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Writing Mathematics: A Nut and a Bolt of Style

By Frank A. Farris

In his book, Style: Ten Lessons in Clarity and Grace, Joseph M. Williams shows us how to rewrite dense technical passages in order to make them easier to read. If you don't have time to read this excellent book, let me summarize one point for you: English speakers are predisposed to talk about actors taking action, and therefore we should provide that structure for our readers when we write.

As editor of Mathematics Magazine, I see a lot of manuscripts. Some of them are written with a charming sense of style, but many of them leave me thinking that the author's only concern was to set out the mathematics clearly. This is a fine place to start, but the tradition of the Magazine is to offer things that people will enjoy reading, and this requires more than clarity. Let me explain an important step authors can take in order to make their work more attractive.

There are many sources for comprehensive advice about writing mathematics; some are listed in the Editorial Guidelines at the Magazine website (at http://www.maa.org/pubs/mathmag.html). They all warn against using the passive voice, a point that Williams elaborates. My hope here is to expand on that idea and even offer some homework to help readers experience it for themselves.

First, an explanation: I wrote all the examples myself. Although some may be based on things I've read in actual manuscripts, I would not hold up anyone's writing as a public bad example. Unless it's my own.

Start by trying to read this passage:

> The negation of Euclid's Parallel Postulate was the starting point for the numerous discoveries of Saccheri, from which a concrete contradiction was surely expected by him, but which were later shown to be true in the context of noneuclidean geometry.

It is grammatically correct, but hard to read. Of course, it is inherently difficult to communicate abstract ideas, but this passage requires far too much mental juggling. Readers have to hold in mind too many syntactical elements for later assembly. The negation of Euclid's Parallel Postulate is a complicated abstraction and the sentence structure A was the starting point for B is less than concrete. It all leaves us wondering, "What happened?"

Try rewriting this yourself in a way that highlights Saccheri, who, after all, is the person whose actions we are talking about. This is my version:

> Saccheri spent his career discovering consequences that follow from assuming that Euclid's Parallel Postulate is false. Although he surely expected to reach a contradiction, his conclusions are true in noneuclidean geometry.

Notice that I used two sentences instead of one. When we have become experts on a particular bit of mathematics, we use mental shorthands that tempt us to write long sentences with too great a burden of information. One remedy for this is to break up a complicated thought into two simpler pieces.

Notice also that the complicated abstraction, assuming that Euclid's Parallel Postulate is false, comes at the end of a sentence; when we arrive there in our reading, we already know the grammar of the sentence and can handle the abstraction more comfortably. And I thought the abstraction was easier to understand when phrased as an activity.

I recently taught a course called Writing for the Mathematical Sciences, in which each student wrote two papers. To set the tone on the first day of class, I kept a straight face as I displayed one version of the first two paragraphs of my syllabus on an overhead:

> By means of written communication people can basically have the things they think be shared with other people. Having understanding of your writing by the various kinds of people about many things needs a lot of different skills to be used. In this course, developing abilities of written mathematical communication will be the principal focus.
>
> Since it is probable that really talking about exactly how meaning gets communicated gets to be too difficult of a philosophical problem, the assumption will be made that there is a common standard of expression in mathematics, which will be understandable, as long as it is clear, by a group we call American mathematicians, with some things you have to do like good English grammar, some general rules where breaking is allowed, and some things that are left up to the tasteful decision-making and stylistics of the person by whom it was written. But without talking about something as complicated as a language community, even though we need to learn all about their conventions, it is to be believed that if you can understand your own writing yourself, then its comprehensibility to other people will usually be implied in general. However, sometimes you can think you are reading your own writing, but you actually aren't.

Some students saw through my deception. They made interesting points about why this passage was hard to read, though they had to agree that it is grammatical, and even possible to decipher. Before reading on, you might enjoy rewriting it yourself. The passage illustrates various common infelicities, but to focus on today's Nut and Bolt, try to highlight an actor taking action when rewriting each sentence. Here is my version:

> Writing can help you share your experience. Depending on the kind of experience this is, and depending on whom you hope to reach, you need different skills to make yourself understood. In this course, we will practice writing to communicate mathematical experience.

Philosophical questions of meaning and how to transmit it are tricky. To avoid such things, we will assume that the community of American mathematicians forms a well-defined language group, who can understand things written clearly in their idiom. This hypothetical community has some ironclad conventions (including standard English grammar), some mutable rules, and some relatively open choices of style and taste. Learning these standards is important, but here is some simpler advice: if you write things that you find easy to understand, your fellow students and I will probably be able to follow as well. Of course, learning to read your own writing is not as easy as it sounds.

Writing about actors taking action is not my only recommendation for a good mathematical style. I also prefer that authors lead with examples, rather than announce abstractions and give examples later. I appreciate authors' personalizing their writing by using the first person. Perhaps each of these merits an essay, preferably written by someone else.

I also have a few pet peeves about the mechanics of writing: When an author writes i.e., I will change it to that is; and when an author uses quotes to show that certain "words" are not being "used" in the customary sense, I remove the quotes and reword the passage. A misplaced modifier sometimes gives me a laugh, as in "With further instruction, these examples could be used in high school;" one imagines how difficult it must be to instruct examples. On the other hand, I am not a linguistic prig; when the setting is right, I allow authors to gaily split infinitives. And the day is probably coming when I'll print something akin to "every student must write their own paper," although that particular bullet may be dodged very easily in this particular passage.

Back to my primary advice to authors: go through your manuscript, underline every verb, and change the sentences where the verb is flabby. We mathematicians do so very many things; we count interesting sets, we compute approximate solutions to differential equations, we expand functions as infinite series. We speak of mathematical objects as actors in action: cosets decompose a group, pentagons can tile the plane, zeros of the Riemann zeta function may or may not all lie on a particular line. There is no shortage of vivid verbs to use. And since we represent so many of the different types of people on Earth, there is a richness to be revealed when we allow our individual selves to show through the mathematics.

Frank Farris is the editor of Mathematics Magazine.

On May 15, 2002, the MAA participated in the Coalition for National Science Funding (CNSF) Exhibit and Reception for Congress. This year's exhibitor was MAA Second Vice President Joseph A. Gallian. The subject area of his exhibit was the very successful REU program that he has run for many years at the University of Minnesota-Duluth. On the day of the exhibit, he, his two student presenters, and MAA Executive Director Tina Straley visited the offices and the exhibit with members of Congress and/or staff of every Senator and Representative from Minnesota, including a private meeting with Senator Paul Wellstone. Pictured left to right are: Tina Straley, MAA Executive Director, Joseph A. Gallian, MAA Second Vice President, Senator Paul Wellstone, Sarah Moss, Harvard University, and Melanie Wood, Duke University.