


CREDIT: N.HENDRICKSON / ISTOCKPHOTO

How to read a scientific paper

By [Adam Ruben](#) Jan. 20, 2016 , 3:15 PM

Nothing makes you feel stupid quite like reading a scientific journal article.

I remember my first experience with these ultra-congested and aggressively bland manuscripts so dense that scientists are sometimes caught eating them to stay regular. I was in college taking a seminar course in which we had to read and discuss a new paper each week. And something just wasn't working for me.

Every week I would sit with the article, read every single sentence, and then discover that I hadn't learned a single thing. I'd attend class armed with exactly one piece of knowledge: I knew I had read the paper. The instructor would ask a question; I'd have no idea what she was asking. She'd ask a simpler question—still no idea. *But I'd read the damn paper!*

It reminded me of kindergarten, when I would feel proud after reading a book above my grade level. But if you had asked me a simple question about the book's contents—What kind of animal is Wilbur? How did Encyclopedia Brown know that Bugs Meany wasn't really birdwatching?—I couldn't have answered it.

A few weeks into the seminar, I decided enough was enough. I wasn't going to read another paper without understanding it. So I took that week's journal article to the library. Not just the regular library, but the obscure little biology library, one of those dusty academic hidey-holes only populated by the most wretched forms of life, which are, of course, insects and postdocs.

I placed the paper on a large empty desk. I eliminated all other distractions. To avoid interruptions from friends encouraging alcohol consumption, as friends do in college, I

sat in an obscure anteroom with no foot traffic. To avoid interruptions from cellphone calls, I made sure it was 1999.

Most importantly, if I didn't understand a word in a sentence, I forbade myself from proceeding to the next sentence until I looked it up in a textbook and then reread the sentence until it made sense.

I specifically remember this happening with the word "exogenous." Somehow I had always glossed over this word, as though it was probably unimportant to its sentence. Wrong.

It took me more than 2 hours to read a three-page paper. But this time, I actually understood it.

And I thought, "Wow. I *get* it. I really *get* it."

And I thought, "Oh crap. I'm going to have to do this again, aren't I?"

Every week I would sit with the article, read every single sentence, and then discover that I hadn't learned a single thing.

If you're at the beginning of your career in science, you may be struggling with the same problem. It may help you to familiarize yourself with the 10 Stages of Reading a Scientific Paper:

1. Optimism. "This can't be too difficult," you tell yourself with a smile—in the same way you tell yourself, "It's not damaging to drink eight cups of coffee a day" or "There are plenty of tenure-track jobs." After all, you've been reading *words* for decades. And that's all a scientific paper is, right? Words?

2. Fear. This is the stage when you realize, "Uh ... I don't think all of these are words." So you slow down a little. Sound out the syllables, parse the jargon, look up the acronyms, and review your work several times. Congratulations: You have now read the title.

3. Regret. You begin to realize that you should have budgeted much more time for this whole undertaking. Why, oh why, did you think you could read the article in a single bus ride? If only you had more time. If only you had one of those buzzer buttons from workplaces in the 1960s, and you could just press it and say, "Phoebe, cancel my January." If only there was a compact version of the same article, something on the order of 250 or fewer words, printed in bold at the beginning of the paper...

4. Corner-cutting. Why, what's this? An abstract, all for me? Blessed be the editors of scientific journals who knew that no article is comprehensible, so they asked their writers to provide, à la [Spaceballs](#), "the short, short version." Okay. Let's do this.

5. Bafflement. What the hell? Was that abstract supposed to explain something? Why was the average sentence 40 words long? Why were there so many acronyms? Why did the authors use the word “characterize” five times?

6. Distraction. What if there was, like, a smartphone for ducks? How would that work? What would they use it for? And what was that Paul Simon lyric, the one from “You Can Call Me Al,” that’s been in your head all day? How would your life change if you owned a bread maker? You’d have to buy yeast. Is yeast expensive? You could make your own bread every few days, but then it might go stale. It’s not the same as store-bought bread; it’s just not. Oh, right! “Don’t want to end up a cartoon in a cartoon graveyard.” Is Paul Simon still alive? You should check Wikipedia. Sometimes you confuse him with Paul McCartney or Paul Shaffer. Shame about David Bowie. Can you put coffee in a humidifier?

7. Realization that 15 minutes have gone by and you haven’t progressed to the next sentence.

8. Determination. All righty. Really gonna read this time. Really gonna do it. Yup, yuppers, yup-a-roo, readin’ words is what you do. Let’s just point those pupils at the dried ink on the page, and ...

9. Rage. HOW COULD ANY HUMAN BRAIN PRODUCE SUCH SENTENCES?

10. Genuine contemplation of a career in the humanities. Academic papers written on nonscientific subjects are easy to understand, right? Right?

What a strange document a scientific journal article is. We work on them for months or even years. We write them in a highly specialized vernacular that even most other scientists don’t share. We place them behind a paywall and charge something ridiculous, like \$34.95, for the privilege of reading them. We so readily accept their inaccessibility that we have to start “journal clubs” in the hopes that our friends might understand them and summarize them for us.

Can you imagine if mainstream magazine articles were like science papers? Picture a *Time* cover story with 48 authors. Or a piece in *The Economist* that required, after every object described, a parenthetical listing of the company that produced the object and the city where that company is based. Or a *People* editorial about Jimmy Kimmel that could only be published following a rigorous review process by experts in the field of Jimmy Kimmel.

Do you know what you’d call a magazine article that required intellectual scrutiny and uninterrupted neural commitment to figure out what it’s even trying to say? You’d call it a badly written article.

So for those new to reading journals, welcome. Good luck. And we’re sorry. We’re *trying* to write articles comprehensibly, but sometimes our subdiscipline is so hyperspecific that we need a million acronyms. And sometimes we’re attempting to

sound like good scientists by copying the tone of every article we've read. And sometimes we're just writing badly.

Quackberry. That's what you'd call the smartphone for ducks.

[Read more Experimental Error stories](#)

doi:10.1126/science.caredit.a1600012



Adam Ruben

Adam Ruben, Ph.D., is a practicing scientist and the author of ***[Surviving Your Stupid, Stupid Decision to Go to Grad School](#)*** and ***[Pinball Wizards: Jackpots, Drains, and the Cult of the Silver Ball](#)***.