**Defensive scientific writing**

or

**They're out to get you: a guide to writing for the science graduate student**

The science graduate's life is fraught with danger. Around every corner lurk sceptical referees, dubious thesis examiners, hostile scientists. If your science isn't up to scratch, you'll know in short order. Frequently, the graduate's best line of defence is to learn the art of *defensive scientific writing*. This is a set of principles designed to protect your scientific reputation: let your writing, not your science, take the strain. Having learned the hard way the principles of defensive writing, I found myself wishing I'd had a guide to follow from the outset. So I decided to write one. I make no claim to originality. I have simply collected a few of the gems in common use that have made my life easier.

The guiding principle of defensive scientific writing is this: There's no such thing as a free lunch. You had to work bloody hard to understand the science, and so should the reader. The reader may be determined. Most likely a referee or thesis examiner, they will spend long nights bent intently over your manuscript, red pen in hand. If they reach the end of your account with energy left and critical faculties intact, you're in trouble. They will weigh up the scientific content of your paper or thesis, draw on years of experience, and deliver an assessment of your work, usually damning. But if they've had to divert energy from understanding the scientific content of your work to deciphering your writing, you might be okay. When the thought of wading once more through your craftily chosen jargon and cunningly convoluted sentences fills the exhausted reader with dread, their response will be, 'sod this'. The result is often an improved chance of submission or a shorter viva. At the very least your scientific reputation will survive another day.

Rule 1: Never use a short word where a long and intimidating one will do.

This rule is elementary, and always useful. Scientists, knowing several fields' worth of jargon, are best placed to exploit the principle underlying this rule: If it sounds impressive, it probably is. Don't undersell what you did. Your 'method' should become your 'methodologies' or, better, your 'methodological approach'. That these mean different things is a bonus. While the referee is trying to work out if you're talking about a method, a set of methods, or are making an oblique reference to the branch of logic dealing with the general principles of the formation of knowledge, the admission that you tried to solve your integrals by typing them into Google will have passed them by. Indeed, any word ending in -ology sounds impressive. Other good words are calumniate, equipoise, panegyric, sententious and deracinated. I don't know what they mean, and with luck neither will the referee. Latin words are life-savers. Who will ponder the details of your calculation when it is sandwiched by *in*

*situ*, *mutatis mutandis*, and *deus ex machina*? The best exponents of this principle use words to befuddle the reader like a plane uses chaff to confuse a missile.

Rule 2: Never use the active where you could use the passive.

Sorry - Rule 2: The passive is always to be preferred over the active.

The passive voice gives the impression that your work has been sanctioned by a higher authority, or at least some of your peers. Saying 'We think that glass formation is a purely dynamical effect' will fool nobody. It is clear. It is direct. And just who are *you*? thinks the referee, red pen jotting impolite notes in the margin. 'It has recently become almost universally accepted that glass formation is a purely dynamical phenomenon' may be incorrect, but with luck the referee will spend their energies trying to work out how this upheaval in their field has come about. It is then less likely that the content of your statement will arouse their ire.

The above rules work better when incorporated into a larger strategy for protecting (obscuring is such an ugly word) your science. This can be achieved by careful tailoring of the structure of your article.

Rule 3: Information is more likely to escape undue attention if it is placed where readers least expect to find it.

The usefulness of this rule cannot be overstated, and there are many ways of putting it into practice. Yawning chasms between subject and verb are often best. Consider

'The simplest of the kinetically constrained models, the $d = f = 1$ Fredrickson-Andersen model, a 1-spin-dynamically facilitated system on a simply-connected dual isotropic Euclidean lattice with nothing whatsoever to do with the NIH2terminal portion of the adenosinetriphosphatase (ATPase) subunit 6 gene nor in actual fact any other gene has been identified as the only nontrivial classical system amenable to a frustrated renormalization group analysis.'

One hopes that like a drowning swimmer the reader's attention will disappear below the murky waters separating subject and verb. This is more likely if the previous ten sentences are of equally awkward construction. With luck, the reader will fail to realise that your statement is meaningless. More experienced writers can experiment by transposing the subject and verb in similar sentences, to throw the hound further off the scent. Try starting the sentence with 'That the...', and wend your way from there. Be careful, though: the aim is to convince the reader that re-reading your work to extract its content will be too painful, not that you're illiterate.

Rule 3 can be implemented in other ways. According to those who study these things (ideally, citations like this should be vague, but in the interest of fairness I point to the first reference below), 'the information that begins a sentence establishes for the reader a perspective for viewing the sentence as a unit.' It is therefore very important to change this information as often as possible, lest the determined reader identify a coherent train of thought. Your grant proposal is comprehensible and can

be summarised in two lines? Forget it. They'll give the money to the guy at the desk next to yours who seems to be planning to study all of theoretical physics.

There are many other techniques one can use to make life easier. Writing with a healthy degree of pretension lets the reader know that you're not to be trifled with. Liberal use of words like 'obvious' and 'evident' tell the reader how smart you are, that you too can do twenty lines of calculation in your head. And like a secret sign for the initiated, the phrase 'highly nontrivial' should appear at least once.

Just as defensive driving saves lives, so defensive writing helps protect the career of the aspiring graduate student. Protect your science. Make the reader work. Give nothing for free. Remember, every reader of your work is potentially hostile, be they referee, external examiner, or vastly more intelligent colleague looking to crush (or possibly generalize) your argument.

And always remember the final rule,

Rule 4: Just because you're paranoid doesn't mean they're not out to get you.

You have been warned.

Steve Whitelam

Alternative approaches to writing can be found in

*The Science of Scientific Writing*, George D. Gopen and Judith A. Swan, American Scientist, Volume 78, 550 (1990).

*Politics and the English Language*, George Orwell, (1946).

These approaches are not recommended for the science graduate student.