The unofficial guide for authors

(or how to produce research articles worth citing)

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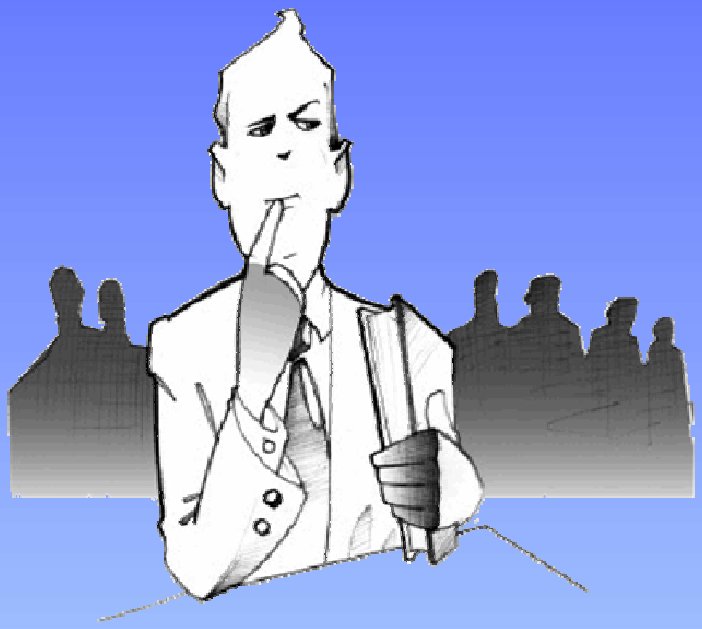

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Foreword

Writing scientific articles and getting them published in peer reviewed journals is not an easy task, and it is often the most time consuming and demanding part of research nowadays. The continuously increasing pressure on scientists, all over the world, to write papers and get them published has created a "publish or perish" syndrome resulting in an enormous increase in the numbers of articles published. Often at the expense of quality.

Many criteria have been proposed for the evaluation of scientific excellence in research institutions. The dominant parameter in most research organizations remains the number of publications and the impact factor of journals in which scientific results get published. It is legitimate to ask whether these are the right criteria for assessing the quality and productivity of a research organization or should we perhaps focus more on the impact these publications make in a period of time?

The JRC is no exception in this context, with publications still ranking high in the periodic action review (PAR) exercises that are organized every year. It is therefore extremely useful and timely to have such an "unofficial guide for authors" published, that may provide some helpful hints and guidance for researchers within the JRC who wish to improve their output and for scientists in general.

Certainly a good publication must have new, relevant results. Excellence in research remains the cornerstone for any scientific publication. Good writing and skillful 'packaging' of scientific achievements can help promote awareness of such new discoveries. This is particularly true in a time when the 'envelope' often tends to be more important then its actual 'substance'. A word of caution is therefore needed: a well-written article may not necessarily report relevant scientific results. While the opposite is clearly often the case: we often come across completely unreadable articles reporting excellent new scientific achievements. As a consequence, too many excellent scientists do not get the recognition they deserve, simply because they are not capable

of presenting their result in a readable form that is acceptable to high-impact scientific journals. This is particularly true for non-anglophone scientists, who have to face the additional hurdle of language barriers.

This short unofficial guide for authors is certainly a valuable source of information for both young students and experienced scientists. It does not have the pretension of being exhaustive, but it surely provides interesting ideas and strategies which can improve the quality of scientific publications.

Luca Montanarella

Action leader (MOSES)

The unofficial guide for authors
(*or how to produce research articles worth citing*)

Tomislav Hengl and Mike Gould

Contents

Most scientific journals provide guidelines for authors – how to format references and prepare artwork, how many copies of the paper to submit and to which address. However, behind any formal editorial system are real people with their professional and personal interests, which often have a profound influence on the chances that your paper will get accepted (or rejected). The official guidelines say little about how you should prepare your paper and what are the chances that it will be accepted. You will not be able to find such information on journal websites. This gave us the idea to write an unofficial guide for authors, in which we could tell you frankly what you can expect from journals, editors, reviewers and, indeed, the whole system of science. We offer some pragmatic tips on how to manage the production of your paper — based on a training programme in academic writing and our own experience. We also address some of the deeper aspects of preparing and publishing research articles as well as the limitations and frustrations that are inherent in current editorial systems such as hyperproduction, phoney co-authors and poor reviews. This guide is primarily intended for inexperienced researchers, although we hope more experienced authors will also find some of the points raised in it of interest.

T. Hengl and M. Gould

In Ispra, March 2006.

Chapter 1

Introduction

1.1 Science and what lies beneath

"First principles, Clarice. Simplicity. Read Marcus Aurelius. Of each particular thing, ask: What is it, in itself, what is its nature...? " [1]

1.1.1 A brief guide to science

Indeed, before jumping into tips 'n tricks for getting your paper published, we need to go way back before the actual submission of the paper and address some philosophical aspects of preparing and publishing research articles. It might surprise you that we start by talking about first principles, but less experienced researchers, in particular, often try to publish their work without having any idea of what science is about, where they see themselves in the world of science, and for whom their work was intended in the first place. We will use the answers to these questions to back up more specific instructions for producing scientific publications. Avoiding philosophical debates, these are the essential concepts:

What is science? — The most compact definition of science is that it is a **collection of objective knowledge that was derived through systematic investigations that are well-described and can be repeated**[2]. In a way, science is an ever-growing evolution of human knowledge about our surroundings

[1] The first simplicity principle of Hannibal Lecter that helped agent Clarice Starling break the case of serial killer. From the "Silence of the lambs" by Thomas Harris.

[2] We would like to emphasize the three key words from this definition that we will come again and again in this article: objective, systematic and repeatable.

and ourselves. This knowledge is often rather soft and needs to be questioned over and over again — "*the greatest obstacle to progress in science is the illusion of knowledge*" (Daniel Boorstin). What we take as fact is often just a hypothesis with a certain amount of evidence, but we should not get into such debates. What is important to emphasize is that science is not only a *encyclopedia galactica*, i.e. a systematized record of facts. Scientists also contribute to science with new, experimental systems, which might not have direct applications straightaway.

What are the rules of science? — Although there is no official booklet listing the laws of science, science does have some basic rules. The number one (unwritten) rule of scientific work is that **scientific knowledge needs to be built on arguments and proofs and not on beliefs or authority**. The second most important rule is that **a researcher needs to offer models that best fit reality and not personal (subjective) aspirations**. For science, even the most pessimistic truth is better than fiction. Another interesting rule is that **there is no democracy in science**: all can be wrong and a single person can be right as long as he/she can prove it. Researchers who do not accept arguments, but follow the herd, often discover that the whole community was mistaken. On the other hand, if existing knowledge is rather 'soft' and uncertain, **pluralism and open discussions, even speculation, need to be allowed**[3]. Of course, as long as these are all backed up by data and strong arguments, science should not limit possible solutions and interpretations of unexplained phenomena: **everything is *a priori* possible; the issue is only how probable it is**. Of course, we are mostly interested and would report only on things that are highly or most probable. The sixth important rule of science is that **scientific proofs need to be built primarily through systematic investigations — research experiments**[4]. In addition, **the results of research experiments need to be reported in an unbiased, clear, concrete, coherent and**

[3]For example, the problem of global warming is still a soft theory — it is therefore advisable to use a variety of models to explain this phenomena and then slowly evaluate them.

[4]Experiments are tests that are systematically designed and described in (more or less) controlled conditions. These can be physical or virtual (and even mind) experiments, i.e. simulations.

logically-structured way, again giving much more emphasis to arguments and proofs than to personal impressions/aspirations. Many people believe that **researchers also need to be able to report on new knowledge in a popular, open-minded way**, trying to reach as wide an audience as possible and not only writing for themselves. The last rule worth mentioning is that **science does not have a final goal nor final theories**[5]. There are certainly no limits to imagination or perfectionism. So if a researcher thinks he/she has the final word or that he/she has discovered the ultimate theory, he/she might be disappointed.

What are the goals of science? — The core goal of any scientific work is **to make discoveries and explain them**. In most (or all) cases, these discoveries / explanations are then used to help people benefit more from their lives. Although many distinguish pure experimental research from applied research, all results, both experimental and applied, are eventually used for the benefit of researchers and/or the wider community. In that sense, science is always application oriented, the only issue is whether users will benefit immediately or much later. However, researchers working on theoretical or experimental topics cannot be held responsible if there is no direct financial benefit from their work. Scientists need a certain degree of creative freedom — just like artists.

Who are scientists? — Scientists are people who actively conduct experiments and investigations in order to explain existing phenomena or suggest new ways to improve current systems. Although scientists are like anyone else, with many different characters and habits, they also have some specific characteristics that differentiate them from others. In principle, scientists are driven to do science by three psychological phenomena: **curiosity**, **imagination** and **perfectionism**. We would also like to add to this trinity **enthusiasm**, although this characteristic can sometimes be counterproductive.

Are you a (born) scientist? — You can certainly check it if you have some of the characteristics listed above. You need to be determined[6], of course, that this

[5] There is a whole book on this topic (Weinberg , 1993).

[6] A good starting point to understanding the essence of science is the Carl Sagan's opus.

is the business that you wish to be in. Then you need to produce records of your ideas and theories and publish them. After some time, you can log into a scientific information system and see if others are referring to your work. The more hits you find, the more certain you can be.

Rules of science

(1) Scientific knowledge needs to be built on arguments and proofs — not on beliefs or authority.

(2) Even the most pessimistic truth is better than fiction.

(3) There is no democracy in science: all can be wrong and a single person can be right.

(4) Pluralism and open discussion, even speculation, need to be allowed.

(5) Everything is *a priori* possible, the issue is only how probable it is.

(6) Scientific proofs need to be built through research experiments that are repeatable and unambiguous.

(7) The results of research experiments need to be reported in an unbiased, clear, concrete, coherent and logically-structured way.

(8) Researchers need to be able to report on new knowledge in a popular, open-minded way.

(9) Science neither has a final goal, nor final theories.

Note that some of the precepts listed above might give you the impression that science is some sort of religion and scientists its followers. Maybe we should focus more on the concrete world of science. For that reason, we will further speak about **researchers** (people who professionally conduct research experiments), **research groups** (groups of researchers working on similar topics and meeting regularly at scientific meetings and workshops), **system of science** (national and international organizations with their members, structure, formal rules and evaluation criteria), **research organizations** (research societies, institutes and schools), **commercial scientific companies** (publishers, scientific information providers) and **research publications** (articles and books published by scientific publishers).

1.1.2 The purpose of a research article

Did you ever ask yourself what the essence of a research article is? Is it solely a report about an experiment or is it an essay or a user guide for colleagues who would like to

conduct similar research? In fact, a research article is a bit of all of these. It looks like a research report, but it also contains some unique spices — (belletristic) elements similar to an essay or article from a magazine. However, unlike essays or novels, articles must rigidly follow a logical structure. In principle, in every research article three levels of structure can be distinguished in all research articles: macro (sections), meso (paragraphs) and micro (sentences). Most journals require that authors precisely follow at least the macro structure[7], although, these days, even the meso structure (the so-called 'logical moves') can be predefined and agreed on (see also the appendix). Note also that the main purpose of every article is the same — to communicate new[8] data and new ideas to a research community.

Important point 1 *The purpose of a research paper is to communicate new, original knowledge (new concepts, new data), so that readers can apply, modify and extend that knowledge.*

Although researchers also communicate their ideas through conferences, meetings and through the educational system, their contribution to science is mainly measured through research output by means of publications. Many researchers[9] in the history of science, who did not publish their work in their time, are no longer connected with their work. This is nicely illustrated by the well-known aphorism *publish or perish*. In some sense, the *publish or perish* aphorism gives a competitive character to scientific work — scientific discoveries are connected with those who first publish them (in a visible journal). That's the name of the game.

1.1.3 Types of research articles

Publication of your ideas/discoveries is not (at least it should not be) the ultimate ambition of a researcher. The most important thing for a researcher is to make a signif-

[7]The common format is IMRaD: Introduction, Methods, Results and Discussion.

[8]Except in the case of a review article where authors try to systematize existing discoveries.

[9]The school example of a researcher that *perished* is the Christian Huygens who may have been a superior scientist to Descartes or even Newton, but did not seriously consider publishing his work (Crump, 2002).

icant contribution to science, i.e. to make an impact. Impact can be evaluated in various ways. One of the best-known organizations that measure the impact of articles and authors is the Institute of Scientific Information[10] (`http://scientific.thomson.com`) in Philadelphia. ISI monitors around 8,000 journals and has accumulated approximately 20 million of articles in its database since immediately after the 2nd World War. In simple terms, ISI enters articles into a database to count the number of times they are cited by others. Based on this simple measure, ISI make lists of the most important authors, journals and articles. So the true motto of a researcher should in fact be: *make an impact or perish.*

Once the article is published, it starts accumulating 'points' i.e. citations. This is the absolute measure of its impact. Of course, it is not fair to compare the number of times a paper has been cited for a 15-year-old paper and a rookie. The most objective measure of the impact of a paper is probably the average number of annual citations (Garfield, 1990), in other words, the relative impact factor. The higher the number of citations per year, the more important the paper. Note also that all articles gradually disappear from references, which means that they all have a citation 'half-life': the number of years that one has to go back in time to account for 50% of the total references (Garfield, 1990). In Natural sciences, the citation half-life typically ranges from 3-10 years, although most articles will only be cited during the first few years (or not at all).

Important point 2 *The most objective evaluation criteria for a research article are the number of times it has been cited per year and its citation half-life.*

Based on how often an article is cited, we can roughly distinguish the following five categories of articles:

***Born-dead* papers** — These are papers that are almost never cited. Their citation half-life is infinitely short, which means that the topics do not have an audience, the paper is 'indigestible' or it's simply dull. Some papers are simply *bad science*

[10]Since 1992, ISI is a part of part of the Thomson Corporation, a private company. Still, many use the old name.

chasing a bad idea, but it takes time until the research community forms an opinion on this. Some might argue that such papers are simply a waste of resources, but this is not completely true. A small proportion of born-dead papers have great potential ('sleeping beauties'), but they are too avant-garde, too introspective or too hypothetical. So, it is good to have a record of some good ideas/discoveries even if we do not exactly know what they mean and how can they be used to solve real-life problems. The real problem is that about two-thirds of all papers belong to this 'born-dead' class (see also the work of Garfield (1979) and Latour (1987)).

***Proving-the-known* papers** — Many papers are routinely well-written, based on excellent data and the whole project seems to be well organized and conducted, but they are simply not significantly novel enough (others have already done the work). They can often still be useful, because they retell known theory in a more 'digestible' way or they are more effective in providing a bigger picture. Note (see point 1), that a paper needs to be successful in transferring new knowledge. So if an author thinks that he/she can do a much better job then the original author, such a paper will be welcomed. Of course, the author then needs to search for and acknowledge the original work, even if he/she is not immediately aware of it (do your homework — dig into the literature).

***Promising* papers** — These are the papers that reveal new discoveries/ideas that are significant for both experimental and applied science. Sometimes, even a badly written paper can be promising. Unlike the born-dead and proving-what-you-know-papers, authors of promising papers show both talent and dedication to science. Also consider that research groups usually need at least a few years to absorb the ideas laid out in a paper, so such promising papers can eventually get promoted to a higher class.

***Most cited* papers** — The most cited (Garfield, 1990) or the most downloaded papers are those that have not only proved to be promising, but also ones that the research community has shown most interest in. Such papers usually

distinguish leading scientists[11] from run-of-the-mill ones. In many cases, the most frequently downloaded papers do not need to be of exceptionally high-quality (they do not even need to have practical implications for everyday life), but they nevertheless tackle the right topics with the right arguments at the right time, and hence provide inspiration for other scientists.

***Breakthrough* papers** — These are absolute outliers and usually mean a partial or complete change in an important theory. The most famous examples are Einstein's four articles, which he published in 1905 in *Annalen der Physik*, Watson and Crick's "*A Structure for Deoxyribose Nucleic Acid*"[12] and such like. The chances that you will write something like this are extremely low, both in space and time. But you never know.

1.1.4 Types of journals

Like scientists, journals have the ambition to lead in their field, which can also be measured through citations. Based on this aspect, (at least) four groups of journal can be identified:

The hottest journals — These journals are the ones that everybody is dreaming of getting their name printed in. It's hard to define the hottest journals or set a boundary between top and standard journals, but one can certainly make a list[13] of the journals with the highest impact. According to sciencewatch.com, only Nature (`http://nature.com`) and Science (`http://sciencemag.org`) are true all-around hot players. Articles from various fields published in these two journals are, on average, cited over 50 times per article.

Journals indexed by ISI — ISI monitors journals and, based on some minimum quality criteria, selects journals that it will index. There are three major groups of journals: Arts & Humanities Citation Index, Science Citation Index and

[11] See also the `http://in-cites.com` for annual analysis of the most cited articles/scientists and ISI's list of the most cited researchers at `http://isihighlycited.com/`.

[12] This one of the most cited research article of all time.

[13] See `http://sciencewatch.com` for an updated list of the hottest journals.

Social Sciences Citation Index. For the Natural Sciences, the most important database is the Science Citation Index (SCI), which lists about 5600 journals. Another important ISI database is Current Contents (CC) Connect (about 8,000 journals), which is somewhat less inclusive than SCI and also less detailed.

Other international journals — Many journals are not indexed by ISI but still offer a chance to communicate your ideas to a wider audience. In this case it is enough if the paper can be easily located and downloaded from Internet. The best-known websites with electronic journals are Elsevier's Science Direct (`http://sciencedirect.com`), Blackwell Synergy (`http://blackwell-synergy.com`), Springerlink (`http://springerlink.com`), Wiley Interscience (`http://www3.interscience.wiley.com/`), Cambridge (`http://journals.-cambridge.org`) and Oxford (`http://oxfordjournals.org/`) University Press. Note that many journals that provide electronic versions of articles are not listed in the CC or SCI database and vice versa. So make sure you check your journal before sending any materials.

Local journals — Papers in what we call local journals are either not accessible to a wider audience or the review process is 'too soft'. Many journals, even if the review process is rigorous, will remain local because the papers are not written in English. Yes, in science too, globalization (read Americanization) is taking place. Still, SCI is the most professional scientometric database in the world.

Obviously, we would all like to send our papers exclusively to journals that are indexed by ISI. On the other hand, sending a relatively good paper to journals that are not indexed by ISI can be a good investment in such a journal. Remember, it is not ISI that decides which journals are the most important ones but you. A lot of journals that are now in ISI's database had to go through a rigorous evaluation before they appeared there.

1.2 What's eating science?

> "*I think it is important to distinguish fraud – a definite intent to deceive – from bad scientific practice, often a result of inexperience or the current pressure to publish... I think fraud can only possibly be a tiny problem in soil science, bad scientific practice is a much bigger one, but by far the biggest problem we have, is a lack of new ideas.*"[14]

In 2005, three MIT students submitted an abstract entitled "*Rooter: a methodology for the typical unification of access points and redundancy*" to the World Multi-Conference on Systemics, Cybernetics and Informatics. The abstract was accepted for oral presentation and printing and nobody would have complained if the authors had not admitted that they produced this abstract using a computer program[15] that randomly assorted computer science jargon and produced a grammatically correct yet nonsensical paper (New Scientist magazine, issue 2496). What the three MIT students indirectly managed to prove is that there is a lot of gibberish being published in science today. A more extreme example is that of Alan Sokal, who managed to publish a totally nonsensical paper in a respected journal. More about misuse of fancy scientific jargon can be found in his book (Sokal and Bricmont, 1998). This brings us to the next topic of this article — the *grey side* of current scientific systems.

As the above quote states, although there is also a lot of fraud and cheating in science, a much bigger problem for science is so-called 'bad scientific practice' or the grey side of scientific work. In our opinion, there are three major causes for most of the grey in science:

- Ludicrous pressure to publish
- A lack of evaluation of reviewers
- Fashionable pliability

[14] Alex McBratney, joint editor-in-chief of Geoderma, speaking about fraud in Alfred Hartemink's book on Publishing in soil science.

[15] You can generate a nonsense paper yourself using the on-line application at `http://pdos.csail.mit.edu/scigen/`.

More on Alan Sokal: Alan Sokal, Professor of Physics at NYU wrote a parody of post-modern science criticism in the late 1990s, called "*Transgressing the boundaries: towards a transformative hermeneutics of quantum gravity?*". This was submitted to the cultural studies journal Social text, without telling the editors that it was a parody. They published it as a serious scholarly article, and when the author revealed the hoax three weeks later, people were very angry with him. Like the genre it was meant to satirize, the article was a mixture of truths, half-truths, falsehoods, non sequiturs and syntactically correct, high-flown language that had no meaning whatsoever. It also contained appeals to authority rather than logic, rhetoric that sounds good but whose meaning is ambiguous, and confusion between the technical and everyday senses of English words (for example, linear, non-linear, local, global, multidimensional, relative, frame of reference, field, anomaly, chaos, catastrophe, logic, irrational, imaginary, complex, real, equality and choice).

1.2.1 Ludicrous pressure to publish

In most national academic systems, scientists are still evaluated by their output (instead of by their impact). People are assessed mainly by the number of papers they publish. The pressure to publish is rising every day. This has a number of negative effects, of which we will mention the three most significant ones:

- *Hyperproduction* — Many researchers find a fruitful topic that is very catchy and gets published easily and then go on to publish (very) similar papers in several different journals, which is known in scientific slang as the *hyperproduction effect* (Newman, 2000). Writing more papers on the same topic might be good because this will make the topic better known to different research groups, but if the papers are extremely similar, and especially if the same data and results are emphasized, this cannot be good for science. In extreme cases, hyperproductive authors only change the title of a paper plus a few lines and then publish it in two or more journals.

- *Lobbying and self-publishing* — Many editors, members of editorial boards and even reviewers are biased towards papers with which they have some personal

connection. This creates a clear conflict of interest. The extreme case is self-publishing: many journals (almost all journals in the world) allow submission of papers of which members of the editorial boards are co-authors. This situation is negative both for editors and the journals. If an editor publishes his/her paper in a journal when he/she works in the editorial board, this will not necessarily be a weak paper. But how can we tell with the obvious conflict of interest?

- *Phoney co-authors* — In many cases, a person listed as a co-author does not actually know much about the paper and would not be able to defend its content or reproduce it from scratch. Obviously, phoney co-authors are listed because of the benefits of getting published. In principle, there are two types of phoney authors: (a) those who use their position and funds to make colleagues list them as co-authors and (b) those who trade authorship among themselves. The latter is less serious and can be summarized as: "*Put me on your paper and I will put you on my papers so we both get two SCIs instead of one each.*"

Phoney co-authorship is a problem that has many negative side-effects, although it does not seem to be all that serious. Phoney co-authors are, in a sense, the parasites of science and they lack moral values. One may argue that, as long as the first author is authentic, all the others can be phoney, but this situation is much more dangerous than it appears. Firstly, if an author supports a parasite, this means that the parasite will stay in the system of science. After a few years, the hard-working authors will want to apply independently for research funds and then they will have to compete with the parasites, who (on paper) may have similar references. A second more serious effect is that an author who permits phoney co-authors shows that he/she is open for trade with scientific discoveries.

Reputations in the system of science are extremely important. Once it is known that an author is ready to trade moral responsibility for material benefits, then all confidence in this individual will be lost and others will try to avoid collaborating with him/her. The worst case scenario is that an author accepts the system as such and then one day waits for his/her turn to be a parasite on other colleagues.

Figure 1.1: Editors usually have the last word in an editorial system. Often, they do not need to justify their actions and decisions to anybody.

Important point 3 *Is someone who just signs bills an author? The author of an article can only be someone who contributed to the intellectual content of a manuscript by participating in the design of an experiment, in data processing or in writing and/or editing the article.*

In our opinion, an author of the article can only be someone who participated (physically and/or mentally) either in:

1. field/laboratory data collection, and/or

2. data processing and statistical analysis, and/or

3. writing and editing of the paper.

If someone is listed as a co-author, this means that he/she made a significant contribution to the intellectual content of the manuscript. A research investigation is not routine work[16], so if somebody is a co-author of the article, that should also mean that he/she invested some of his own creativity and original ideas/data. Our experience is that the principal author is usually responsible for production of about one to two thirds of the paper, while the co-authors mostly get involved in the final phases of production. So if your supervisor, head of project or other superior asks for their name to be listed on the paper, there is still some time for them to get involved. However, if they ask for their name to be automatically listed on the paper without any serious involvement, be sure that this is wrong and immoral.

1.2.2 A lack of evaluation of reviewers

Because reviewers are typically not rewarded or even mentioned for their work, they often deliver a slow or poor service. In fact, reviewers are asked to do high-quality consultancy without receiving any benefit at all. In an optimal situation, a reviewer will take one day to read the paper and then a few days to cross-check its findings. Such investment of time is obviously a luxury that few can afford, so reviews are usually done in a few hours. Because researchers are publishing more and more, there is less and less time to do proper reviews. In fact, many good reviewers have to refuse to do reviews because they are over-booked with papers or they agree to do reviews which are incomplete or superficial (Moore, 2005). Reviewers often grade and comment only on the form and style of a paper and not on its intellectual content.

At the moment, most journals allow 3-6 months for the return of reviews, which does not mean that the reviewers spend that much time reading and thinking about the papers. Unfortunately, when a paper lands on a reviewer's desk, it will first gather dust for some time. Eventually, the reviewer will find time to read it and make comments (usually half a day). Often the editor needs to find a replacement for the reviewer because he/she does not respond. Because reviewers are not rewarded for

[16]For example, a laboratory technician should probably not become a co-author of the article for a routine laboratory analysis that he/she conducts on a regular basis.

their work,[17] reviewers can have problems justifying this investment of time to their employers. In the worst case scenario, the reviewers can sit on a paper or give it a bad review because it is in their interest. The editors or publisher cannot complain because they are not paying for this work. As a result, reviewers have no feeling of responsibility for their output.

Important point 4 *The biggest problem of most scientific journals is that the review process is slow, inefficient, inconsistent, unrepresentative and biased. This is simply because reviewers are not rewarded for their work or evaluated on their performance.*

Because publishers do not appreciate the work of reviewers, they are forced to work with poor or delayed reviews. In most cases, an editor will be happy if he/she gets two completed review forms. It can be easily shown that deciding about a paper based on two or three samples can lead to fairly poor estimates. In fact, two reviews can even contradict each other. To illustrate this problem, we will use the Monte-Carlo simulations with different sample sizes. In this example there are four grades for papers: ("1") accepted with minor revision, ("2") accepted with moderate revision, ("3") major revisions needed and ("4") rejected. Now imagine that the grades are based on negative points (0–100), where papers with < 10 negative points are classified as "1", < 40 as "2", < 70 as "3", while the papers with ≥ 70 points are rejected. Fig. 1.2 shows that the results of the Monte-Carlo simulations using x=40, s_x=20 and 2, 3 and 5 for sample size. Note that in the case of only two samples, the decisions can vary from accepted with moderate changes to rejection (Fig. 1.2a). We estimated that, if a sample of two is used, in about 30–50% of cases the decision grade will differ from the expected one. The situation is a bit better for the sample of three (only 30–40%) and much better if a sample of five is used ($< 20\%$). The results of this simulation exercise, of course, depend on how variable the opinion of the reviewers is, but we hope we illustrated the problem.

[17] Many companies, even governmental organizations, do not like the fact that their staff spend paid time on reviewing papers, from which only the publisher receives financial benefit.

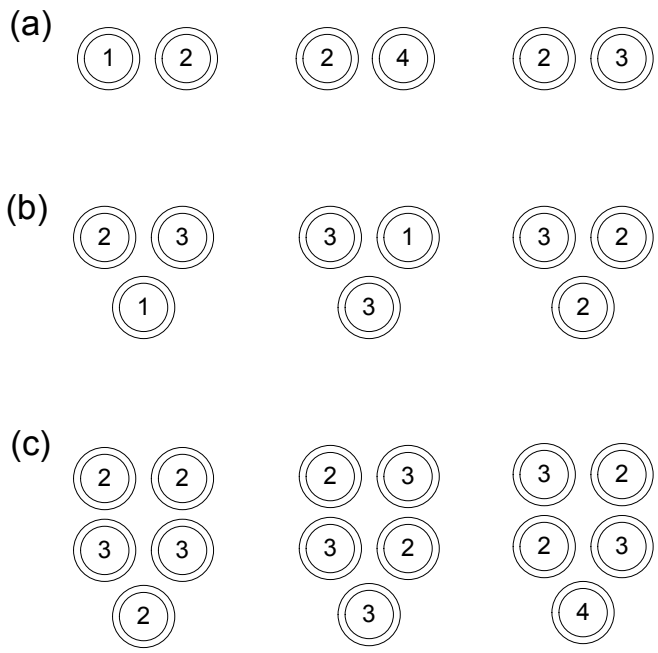

Figure 1.2: Three simulations of reviewers' decision with different samples. Deciding on an average from a sample of two can lead to some strange outcomes (a). Three is slightly better, but still difficult (b). With five samples (c) we can be much more confident. "1" — accepted with minor revision; "2" — accepted with moderate revision; "3" — major revisions needed and "4" rejected.

1.2.3 Fashionable pliability

The final serious problem with the current system of science is the ease with which authors follow fashionable topics or styles. On the one hand, it is positive to learn from top researchers. On the other hand, those who imitate other authors forget that in science we need to be cautious and critical about everything. In fact, many researchers made a respectable career by proving that something does not work or is inaccurate. Some authors see their supervisors as Gods of science and blandly repeat whatever they say or write. Their identity is thus lost and they become eternal second authors. Other authors think that if they pick up a 'sexy' topic that this will guarantee them success in getting their papers published (which is often unfortunately true). Form

should never be more important than content.

Young academics and, especially non-native speakers, assume that the best way to get published is to imitate the heavy, unreadable articles they see in many journals and textbooks. Such beliefs are based on a big misunderstanding. What actually gets articles published in top journals and more importantly — read, is clear, well-structured, well-argued writing. Another common misconception among researchers is that they will make the ultimate research career as long as they publish in Nature, Science or a similar journal with a high impact factor[18]. This is a rather naïve conception, which is nicely demonstrated by Seglen (1997). The correlation between a journal's impact and the actual citation rate of articles from individual scientists or research groups is often poor. In fact, publication in a high impact journal will not necessarily increase the impact of an article (Seglen, 1997). Therefore, you should focus on writing high-quality articles and not on ways of getting into the top journals at any cost.

1.2.4 Possible solutions

We all know that problems such as hyperproduction, phoney co-authors, self-publication, copycatting and poor reviews will continue to exist. The question is whether such practices can be reduced or even prevented? We can try to put prevention mechanisms in place. For example, a simple solution to lobbying and self publishing would be not to allow editors to handle papers where there could be a conflict of interest[19]. However, this is not as simple as it may seem, because researchers work as editors mainly on a voluntary basis without any financial reward, which means that not many people would edit journals if they were prevented from processing papers in which they have some interest.

The artificial pressure to publish, with all of its negative side-effects, can be simply avoided by introducing more sophisticated evaluation criteria. As previously men-

[18]The impact factor of a journal is defined as the ratio between citations and recent citable items published in the previous two years or, in other words, as the average number of citations in a given year of articles published in that journal in the preceding two years.

[19]Papers in which the editors are listed as co-authors or papers from departments/units where the editors are employed.

tioned, society should think much more about quality[20] than quantity. Having your name on 20 *born-dead* SCI papers cannot be more important than publishing a single high-impact paper. In fact, in many countries, scientific evaluation teams do not even distinguish if a person is the first or the last author of the publication.

Poor or delayed reviews can also be avoided by rewarding reviewers for their work. This need not necessarily be a financial award. It would be enough for journals to list reviewers and the amount of work they have done. In fact, editors could monitor how satisfied authors are with the work of reviewers and then, based on such criteria, promote successful reviewers to become senior reviewers or at least give them some kind of diploma or symbolic reward. Reviewers could then add such information to their CVs and use it to get greater acknowledgment in their research community. Another (cheap) solution to the problem of biased and unrepresentative reviews would be to ask all members of a society to participate in the review of all papers. This could be organized through on-line editorial systems, in which all reviewers can (at any moment) see the results of the reviews and jointly grade the intellectual and technical quality of an article.

Scientific journals could learn much from the Open encyclopedia, Wikipedia for example. In Wikipedia (`http://wikipedia.org`), every registered member can at any time edit a topic and see the history with all previous versions. This saves reviewers a lot of time because they do not have to repeat themselves, but it also saves the authors time, because they get feedback much faster. These days, authors can also get involved in publishing papers through a web application (see for example `http://writely.com`).

In fact, we would encourage all authors to co-publish their work on the web and to support an initiative called open access archiving. Any establishment is inherently conservative and the publishing world is no exception. Currently authors often have to wait far too long before their work is published and journals forbid them to disclose results during this period (e.g. at conferences). This is not good for the progress of science. But there are glimmers of light on the horizon. The greatest hope for scientists — especially in developing countries — may well be OA (Open Access) Publishing,

[20] Google derives most of its profit from the brilliant idea of listing sites by the number of times they have been accessed.

although there are still some uncertainties surrounding the best way to finance this approach. OA Archiving[21] on the other hand is simple, cheap and essentially 'win win' in character. The main advantages of Open Access Archiving are:

1. Nothing needs to change for publishers, because they will continue to publish in parallel with the OA Archives (case study: physics archive `http://arxive.org` initiated in 1991). Around 85% of publishers have agreed to the institutional archiving of already published papers in OA Archives, including Elsevier and Nature Publishing.

2. Nothing needs to change for authors because they can continue to publish papers in their favorite journals. However, the impact of their work will be hugely increased if they can also archive their papers in institutional archives using the free software that allows interoperable searching across all archives. The latest figures quote 5 times the impact for OA papers compared with non-OA equivalents, but more detailed research is underway (Harnad and Brody, 2004). Authors would be wise to publish in one of the majority of journals that agree to OA Archiving in order to benefit from this much increased international impact. Impact factors are mathematical and impartial to whether sources are printed or web-based. OA-compliant archives are now also searchable through various search engines. See also the Directory of Open Access Journals (`http://doaj.org/`).

3. The research output of the authors' institutes can be greatly enhanced by setting up institutional OA Archives, show-casing their academic publications. OA Archives use free software and there are many support organizations. Note: three major workshops on setting up Open Access Archives were held in the summer of 2005 in Brazil, China and India (Chan and Costa, 2005).

4. If institutes are unable to set up their own institutional archives, authors may archive their research in any of the established archives (e.g. Cogprints, Bioline International, etc.). It does not matter where papers are archived, since the

[21] Archiving of already published and refereed research papers in interoperable, minimal-cost institutional archives.

archives are all interoperable. However, establishing institutional archives has the advantage of additionally promoting the research output of the institutes.

5. As more and more archives are established, more of the world's research will become accessible for free internationally. Stevan Harnad of Cogprints puts it like this: "*Archive unto others as you would have them archive unto you*" (Harnad and Brody, 2004). For developing country institutes, the main benefits (as well as having access to the increasing volume of international research output) are sharing their research with countries facing similar research priorities and making their research 'visible' internationally clearly has advantages (closing the South/North information gap).

The UK Government Select Committee Report on Science Publishing[22] has said: "*We recommend that the Research Councils and other official funding organizations mandate their funded researchers to deposit a copy of their articles in their institution's repository within one month of publication... as a condition of their grant*", and the US has recommended that the publications from the National Institutes of Health be likewise archived. Archiving already published research in interoperable institutional archives greatly benefits global science at virtually zero cost. This can be done now, without changing established publishing practices. For developing country science and medical research this offers enormous opportunities. Maybe the World Health Organization should consider supporting the setting up of an OA Archive for medical research publications so that all developing countries can benefit from free access? It's that rare thing — a truly 'win win' proposition.

Note that we do not want to imply here that the scientific publishers and commercial agencies should be replaced with quick-and-dirty systems[23]. However, our general impression is that the time from research to application could be shortened to the benefit of all. It seems that the best way to achieve this objective is to replace the traditional editorial systems with (cheap) web-applications that can speed up both data editing and distribution.

[22]Recommendations at `http://epublishingtrust.org`

[23]Note that, in the case of OA publishing, there are also two distinct categories of papers: preprints (no peer review, no editing) and post-prints (peer reviewed, editing). This allows scientists to get new work out quickly, even with limited credibility.

Chapter 2

Guide to authors

2.1 From ideas to first draft

"It's not just a matter of presenting your work accurately — you have to sell it!" [1]

So far, we have discussed some of the problems with the current system of science. Now we can recommend you some tips 'n tricks on how to produce high-quality papers. The first tip is to **carefully plan the whole thing right from the start**. Papers are usually born from ideas, i.e. when an author intuitively senses an important discovery. In principle, every idea/discovery can lead to a potential publication. The only question is in how many copies it will be finally printed (Fig. 2.1). So you should first ask yourselves whether your work is truly novel and whether it has a large enough potential audience[2]? In many cases, you need to be honest and face the reality that the idea you have is simply not good enough for top journals or not even good enough for any journal. Such work can still be published, but maybe in different format. Once you are sure, however, that you want to produce a research article, you can proceed with the following steps.

[1] David G. Rossiter, during one of our meetings at ITC.

[2] The researcher who managed to attract the largest audience until the day is probably Carl Sagan with his "Cosmos" documentary series.

Important point 5 *Early drafts of a manuscript may be publishable and useful for science; the only question is: how many copies should be printed/distributed?*

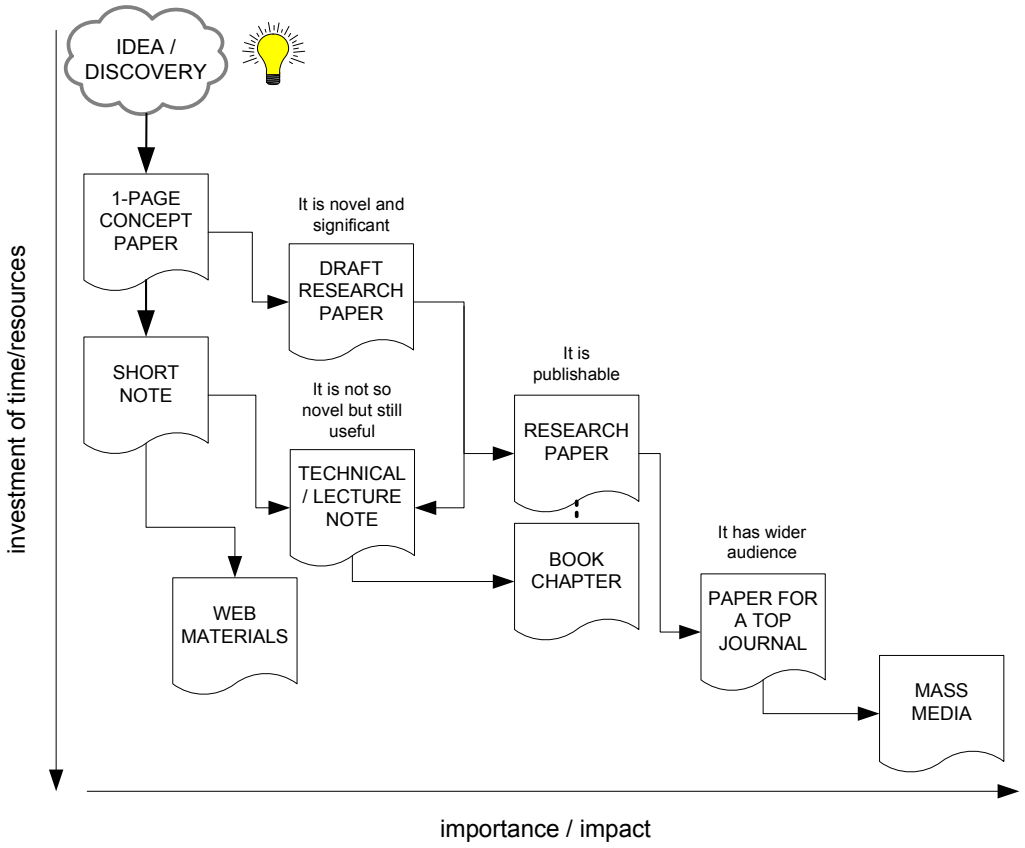

Figure 2.1: Types of publications in relation to investment of time/resources and potential impact.

2.1.1 The one-page concept paper

The first step you should take is to prepare a one-page concept paper. This should include the topic, the authors and their roles and responsibilities, main ideas and assumptions, technical details about the experimental setup and a time-line with phases and deliverables. After the main design of the paper has been established, it is much easier to organize the production of the paper. Think about it as a small project. These are some issues that you should definitively consider when preparing a one-page concept paper:

- What do you want to 'sell' with this paper?
- Is the topic really[3] novel?
- Who is it intended for (research groups)?
- What will be its strong aspects?
- How are you going to prove your hypothesis and is this proof going to be convincing?
- Will you be able to organize the experiment and data processing (resources, support)?
- Who will be first, second etc. author and what will be their responsibilities?
- In which form do you want to publish it?

Important point 6 *The most important step in starting a paper is to produce a one-page concept paper. This should include the topic, authors, their roles and responsibilities, main ideas and assumptions, technical details about the experimental setup and a time-line with deliverables.*

[3]Often we are sure that the topic we are working on is completely novel. We then find out that it has already been discussed and described, sometimes as long as 50 years ago.

2.1.2 Rethink the results and repeat the experiment

Now you have your master plan, you can proceed with the collection of data i.e. experiments. The first results confirm your expectations and you are excited about the whole thing. You would like to publish it as soon as possible. At this stage, it might be wise to **reconsider some of your results and even repeat the experiment several times**. Sleep on it. The worst case scenario is that you get your paper published and then find out that some things were incorrect or wrongly interpreted. Of course, once people find out, you will get a bad reputation and will have much a lower chance of publishing similar papers. This means that, although you scored a publication, you have damaged your career.

Authors are often impatient to publish, so they hide unexpected findings or things that they cannot explain. This is bad scientific practice with many negative effects, both for the authors and the scientific community. In fact, **the most important discoveries are often hidden among the results/effects that you cannot explain**. Are you aware that the most significant discoveries[4] in the world happened unexpectedly, through serendipity or even error? Really important ideas only become clear in retrospect. Great ideas might be emerging right now, but we don't know it. Good ideas are like yeast in the historical progress of science. In other words, if you are too sure about the results you expect and too routine in your work, do not expect to discover something great. For the same reason, **always be very flexible and ready to adjust the key topic of your article**, depending on what you and your co-authors think is the most significant discovery.

2.1.3 Investigate your audience

Once you have done several tests and got the same results over and over again, you will be very confident about your discoveries. However, you should not immediately start writing the paper. Now is a good moment to investigate your audience, i.e. those who will read and evaluate your work. This is nicely emphasized by Gopen and Swan (1990): "*An academic paper cannot exist without the interpretation of each*

[4]For example, electricity, telephone, Röntgen rays, cosmic background radiation, etc. See also the book by Jones and O'Brian (1994).

reader. If the reader is to understand the writer, the writer has to know what the reader needs. We can't be sure that even a single sentence we write will mean the same to every reader; all we can do is increase the chances that most readers will interpret our writing the way we intended." The best way to find out how potential reviewers will receive your paper is to **communicate some preliminary results at a research conference or seminar**. Communicating your preliminary results and key ideas to potential reviewers will give you ideas about what they will see as strong points and what they will criticize.

If you do not get any questions about your work, this is a bad sign. Either your colleagues are not interested in the topic, or they have problems understanding it, or you have not emphasized the key points in your presentation. Also, if you offer too many ideas/results (even good ones), this can tire an audience and they will not be receptive to your work. The same will probably happen with the paper. Sometimes, throwing things out of the paper really helps — **less is more**! Many investigations (see for example the work of Hartemink (2002) about publishing in soil science) have shown that **shorter, more focused papers generally have a higher impact**[5].

Research conferences are also a good place to find out more about the topics that your colleagues are working on. It is not only important to find out what others think about your ideas, it is also important to know what the most interesting topics that people are working on at the moment are. The best scenario is that your topic (research problem) is attacked by many authors and that it is hot. This is definitively a sign to start preparing the first draft of your paper.

2.1.4 Write it up — now that's easy!

OK. Now you have all the data, you are sure about your results and the message that you want to transmit, and you are sure that there is an audience for it. You can now start writing the paper. If all the above criteria are satisfied, writing the article could just be the easiest part of the job. Because information is much easier to interpret if it is placed where most readers expect to find it, many scientific articles follow the broad

[5]Blaise Pascal once said: "*I have made this longer than usual, only because I have not had the the time to make it shorter.*"

IMRaD structure (Introduction, Method, Results, and Discussion). This provides a kind of roadmap for readers. In particular, writing the methods and results sections can be a pretty straightforward job.

> **Important point 7** *Clarity of writing follows clarity of thought. So first think what you want to say. Then write it as simply as possible.*

Your first draft will probably just be "*an incoherent stack of notes you've written to yourself*" (Jones, 2003). But this should not worry you because most high-quality papers go through 10 or more editing iterations. Even if you are just putting the pieces together, you should already check whether your first draft contains the following main elements:

- **'The big picture'** — the background to your research and why it's important.
- **The purpose statement** — what you set out to show.
- **How you went about answering the research question** — what you did.
- **The answer to the research question** — what you concluded.
- **The answer to the *so what?* question** — why should the reader care?
- **The consequences for future research** — note this could mean a change in the 'big picture' — the circle is then complete.

For more detailed tips 'n tricks, see also our "*Rules of thumb for writing research articles*" in the appendix. If you closely follow these guidelines, you should be able to produce the first draft of your article, which you can then revise and polish to perfection. At this stage, you should **first focus on the quality of the writing** and not think so much about the impact factor of the journals, where you want to publish your work or about the number of publications you can produce from these results. Keep in mind that a good paper is one that makes an impact, i.e. one that will be widely read and used by many to further their research. If you invert point 1, you will get an answer to the question how to write high-quality papers:

Important point 8 *A well-written article is one in which target readers are able to apply, modify and extend its content, swiftly and accurately, without much external support.*

Note the word apply! Especially if a paper is about new methods, it should address the issue of whether readers can understand the article and apply its findings in their work.

When you re-read your paper, you may still be unhappy with it. It might have many novel elements, but if you feel that something is missing — excitement, enlightenment, sparkle... call it what you like, such papers will not make much of an impact in science. Then go back to your title, introduction and discussion and see if you can emphasize the story of the article more powerfully. The points that you are trying to make need to be visible, clear and strong. You should not be afraid of adding some new thoughts — terms or expressions. Do not forget that scientific writing is both a science and an art.

How do you create your own style of writing? Rule No. 1 is, of course, to avoid copying sentences from other people — be yourself. On the other hand, a distinctive writing style often comes through the richness of phrases, expressions and idiosyncratic use of language. So make sure you do your homework and read other people's work[6]. **The best writers in the world are also the best readers**. This is because creative people inspire each other and great ideas can be born through interactive brain-storming. Another thing you might consider is to think up original expressions or mottos (these are known as *streamers* or *callouts*). One day, somebody might identify or even remember you for this.

It usually will take at least three to five iterations until you have a version that is ready for submission. If you and your co-authors are not sure any more which things should be left out and which should be extended, this is a sign that you should now send the paper to the journal. It is not a good idea to keep going round in circles with your co-authors.

[6]For example, if you are interested to learn how to write in ordinary language but for both scientists and non-scientists, start with the Dawkin's book "The selfish gene."

Why is it important to write science using popular language? — For many fiction writers, academic writing is a stereotyped joke — a museum of passive voice, obscure and dull jargon, and stilted paragraphs — without excitement or entanglement (Jasper, 2002; Webster, 2003). Early in their careers, most academics develop the idea that editors are impressed by a 'dense' writing style with heavy abstract nouns instead of lively active verbs. Similarly, researchers must take care to use everyday (popular) language wherever possible to captivate an audience that is intelligent but does not necessarily knows much about the topic. Stylewise, we recommend using the language of everyday speech — not that of spokesmen, lawyers and bureaucrats — to link scientific concepts. For example, use words with an Anglo-Saxon base to link scientific terms, which usually have a Latin/French origin. Fortunately, much scientific and technical writing in the past years has gone strongly in the direction of spoken English — shorter sentences and more direct, plain language. Unfortunately, there is still a tendency to overuse the kind of jargon that is sometimes referred to as 'business babble': "*As soon as these resources are there, we will kick off the implementation*" instead of "*As soon as these people are appointed, we'll start implementing the system*". Recall also Rule of science No. 8.

2.1.5 Analyze the article sentence by sentence

Once you are sure that you and co-authors are satisfied with the macro (sections) and meso (paragraphs) structure of your article, you might consider zooming even more into the paper. The key to improving the micro structure of a paper is to compress sentences, improve balance in the sentences and the links between the sentences (this is known as "*the art of line editing*"). There are a few important steps that you might consider:

- **Compress the sentence** by reducing unnecessary or redundant words. Instead of writing "*a considerable number of*" use "*many*"; instead of "*this result would seem to indicate*" use "*this indicates*". However, be careful not to overdo the use of short sentences — "*Every sentence cannot be urgent. Good writing normally requires a combination of longer and shorter sentences, carefully orchestrated in each paragraph*" (Jasper, 2002).

- **Improve the flow**: at the beginning of a sentence put old information that links back to the previous one and, at the end, put the new information you want readers to focus on. In English, the steps in an argument tend to be built up in long, integrated paragraphs, with each step linked to the one before, usually through sentence subjects. Example: "*The use of land, water and minerals has increased more than tenfold during the past two centuries* ⇒ *Future increases in population and economic development will intensify this pressure* ⇒ *The cumulative impacts of human activities are likely to lead to major environmental changes, varying from disruption of local ecosystems to disturbance of the biosphere.*"

- **Use link words** such as *although*, *as is clear from*, *as a result of which*, *but*, *most of which*, *or*, *so*, gerund forms (*using... requires*), *while*, *which is why*, *which indicates that*, *when*, *where*, and *yet*. This approach improves 'message management' by arranging information to show what is important, grouping related ideas, and highlighting the relationships between different parts of the argument. It enhances readability, allows variation in sentence length, and avoids redundancy.

- If too much information is placed at the front of the sentence (**frontal overload**) and too little at the end, the rhythm of the sentence is disturbed and it becomes more difficult for many readers to process the information. Instead of writing: "*Working with students is what attracts me most in this job*" write: "*What attracts me most in this job is working with students*".

- Putting **information in the middle** of a sentence may disturb its flow and can lead to the wrong elements (e.g. pronouns) being stressed, or to redundancy. Unlike Germans, English readers are unused to the verb coming at the end of a sentence. They process information as they go along. Avoid writing: "*It is for the purpose of the present study convenient to...*".

On the use of 'I' — Much discussion in recent years has focused on the use of first person in scientific writing (Raymond, 1993). The traditional (depersonalized) technical, early 18th century writing style is still a prerequisite for submitting articles in which the author writes about what he or she has done in the first person. Editors simply do not accept articles where the author is "telling about his/her impressions in the first face". Indeed, it might sound egoistic if an author were to write everything in the first person. Recall Rule of science No. 7 — an research article needs to be objective and unbiased. Therefore, research articles should not be just a chronological narration of work done. If an author has produced some results, and if these are accurate, then we should all come to the same results and hence the use of "It can be concluded" is completely legitimate. However, if you write "It is assumed that...", "It was decided to...", "Sites were chosen...", the reader might ask: who assumes?, who decided? — the author? or his boss? his client? or... Obviously, if such information is missing, readers may completely misunderstand the paper (Webster, 2003). There are definitely situations when authors need to make a clear distinction with between their opinion and the opinion/results of others. Recall also Important point # 1.

2.1.6 Avoid common language mistakes

Editors have discovered that many inexperienced authors (especially non-native English speakers) often repeat the same mistakes. Here we list some of the most frequent ones:

- Active or passive? — Note that it may be necessary to use a passive verb to maintain sentence flow. However, wherever possible, use active constructions within sentences (e.g. write "*This programme focuses on...*" rather than "*The programme is focused on...*").

- He or she? — Use plural forms to avoid sexist writing. Instead of "*... the end user, unless 'he' possesses...*" ⇒ "*... end-users unless 'they' possess...*". If this solution doesn't work, then use "he or she" / "his or her."

- Color or colour? — Use either UK or USA spelling, consistently. Follow the spelling of the Oxford Advanced Learner's Dictionary of English (for instance:

analyse, honour, colour, realize, organize, programme, centre) or use the US Websters dictionary. Words in a title or a heading should be written in lower case, except for the first word and any proper nouns such as names of persons, organizations or countries, if you use UK style. In the US all keywords in headings are capitalized.

- To measure or to make a measurement of? — Wherever possible use verbs, not heavy, abstract nouns (e.g. write "*achieve a reduction*" rather than simply "*reduce*"). Nouns make sentences stand still. Verbs make them move and push our meaning across to readers. Turning verbs into nouns hides their actions. Use "*adapting to*" instead of "*the adaptation to*"; "*for measuring*" instead of "*for the measurement of*"; a project "*designed to develop*" instead of "*aiming at the development of . . .*".

- Munich or München? — Foreign terms for which there are no widely accepted English equivalents should be used with an English translation (in brackets) the first time they appear. Spell all foreign words correctly and pay special attention to diacritical accent marks such as è, é, ä, ö and ü.

- NGO or ngo? — Abbreviations must be capitalized. If they can be made plural, this should be done by adding a lower-case s without an apostrophe. For instance: NGOs rather than ngo's. Spell out terms that are subsequently abbreviated when you use them for the first time, with the abbreviation between parentheses. For instance: Organization for Economic Cooperation and Development (OECD).

- Europe or europe? — Names of newspapers, periodicals and organizations, official titles, and the like are to be given in their original spellings (with English translations in parentheses, where necessary). Geographical terms commonly accepted as proper names are capitalized. Terms are not capitalized when they denote simply direction or compass points. For instance: The Middle East, but western, central and eastern Europe.

On the use of *however*, *therefore*, *so* and *thus* — In research on readability — what makes texts readable or not — scholarly writing ranks the lowest, not just for the content but also for the 'style' in which it's written (Raymond, 1993). A number of textual factors are analyzed: length of sentences, word choice, etc. One factor is the use and placement of linking words such as 'however' (as well as thus, therefore, and, but, also, because, although, etc.). Placing these words at the beginning of sentences can help to signal to readers quickly — without them having to delve — when the author intends to make a logic connection or shift. However, if it sounds unnatural it will reduce readability, so the impact may be different on native and non-native speakers of English. The use of 'however' and 'thus' at the beginning of sentences is, of course, different in written and spoken English. And written English in the US tends more than British English to mimic spoken English. Why can the connector 'so' be placed in the initial position, while our other connectors are less preferred in that position? Clearly, there is no actual grammatical rule actually forbidding connectors at the beginning of sentences. And native speakers do use them. So it's not actually wrong. The difference with 'so' is that a sentence starting with 'so' flows along quite happily, whereas one that starts with 'thus' has to come to a stop before it even gets started. This is slightly less of a problem with 'therefore' and less awkward still in the case of 'however'.

- Hyphenation or hy-phe-na-ti-on? — Hyphenation should always break at syllable boundaries. In reports, leave a blank line between paragraphs and do not use indentation at the beginning of a new paragraph. Avoid a single line of text at the top or bottom of a page (known as 'widows' and 'orphans').

- Dot or comma? — Use the comma (,) rather than the full stop (.) in numbers containing more than four digits (for example: 10,000). Be aware of and consistent in your use of currency symbols. These symbols precede the amount of money. Use the euro sign (€); do not use the words euro or euros. Other currencies should be treated similarly. If you need to refer to American dollars, use US$. Don't leave a space between the currency sign and the amount. For instance: €10,000 rather than € 10,000 (or 10.000 euros). Use a full stop rather than a comma for decimal places (e.g. write 4.25, not 4,25). Round currency figures off to the nearest euro (or other currency). For instance: €10,234.59

must be written as €10,235. Numbers below 10 are written in full when used in text (one, two, three... nine) unless the sentence contains a combination of numbers. For instance: "*Nine delegates attended the meeting. The 9 delegates represented 18 organizations.*"

- A small number of or a few? — Avoid using long-winded expression: always try to use a shorter alternative, e.g. replace "*A small number of*" with "*few*"; "*Despite the fact that*" with "*Although*"; "*In order to*" with "*To*"; "*Has been engaged in a study of*" with "*Has studied*"; "*There is a reason to believe*" with "*I think*";

2.2 Pre-submission checklist

"*You cannot eat an elephant in a day.*" [7]

Prior to submitting your article, we strongly advise seriously investigating the journal in which you intend to publish your work and perhaps you should rethink some elements in your paper. There are still many things that you need to consider.

2.2.1 Find the right journal

Once you have prepared a one-page concept paper, you should already have a good idea about where to publish the manuscript. Your paper needs to closely match the scope and format of the journal, otherwise even if it is a very promising paper, it may well be rejected (right message in the wrong place). If you have a list of possible journals, now is the time to think about which will be the best candidate. **Always go first for the highest quality journal that may be interested in your topic**. If the journal rejects the paper, you can always turn to the second on the list. The following checklist can help you judge the quality of a journal and the editorial process:

- Check if the journal is indexed by ISI in the SCI or CC database. This you can do at any time from ISI's Master journal list[8]. If the journal is listed by ISI, this

[7] Colloquial Croatian saying.

[8] See `http://scientific.thomson.com/mjl/`

will increase the chances that the article will be seriously considered. You can also check the impact of the journal or even the impact of the country[9] where you intend to publish.

- Check if the article (or at least its abstract) will be available on-line in a PDF format. This will increase the chances that it will be accessed by many readers.

- Check if your article will receive an unique identifier, such as a Digital Object Identifier[10], which is something like the ISBN for books. This will make it easier to locate.

- Check if the journal provides English language and graphics editing. Journals usually do not do this, but you can often find out from colleagues. This will increase the chances that the article will be of high technical quality.

- Check if the journal has an on-line editorial system. This will help ensure that your article is not kept on hold for a long period of time.

- Check if the journal offers a double-blind review. This will help ensure that you will receive a fair and unbiased review.

Note that each journal has its own review system, preferred style and specific jargon. You should match your paper and with the context of the journal. At this stage, you should re-think the title of your paper and maybe some of its key points. **There is about a 10 times higher probability that somebody will read the title and abstract of your paper than the paper itself**. You should therefore spend about 10 times as much effort on writing and rewriting them. The topic of how to brainstorm good titles probably deserves a whole new article. Some ideas are given in the appendix.

[9]For example, the country with the highest number of citations per article in the last 10 years is Switzerland. It is also the country with the highest number of citations per researcher. See also `http://sciencegateway.org/rank/`

[10]See `http://doi.org` for more details.

2.2.2 Do the work of the reviewers yourself

Another useful pre-submission tip is to **try to do the work of the reviewers yourself** or give the paper to your colleagues and ask them to review it. Once you have created some psychological distance from the draft paper, you can read your work more critically. Reviewers commonly complain about similar things — either they are not convinced enough, they are frustrated trying to understand it, or they are disappointed that you are not acknowledging their work. In general, you can make a stronger argument if you:

Consider alternative solutions — Compare your method with alternative methods using rigorous criteria. Try to describe both the strong and weak aspects of your method in relation to alternative techniques. Recall rule of science No. 7: report your discoveries in an unbiased way; you should even try to challenge your own initial ideas.

Test it under different conditions — Evaluate the performance of your method using several case studies i.e. experiments. How does the method behave under different conditions, both global and local? How universal are your discoveries/conclusions?

Emphasize possible applications/implications — If you give very concrete instructions to readers on how to apply your methodology, this will certainly increase its impact.

Identify yourself with a broader research group — Think of a research group as an international company in which you have your shares. You need to support the work of your colleagues and find your identity (your *niche*) in that company. This means that you need to be self-critical and acknowledge the fact 'that other colleagues might find better solutions. Modest opinions and statements are usually more accurate!

This means that you may have to return to your data and even do some extra data collection. Although you might not be in the mood to do this, think about how you would feel if you were to receive a negative review (rejection or serious revision

needed). And you would lose some six or more months waiting for advice that you can anticipate now.

- You have carefully and systematically **studied the work of colleagues** and referred to it
- You have **critically evaluated** your methods/results versus the state-of-the-art findings
- You have tested the performance of your technique using **multiple case studies / experiments**
- You **make significant claims**, but these are backed up by strong arguments
- You have considered what **implications of this work** are and how these ideas/discoveries can be used to **solve real-life problems**
- You have **adjusted your style and *jargon*** to the target audience

- You do not actually know what has been published by others on this topic
- You are sure that your technique is optimal and that there is no better alternative
- You do not actually know if you will get the same results under various conditions
- You do not want to make significant claims or you are making them without sufficient proof
- You do not actually know how your technique can be applied to solve real-life problems and what the implications of your findings are
- You have not previously tried to communicate your ideas/results to the targeted research group

Figure 2.2: Some Do's and Don'ts that you might consider before submitting your article.

2.2.3 Make a full information package

Consider a multi-level description of your method/results — go from the simplest case to a more specific case and then on to a general case. For example, we recently prepared a paper with colleagues about an interpolation technique called regression-

kriging (Hengl et al., 2006). In this paper, we demonstrate how the methods work using the simplest case (five points only) and then three case studies with different environmental data. The simple case study (show real numbers/figures) will help readers understand the technique, while the multiple case studies will convince them that it works in various conditions. The important thing is that readers can zoom in and out in the technique, depending on their interest.

Prepare additional promotional[11] materials such as websites, posters, brochures etc. that can help users understand your work or convince them that the results are correct. Graphical elements can play a key role here because scientific information is often communicated more easily through figures[12]. Sometimes it can help your paper if you include extra diagrams — even sketches or photographs. Such final editing might seem like make-up-ing of papers but, usually, whatever helps you convey your message or at least draws attention to it is good[13]. So your final product might include:

- The core paper itself (15 pages of text typically).
- Technical notes or supplementary materials in which data collection, analysis and interpretation are evaluated in detail.
- A website where all supplementary materials/datasets can be found and accessed[14]. A website is also very useful for multimedia such as animations, videos etc.
- Promotional materials such as brochures, posters and similar, where the key ideas/discoveries are presented in a popular way.

[11] In business, this is called *post-production* and is especially well developed in the show business.

[12] Displaying data is also an art! See also an amusing article on how to display data (badly) by Wainer (1984).

[13] Stewart (1989), for example, named his book "*Does God play dice?*" A title can draw a lot of attention!

[14] In general, it is not recommended that you put your whole manuscript on the web before it has been accepted for publication (unless the publisher accepts distribution of pre-prints). 'Soft' publications are soon forgotten and somebody else might take the credit.

2.2.4 Final tips

During the review process, you should also consider some of the following things that might be crucial for the success of your article:

Meet your editors — Investigate the people who will decide about your work: editors, established researchers and other potential reviewers. **Check all the little things that annoy them** and try to deal with them. If you want to ask them something about your paper, do it in a concise and concrete way. Editors are extremely busy people.

Be ready for unfortunate developments — Be prepared to receive biased, harsh or even offensive reviews. **It is very possible that your paper is weak and misses the most important point** (recall rule of science No. 5) or does not have an audience, but this needs to be backed up by detailed arguments. Otherwise, if you have received a poor review, consider finding a higher quality journal. Recall rule of science No. 1: there is no authority in science, only arguments.

Work with your heart, write with your head — One needs a lot of passion to do research and write research publications, but **being emotional when communicating with editors, reviewers and other colleagues is something you should always avoid**.

Don't get discouraged and give up — Fighting for a publication is like playing a sports match — the further you get, the more serious you need to be. Once you submit your article, this is only the beginning of the game.

Be honest towards yourself and your work — Take some distance from your work and try to critically evaluate it. Then, try to improve or even re-design the paper. If you cannot afford to do this, then just be honest and mention the limitations of your findings. Recall rule of science No. 2: even the most pessimistic truth is better than illusion.

If your paper gets rejected or the editors asks for major revisions, there are three possible scenarios:

You have sent it to the 'wrong' journal — As already mentioned, the choice of journal can be crucial for the success of the paper. If the topic of your paper does not fit the scope of the journal, of course they will reject it. Similarly, the quality of your paper should match the quality of the journal. A PhD student cannot expect to get a positive response if he/she sends his/her paper to Nature.

You have received a lousy review — This does not happen too often, but it may happen because of the reasons mentioned previously. You can consider writing to the editor to ask for a second review. If the editor disagrees with you without sufficient justification, then you should give up on this journal and send the paper to a higher quality journal. Sometimes, if the review you received is lousy, but the paper has been accepted for publication, you should still consider sending it to a higher quality journal.

The reviewers are correct and clear — The best thing to do in a situation like this is to give up on the current version and completely change course. Often when we work on the same topic for an extensive period of time, we can no longer see it objectively. Some people become obsessed with their work and have a very hard time giving it up. It is human nature to be biased toward our own beliefs and concepts. Many researchers simply cannot give up parts of a project they have been working on for a long time. In such situations, it might be wise to consult some senior colleagues and then be honest with yourself. A researcher should always **be very flexible in considering a change of course** or even a change of topic that he/she is working on.

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Chapter 3

Appendix

Rules of thumb for writing research articles

Try to pick a catchy title!

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Abstract

An abstract should be short but give the overall idea: what was done, what was found and what the main conclusions are

This paper lists 'rules of thumb' for writing research articles (RA) and getting them published. These were discussed during a scientific writing course organized for ITC PhD students by Cressie Communication Services. Important aspects of the macro and sub-structure of a paper were explored in group discussions. The (meso)structure and functions of different sections of RAs are described. The results of previous investigations and interviews among journal editors were used to identify what makes a good RA. It was concluded that clear, logical, coherent, balanced and well-structured writing gets papers published and read. Some important rules of the thumb were: *Adjust your writing to the audience and purpose*, *Avoid redundancy and unnecessary explanations* and *Write like you speak and then revise*. These rules can help inexperienced writers present their work in a more effective way.

Key words: research article, writing, rules of thumb, structure

1 Introduction

MOVE 1: Introduce the topic and emphasize why it is important!

A scientific or research article or paper is a technical (or essayistic?) document that describes a significant experimental, theoretical or observational extension of current knowledge, or advances in the practical application of known principles (O'Conner and Woodford, 1976). It is important to emphasize the fact that a research article (further referred as RA) should report on research findings that are not only sound (valid) and previously unpublished (original), but also add some new understanding, observation, proofs, i.e. potentially important information (Gordon, 1983). Unlike a novel, newspaper article or an essay, an RA has a required structure and style, which is by international consensus known as *Introduction-Methods-Results-Discussion* or IMRaD. However, an RA is not only a technically rigid document, but also a subjective intellectual product that unavoidably re-

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flects personal opinions and beliefs. Therefore, it requires skill both in structuring and formulating concepts and findings. These skills are acquired through experience, but can also be taught.

MOVE 2: Relate to current knowledge:

There are many books on general guidelines for scientists wishing to write RAs and survive the review process (Germano, 2001; Day, 1994; Trelease, 1958). These days, many scientific societies publish quite detailed style manuals to help both authors and publishers; see for example the CBE's style manual (1994) or the ACA-CSA-SSSA's manual (1998). In this paper, the conventions for writing an RA have been extended to the level of the macro, meso and micro-elements of the paper.

"What's been done" and "What need's to be done?"

Various authors have investigated the principles of creating a good title (Ackles, 1996), writing a good abstract or introduction (McPhee, 2001; Swales, 1981). Some go to the level of the micro-structure of the RA (sentences), providing guidelines for structure and style (Gopen and Swan, 1990; Turk and Kirkman, 1989; Kirman, 1992). However, writing an RA is a bit like climbing a *monkey-puzzle tree*, especially if you are a non-native English speaker (further referred to as L2). What makes a good paper and can we offer guidelines to young researchers?

Introduce the GAP

Objective

With this motivation, we tried to formulate some rules of thumb for writing (and publishing) RAs. These were gathered during discussions in the course "Scientific writing for non-native English speakers", but they also reflect our personal experience of scientific writing. The idea behind this paper was to summarize the main conclusions from these discussions in an easy-to-read format.

MOVE 3: Introduce your work Give the purpose and main objective

Note that we do not focus on correctness. Rather, we try to show how authors would be more/less likely to write in a particular way in a specified context. The need for unambiguous clear rules, rather than fuzzy preferences, is probably culturally determined (Hofstede, 1996). Fortunately, the structure of scientific writing is well-defined and we can also indicate what makes good style.

2 Methods and materials

Describe the experimental set-up

The Scientific writing course, organized annually for ITC PhD students, was held between March 8 and April 26 in 2002. There were nine students, who followed five full-day classes. This gave enough time to do homework and numerous assignments in between classes. The classes were organized in such a way that the participants worked in groups or individually and discussed the most important issues, first among themselves and then with the whole group.

Focus of the study

The following topics were discussed in detail (in chronological order): the standard structure or elements of an RA, macro, meso and micro levels of an RA, general problems with readability and communication, the functions and content of the Introduction, Methods, Results and Discussion sections, writing successful abstracts and tips for submitting an RA for publication in a journal.

The participants were from eight countries (L2) and

Fig. 1. Photo from the Scientific writing class at ITC. Discussion about the "Discussion" section.

four continents, which provided a good basis for discussing cultural-academic differences (Prince et al., 1999).

Explain the methodology

The material and facilities were organized by Ian Cressie 2002, while most of the classes were led by Michael Gould, documentation consultant and advisory editor. The participants generated some graphs and flow diagrams manually (Fig. 1), which we then modified and transferred to a manuscript form.

The basic concept of the course is that the students should learn from real examples and their own mistakes. In most cases, participants were analysing and correcting each other's work. In other cases, participants were making comments on examples prepared by Ian Cressie. A typical exercise was, for example: a short RA is given to students who have to write an abstract, respecting the appropriate conventions.

Establish an author's 'voice'

An RA is like a cook-book! Be specific and provide all the necessary details

Most of the rules mentioned in this article were agreed by the majority of participants. We have also used the results of previous investigations and inquiries by journal editors to support general conclusions. Nevertheless, some of the statements and principles reflect personal views and opinions and should not be confused with the cited literature. The listed rules and tips given here apply primarily to application-based sciences and RAs intended for publication in such journals.

3 Results

3.1 RA structure and style

A RA was first divided into a number of sections (futher referred to as RAS) and elements (RAE). The participants agreed that the main article sections that are required in any modern journal are, in this order: Title, Authors, Abstract, Introduction (I), Methodology (M), Results (R), Conclusions and Discussion (D) and References. These are the core of an RA. Additional listed RAS's were: Author-paper documentation, Keywords, Acknowledgements, Abbreviations and Appendices. The RAEs listed were: tables, figures (graphs, maps, diagrams, sketches etc.), equations, citations and footnotes and comments.

Provide a summary of results

The RAEs can come in different places in the RA. However, tables and figures are more usual in the Results section and equations and citations in the Methods section and Introduction. All of these RAS's and RAEs have their function and required style and should form a coherent whole. The functions of the main RAS's are given in Table 1.

The participants agreed that some RAs, even with good data and interesting results, will be rejected if the style and format of the paper are not tailored to the needs of a particular audience. This confirms the results of Gosden (1992, Fig.1) who asked over 100 journal editors what they thought were the most important issues for non-English authors who want to get published. These were, in order of priority:

Compare results

(1) Clear, logical linking of sentences
(2) Coherent development of the topic in paragraphs (old before new information)
(3) Use of grammatically correct sentences
(4) An ability to make effective claims at the right level
(5) Clear organization of sections of a paper, and
(6) Placing their work in a wider context (especially relevant for authors in developing countries)

The misplacement of old and new information is not just a problem for non-native speakers, it is also the No. 1 problem in American professional writing (Gopen and Swan, 1990; Germano, 2001). The participants analysed a flawed paper by an unknown author and decided, after some discussion, that they would reject the publication.

3.2 RA sub-structure

The participants also discovered that all RAS's can be separated into subsections using clear signposts, which can improve the way the argument is built up in an RA. The subsections we identified were: research topic and definitions, research objectives (questions), methodological techniques, experimental set-up, object of the study (e.g. study area), main discoveries (analysed data), answers to research questions, explanation of the conclusions and further research and implications.

Focus: put more focus on what should be emphasized

The main RAS's are listed in a flow chart, showing the main relations between the different sections (Fig. 2). Fig. 3 shows the substructure of Introduction and Discussion as the most important RAS's.

Table 1
Research Article Sections (RAS), main functions, preferred style and related rules of thumb.

RAS	Main functions	Preferred style	Rules of thumb
Title	• indicates content and main discoveries • attracts the reader's attention	• short and simple words (7-10) • purposive (targets a specific audience)	• avoid complex grammar • make it catchy! • avoid redundancy ("*An investigation of...* ", "*The analysis of...* ", "*Effect of...* ", "*Influence of...* ", "*New method...*")
Abstract	• reflects the main 'story' of the RA • calls attention but avoids extra explanations	• past (perfect) tense and passive voice(!) • short and concise sentences • no citations, tables, equations, graphs etc.	• avoid introducing the topic • explain: what was done, what was found and what are the main conclusions • bring summary 'numbers'
Introduction	• introduces the topic and defines the terminology • relates to existing research • indicated the focus of the paper and research objectives	• present tense for referring to established knowledge or past tense for literature review • extensive overview of literature	• use state-of-the-art references • follow logical moves • define your terminology to avoid confusion
Methodology	• provides enough detail for competent researchers to repeat the experiment • who, what, when, where, how and why?	• past tense • correct and internationally recognised style and format (units, variables, materials etc.)	• mention everything you did that can make importance to the results • don't cover your traces ("*some data was ignored*") • establish an author's voice ("*we decided to ignore this data*") • if a technique is widely known, refer to it by its name (don't re-explain it) • use simple(st) example to explain complex methodology
Results	• gives summary results in graphics and numbers • compares different 'treatments' • gives quantified proofs (statistical tests)	• past tense • use tables and graphs and other illustrations	• present summary data related to the RA objectives and not all research results • call attention to the most significant findings • make a clear distinction between your work and that of others
Conclusions and Discussion	• answers research questions/objectives • explains discrepancies and unexpected findings • states importance of discoveries and future implications	• simple or present tense (past tense if it is related to results) • allows scientific speculation (if necessary)	• do not recapitulate results but make statements • make strong statements (avoid "*It may be concluded...* " style) • do not hide unexpected results — they can be the most important ones
References	• provide a list of related literature and sources of information • support the ideas in the paper	• depends on journal but authors/editors, year and title must be included	• always cite the most accessible references • cite primary source rather than review papers

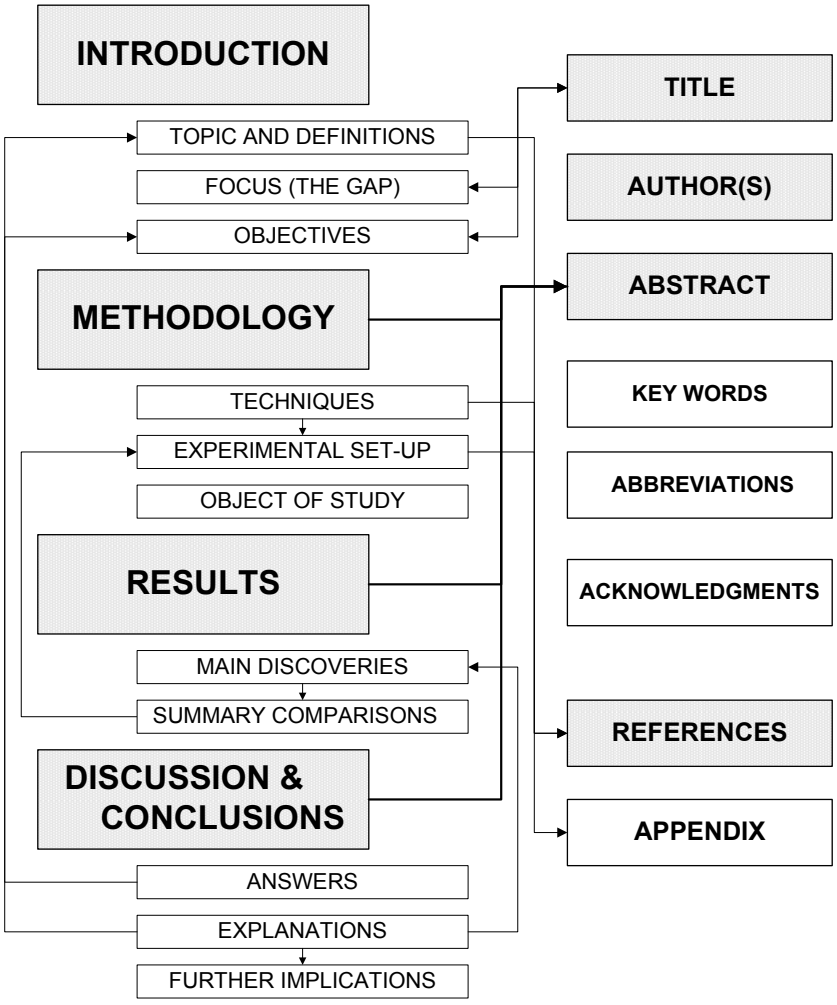

Fig. 2. Flow diagram: research article sections (shaded) and subsections, and their main relations.

4 Conclusions and discussion

What is the purpose of an RA and what makes it a good one, and who decides that it is a good RA? Are there rules for easier writing? If the main function of an RA is to transfer new knowledge on a research topic, then a good paper is one that is clear, coherent, focused, well argued and uses language that does not have any ambiguity. However, it is not only the message that is important.

Answer the research question

Provide summary conclusions

The RA must have a well-defined structure and serve as a kind of cook book, so that others can reproduce and repeat the experiments described in it. There are some rules that can make the writing and publishing of RAs easier. Here, we summarise some which should always be kept in mind by an inexperienced researcher (Table 2). We put all of these together to make a list of some 40 logical steps, which can be found at the end of this article.

Although it was assumed in the past that 'thicker' articles with a wider range of vocabulary are

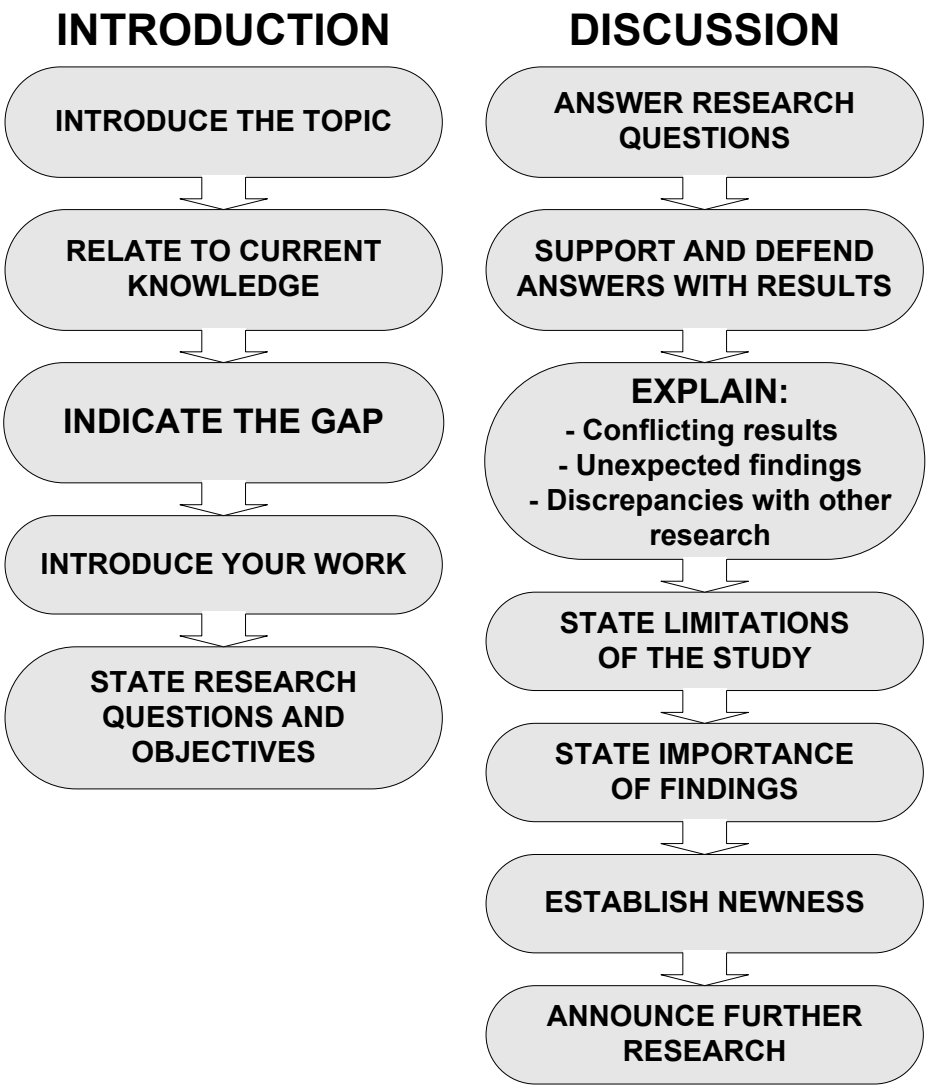

Fig. 3. Flow diagram: logical framework for RA sub-sections of Introduction and Discussion agreed by most of the participants.

preferable, most editors (and readers) prefer simple, clear and coherent writing (KISS — Keep It Short and Simple), rather than a fancy or complex, pseudo-scientific style. Funkhouser and Maccoby (1971) showed that information gain is especially enhanced by the *use of examples*, i.e. it helps a lot to use parallels from everyday life, historical points, etc. Some sections, such as the Introduction and Discussion, must intrigue readers, and be a tractor of their interest. For example, an interesting title can catch readers' attention and will be easily remembered (e.g.: T.Y. Li and J. Yorke named their famous paper on chaos: "*The period three means chaos*"). Some sections simply require more skill and are more important.

Unexpected findings

It is estimated that of all the published journal RAs in the world, less than 5% are read in detail. However, more than 50%

Table 2
Selected golden rules for easier publishing.

NAME	GOLDEN RULE
TAKE A READER'S VIEW	Write for your audience not for yourself.
TELL A STORY	Direct your RA but keep a clear focus in the paper and present only results that relate to it.
BE YOURSELF	Write like you speak and then revise and polish.
MAKE IT SIMPLE	Use simple(st) examples to explain complex methodology.
MAKE IT CONCRETE	Use concrete words and strong verbs, avoid noun clusters (more than three words), abstract and ambiguous words.
MAKE IT SHORT	Avoid redundancy, repetition and over-explanation of familiar techniques and terminology.
TAKE RESPONSIBILITY	Make a clear distinction between your work and that of others.
MAKE STRONG STATEMENTS	"We concluded... " instead of "It may be concluded... "
EMPHASIZE	Learn to use little words in a big way.
BE SELF-CRITICAL	Consider the uncertainty of conclusions and their implications and acknowledge the work of others.
NEVER STOP EDITING	The key to writing well is extensive editing.

of abstracts are read and so the quality of an abstract is much more important (Gordon, 1983). Therefore, the abstract should present the 'story' of the RA in miniature and should make sense standalone.

The sub-structure of an Introduction was first described by Swales (1981) with his "*four moves*". These later on become three, the so-called CaRS model (Create-A-Research-Space), which are: establish a research *territory*, establish a research *niche* and occupy the niche (Swales and Feak, 1994). The participants in the course concluded that especially the meso-structure of the Introduction and Discussion should follow a logical flow of 'moves' as in chess (Fig. 2 & 3).

Establish newness

The more structured and precise a paper is, the greater the chance that it will get published. Each of the RA elements has to fulfil its function in order to achieve this goal. The importance of following a logical structure is nicely illustrated by Gopen and Swan (1990): "*People need signposts to understand what you're communicating. First establish the context based on what they know. Then move towards the new facts you want to convey. Beginning with exciting new information and ending with something we already know leaves us disappointed and spoils the flow.*"

However, this is not the whole story. A RA has to target a specific audience/Journal, has to be novel and of high interest. Finally, one thing should be uppermost in researchers' minds: a good article is not only an article that has been published in a top journal — it is the reaction it causes that makes the difference.

Explain discrepancies

Therefore, a good article is not just one that is well written. A good article is one that is read and cited. In some cases, even a good paper will get rejected. Unfortunately, sometimes the reasons for this can be subjective (maybe in around a third of all cases). Editors are often biased, they prefer one or another approach, academic level, gender... nation. These problems and issues such as fraud, plagiarism and ethics (Rossiter, 2001) are not discussed here, but they certainly need attention.

Searching, inputting and formatting references has been much improved lately with the help of so-called "information management tools" (web-applications, on-line libraries, reference management tools, etc.). In addition, the role of companies involved in sorting and filtering, will become more important.

Further research and implications

In the future, we can expect more structured guidelines for writing an RA (perhaps even templates?). The RA will also probably support multimedia (animations, sound recordings), which will improve communication between authors and readers/users. These innovations will inevitably require some new rules of thumb.

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Put it all together:

writing an RA in 40 STEPS!

MAKE DRAFT	STEP 1	Draft a working **title**
	STEP 2	Introduce the **topic** and define terminology
	STEP 3	Emphasize why the topic is important
	STEP 4	Relate to **current knowledge**: what's already been done
	STEP 5	Indicate the **gap**: what needs to be done?
	STEP 6	Pose research **questions**
	STEP 7	State your overall purpose and **objectives**
	STEP 8	List methodological **steps**
	STEP 9	Explain the **theory** behind the methodology used
	STEP 10	Describe the **experimental set-up**
	STEP 11	Describe the technical details
	STEP 12	Provide summary **results**
	STEP 13	Compare different results
	STEP 14	Focus on main **discoveries**
	STEP 15	Answer the research question (**conclusions**)
	STEP 16	Support and defend **answers**
	STEP 17	Explain conflicting results, unexpected findings and **discrepancies** with other research
	STEP 18	State the **limitations** of the study
	STEP 19	State the **importance** of your findings
	STEP 20	Establish **newness**
	STEP 21	Announce **further research**
	STEP 22	ABSTRACT: what was done, what was found and what the main conclusions are
REVISE	STEP 23	Is the title clear and does it reflect the content and main findings?
	STEP 24	Are key terms clear and familiar?
	STEP 25	Are the objectives clear and relevant to the audience?
	STEP 26	Are all variables, techniques and materials listed, explained and linked to existing knowledge - are the results reproducible?
	STEP 27	Are all results and comparisons relevant to the stated objectives?
	STEP 28	Are some statements and findings repeated in the text, tables of figures?
	STEP 29	Do the main conclusions reflect the questions posed?
	STEP 30	Will the main findings be acceptable to the scientific community?
	STEP 31	Is the text coherent, clear and focused on a specific problem/topic?
	STEP 32	Does the abstract make sense standalone (does it reflect the main story)?
POLISH	STEP 33	Are tenses used appropriately (including the active and passive voice)?
	STEP 34	Are all equations mathematically correct and explained in the text?
	STEP 35	Are all abbreviations explained?
	STEP 36	Reconsider (avoid) using words such as "very", "better", "may", "appears", "more", "convinced", "perfect", "impression" in the text.
	STEP 37	Are all abbreviations, measurement units, variables and techniques internationally recognized (IS)?
	STEP 38	Are all figures/tables relevant and of good quality?
	STEP 39	Are all figures, tables and equations listed and mentioned in the text?
	STEP 40	Are all references relevant, up to date and accessible?

Fig. 4. The 40 steps to write an RA.

EUR 22191 EN – THE UNOFFICIAL GUIDE FOR AUTHORS (OR HOW TO PRODUCE RESEARCH ARTICLES WORTH CITING)

T. HENGL & M. GOULD

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This guide offers pragmatic tips on how to prepare a research article --- starting from a one-page concept paper, via the first draft, to the final version. In addition, it addresses deeper aspects of preparing and publishing research articles as well as some of the limitations and frustrations that are inherent in current editorial systems such as hyperproduction, phoney co-authors and poor reviews. Free (digital) copies of these materials can be obtained directly from the European Commission websites. Printouts can be ordered by contacting the authors.

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