a censor, one who deletes harmful material; the opposite view is to see the referee as a kind of patient corrector, an invisible person that corrects and remedies poorly-written manuscripts. Referees are no more no less than "gatekeepers", assisting the editors keeping the system going by helping them to determine what gets published.

Most editors and referees try to help you and most papers get published (my own rejection rate is about 3%). Referees either operate anonymously, or waive anonymity by signing their reports. It is very important to learn to understand how the refereeing system works, and how to handle it for your own profit. It is important to learn to cope with the good and bad sides of the referee system, and to refrain from abusing the system.

8.1. Accepting the Limits of Discovery

There are two dangerous misconceptions the young scientist must forsake: that the work was done all by yourself, without any help from others, and the hope that what you have written is something totally new.

The first point is related to the fact that you always rely on science done by others, even before you started your study. The second point is that it can happen that, after finishing a study, you discover that someone else has done a similar thing long before you. There is no other way out than to mention that reference, possibly adding a statement that you discovered this work only after you had written down your conclusions.

8.2. Accept that Strangers Criticise your Work

This is perhaps one of the most difficult psychological aspects a young scientist must learn to live with: someone, whom you may not know or whom you may not like, will take your work apart, and return some critical remarks.

8.3. Proofreading

Proofreading is not a natural talent, but an acquired skill, and you must learn to master it by developing an "eagle eye" for your own mistakes. Proofread very slowly, one word at a time, and read what is written on the page, not what you think is there. The very last double-check in proofreading should be title and abstract. Always ask someone else to check the title page of your thesis manuscript (especially the ommission of blank spaces and the wrong use of the hyphen), since such are the most painful mistakes to live with.

After reading over your manuscript several times, you will somehow become "blind" to errors because you subconsciously dictate rather then read. Ask a close friend or a colleague who is not involved in your work to proofread your entire manuscript. This is, by the way, how the Editors of these Proceedings have worked together: one of us reads and corrects all papers several times, while the other's mind remains fresh. The second-stage proofreading of all corrected manuscripts then reveals a multitude of typos, omissions and mistakes that the first Editor could not possibly detect at this stage.

There are several beliefs about when to stop proofreading. One is the fatal "*no matter how many times you read the manuscript, there will always be undetected errors, hence proofreading is useless*". The other is what I overheard one of my former senior colleagues saying "*we have done enough now and any remaining errors will be flagged by the referee*". Both attitudes abuse the system.

But you should always be aware that, once all the experimental and analytical work is done, one must stop at some point, and refrain from going on forever changing what has been changed already. This phenomenon is quite typical for a situation with "too many bosses", i.e. the student having to take to heart the advice of too many senior co-authors. It is good to be aware of the so-called *Law of Diminishing Returns*: a general law of economics proposed by Malthus (1798), stating that if one factor of production is increased (here the writing) while the others remain constant (the data and analysis), the overall returns will relatively decrease after a certain point. It is a matter of training and skill to find the optimal point where to stop writing.

8.4. Etiquette and Netiquette for your Profit

Etiquette is a set of rules of conduct to be observed in social or official life; *netiquette* is the etiquette of cyberspace. Whereas etiquette, as a code of conduct, may appear obsolete these days, business companies offering almost identical

products at cutting-edge prices do discover that "good manners" may make the difference. The same is true when dealing with referees and editors: sloppy conduct may harm your cause.

The first rule is: always respond or reply to editors and referees, also if your paper is refused. Even sending a simple message acknowledging their mail (for example saying that you will revise the manuscript and submit again) is much better than not replying at all. By all means, avoid being rude: remember that your words are written, and that they can come back to haunt you.

The second rule is to respect the editor's time and bandwidth by avoiding voluminous mails and unnecessary attachments. I had a case where an author sent the `dvi` file, returned the `sty` file, and even included Windows system files with the submitted archive. Never submit a LaTeX file that you cannot compile, never tell the editor that *"it compiles correctly after hitting* `return`", because no publisher will ever accept such a thing. Nor use "local" typesetting packages which you should not expect to be available at the commercial printer's place overseas.

Referees and editors are working scientists, and have their own research deadlines and teaching duties. It is a matter of education and courtesy to submit to these people manuscripts that have received the highest degree of author attention as possible. It does happen that referees let pass a poor paper. But you should by no means draw wrong conclusions when seeing such a paper in a high-impact journal: mirror your manuscript to the best papers in the journal, and do not submit a poor product because another author has succeeded in getting something published that is not of high standard.

When a referee's report contributes to a signifcant improvement of the manuscript, or when the referee flagged a capital mistake, it is good practice to thank the referee. But do not thank the anonymous referee for *his* help unless you are sure that the referee is male (see Sect. 9.12.).

8.5. Responding to the Referee

Learn to correctly read the referee's message: sometimes the referee asks a question which looks stupid, at first sight. That does not necessarily mean that the referee is slow of mind: it is very probable that the referee, by playing devil's advocate, points to some confusing or vague elements in the preceding passages. Few written statements are misunderstood because the reader lacks intelligence, most of the incorrect interpretations result from foggy writing.

Explain the changes you have made to the manuscript (do not just silently expect the referee to find out what you have changed) and spell out why you prefer not to follow some of the referee's suggestions. If you plainly disagree with the referee, then open a dialogue with this person.

When receiving a very negative referee report, never answer immediately on line, but wait at least twelve hours before responding by email or phone. There is a fair chance that, reading the report over the next day, you may find it less shocking and impossible to digest.

Be forgiving of other people's mistakes: also the referee makes typographical mistakes, especially because the reports are due for a deadline, and the closer to the deadline, the less time is left for proofreading the report. I recently requested an author to add a reddening vector and error bars to their Figure 5, but in fact

I meant to refer to their Figure 6. The author replied *"Figure 5 is a power spectrum and then how to add reddening vector and error bars?"* Such replies do not promote smooth and fast reviewing.

8.6. Becoming a Referee

Students may occasionally be asked to referee a paper of a senior author. The first thing to consider is whether there is any conflict of interest – that is, when close friends or people with whom you are involved in current collaboration are on the author list. You should then normally refuse becoming the referee. Never hope to hide behind anonimity: abuse of such power will always backfire on its originator.

9. What to Avoid at all Price

This Section gives an overview of some major mistakes to avoid.

9.1. Writing Things that you do not Understand

Never add sentences that you do not fully understand (one of the pitfalls of the copy and paste facility). This is especially true for Latin abbreviations, like "et al." which stands for the Latin *et alii* and the very confusing "i.e." and "e.g.": the former stands for *id est* ("that is", or "in other words") whereas the latter means *exemplia gratia*, "for example".

Foreign terms (*Gedanken Experiment*) and other Latin words (*minus, versus, in extenso, ad hoc, a fortiori, etcetera*) should, in principle, be written in italics. The ASP adopts the editorial convention of not italicizing the phrase "et al.".

9.2. Drowning in Acronyms

Science uses a technical terminology that cannot avoid the use of acronyms. Space science jargon, in particular, is peppered with acronyms for space vehicles and parts thereof. Try to avoid inventing acronyms, and if you really feel that an acronym should be used, then first count the number of times the acronym appears in your text. The introduction of a new acronym does not pay if only used two or three times. Make also sure that the acronym you propose has no political or obscene meaning. Make sure that, when using an acronym for the first time, you also give its definition. Never use acronyms which you do not understand, for example young observers may not know what a PMT (Photo-multiplier Tube) is, still the acronym is used. Do not add a genitive to acronyms: "WET's results" is better written as "the results obtained by WET[8]". As said already, no acronyms should appear in the abstract.

9.3. Mixing American & British styles

A paper or a book should use either American or British style. British words ending on *-our, ise, -logue, etc.* are spelled differently in American: color, analyze, catalog. Note also that the Americans write acknowledgment for acknowlegement, and cesium for caesium.

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[8] Whole Earth Telescope

9.4. Clichés

A cliché is something that has become a commonplace. The term *asteroseismology*, for example, has become such an attractive concept to use, that it appears in so many introductions to papers that have very little to do with the seismology of stars. Quite often an author has determined only a couple of frequencies – not even a complete frequency solution – but still wants to sell the product by opening the paper with the magic word. There is just no need for such marketing using a product label that does not cover the content.

9.5. Poor Figures and Tables

Graphical presentations should help the reader understand the arguments in the paper. In fact, the same advice as for presentations should be followed, except that slides mostly accomodate color graphs, whereas most of the publications are in black and white. It makes no sense to point in the Figure caption to blue and red dots when the publication is in gray scale.

A common problem with Figures is that the axis labels are often too small (and the units not given at all), and that the overall image resolution is too low. Avoid large empty spaces above and below the plotted information: such spaces are better used for showing more detail. Beware of undocumented image enhancement that manipulates the image by increasing prettiness at the cost of data fidelity.

The most common typesetting errors in Tables are the column alignment (most authors center every column), the mixing of the mathematics *minus* and the dash, the number of significant digits not conform to the accuracy of the result, and forgetting the leading zero before a decimal (write 0.1000, not 0.1 nor .10).

9.6. Inconsistent Capitalization

Some words may have different meaning when written with initial capitals: the Moon is our moon, whereas moon refers to a natural satellite, and Galaxy refers to our galaxy. A figure can be a printed character or a numerical value, whereas a Figure is a graphical representation. A table is a piece of furniture, a Table is a systematic arrangement of data in rows and columns. In this paper I capitalize editor and publisher when I refer to the Editors or Publisher of this book, when not capitalised, the terms refer to editors and publishers at large. Adjectives (like "editorial") are never capitalised.

9.7. Footnotes

Avoid footnotes since they interrupt the reading process, and render a very poor page layout in Sections with lots of mathematical formulae. This book contains several papers with footnotes (in particular the paper by Enrique Solano because it contains so many URL addresses).

9.8. Vague Concepts

Be very careful when using words with a very strict meaning in mathematics and physics, such as robust, chaos, linear, mode[9]... Sometimes, a very well-defined parameter is described so vaguely that the reader has no clue of what it really represents. For example, σ is normally used for the standard deviation of a single observation, $\pm$ for the error bar representing the standard error of the mean, but in past times, $\pm$ was mostly used for probable error (p.e.). Avoid writing σ, or "the sigma value".

9.9. Unnecessary Emphasis

Some authors too often use boldface or italics to give some words and sentences particular prominence. Over-emphasizing simply works the opposite way. Pay attention not to use superfluous words, for example "existing calibrations" (non-existing calibrations simply do not exist, hence there is no point in emphasizing "existing").

9.10. Misuse of Hyphen, Comma and Apostrophe

Expressions like "zero mean uncorrelated random variable" are difficult to understand, and therefore the English language uses the hyphen (dash) between related words: zero-mean and random-variable. Other examples are radial-velocity curve, light-time effect, 60-cm telescope (not 60cm-telescope), close-binary system. The hyphen in "20-th century" is superfluous since 20th is an abbreviation and contraction.

The comma serves to indicate a pause, and ommission or transposition of a comma may completely change the meaning of the sentence. Consider, for example, the following sentences in which only the number and place of the commas differ: "*Chris said, Conny lets meet tomorrow*" and "*Chris, said Conny, lets meet tomorrow*".

An apostrophe is a mark used to indicate the omission of letters or the possessive case (genitive): Mira (plural Miras – not Mira's), LBV (plural LBVs not LBV's).

9.11. False Friends

False friends are pairs of words in two languages that look or sound similar, but differ in meaning. A very frequent misunderstanding involves *eventually* (meaning an unspecified later time) which matches the French *éventuellement* (possibly). Other examples are *data* and *date*, and the confusion between "to use" and the French *user* instead of *utiliser*.

9.12. Sexism

Sexism is the collection of attitudes that foster stereotypes of social roles based on sex. Traditionally, the third personal masculine pronoun "his" was used to refer to masculine and dual-gender nouns (like astronomer). In modern usage this is considered sexist and therefore "his/her" is sometimes recommended to

[9] A common error is to call a frequency a mode, before even knowing that the frequency is associated with pulsation.

avoid sexism. But this is awkward, especially when used repeatedly in a text, and draws attention away from the real message. One solution is to make the sentence plural. While it is possible to draft a paper avoiding a single occurrence of such sexist elements of expression, one should be careful when reading older papers and texts from times when such concerns were not raised.

Take the following example. When queuing at the Brussels airport security checkpoint on my way to Budapest, I saw a huge drawing with the quote "*By believing in his dreams, a man turns them into reality*", which is an hommage from Hergé to Neil Armstrong and the Apollo XI crew. Struck by what would now be seen as sexist language, I consulted the original French text: "*A force de croire en ses rêves, l'homme en fait une réalité*". Here, *l'homme* – man – was poorly translated to "a man". This vividly illustrates the danger of inadvertent misquoting in translation, see also Sect. 7.3. And this, again, demonstrates that writing is a process: I must have spotted this phrase dozens of times without noticing the point I am making here. So why, exactly on my way to Pécs, am I struck by this imperfection? The answer simply is: because I was composing my paper in the weeks preceding my travel – even during my trip.

9.13. Non-standard Nomenclature

When existing designations of celestial objects are used in your paper, they should never be altered (e.g., neither truncated nor shortened). Do not give your "own" variable star name mentioning the original consolidated nomenclature as "other designation", since this creates confusion when other authors take over your naming scheme. Be honest and do not say that you discovered 23 new variable stars when half a dozen of them were already known before you started the study, and you simply renamed them! The original bibliographical reference for a designation should be given in the first place.

9.14. Improper Words and Word Combinations

English is becoming the *de facto* scientific language, and a very substantial fraction of science papers are written by non-native English-speaking authors. This leads to many problems, which can be handled with due training. Always look up the meaning of a word whenever you are in doubt, especially when words with different meanings have almost the same pronounciation (for example "whole" and "hole"). Words which are considered synonyms in your mother tongue, may have a different connotation in English (like large/great/big, intriguing/interesting or claim/maintain/prove). Beware when acknowledging the ministry: make sure that you refer to the office of the minister, and not the clergy (the body of ministers of religion).

One of the most difficult issues is the proper use of the definite article "the". A definite article is used before singular and plural nouns when the noun is specific. It does not change according to the gender or number of the noun it refers to. This is not so in many other languages, some even do not use the definite article at all, or insert "the" when it is not done in English. The only way to learn is to read a lot, and have your papers proofread by a native English-speaking scientist.

Postscript

Just one word on the supervisor's role in the writing process, which was not included in the talk because time was limited and also because several supervisors were present together with their students. The main impression I got from reading the papers and speaking to the students, was that most supervisors supply good working and funding conditions, but that they often do not have the time to provide adequate guiding during the writing process. Specifically, a fast turnaround time of draft manuscripts is a prerequisite for the student to learn all aspects of the writing process in a smooth and progressive way.

The main lessons to be drawn from our experience is that instruction and guidance are needed when writing down and presenting your results. Training is the vital first step, and consists of acquiring communication skills by means of intensive reading, combined with multiple passes of revision of whatever you set down in writing.

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Appendix: Useful Sources of Reference

- *Merriam Webster Dictionary*[10] is a free online dictionary and thesaurus.
- *Office of Science and Technology Policy*[11] (OSTP)leads an effort to develop and to implement sound science and technology policies.
- The *Web of Science*[12] provides access to information from the most prestigious research journals in the world.

[10] `http://www.m-w.com/`

[11] `http://www.ostp.gov/`

[12] `http://scientific.thomson.com/products/wos/`