A Few Tips on Increasing Research Effectiveness

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A Comment on the Sabine Hossenfelder (YouTube) post:
Do your own research. But do it right. (Aug 26, 2023)
https://youtu.be/nD6hS8WV3ic

> ***NOTE**: My inspiration for writing up these suggestions for increasing personal research effectiveness was the August 26, 2023 Sabine Hossenfelder YouTube video "Do your own research. But do it right." (https://youtu.be/nD6hS8WV3ic) I suggest listening to her video first before reading these suggestions, which are expansions on several of Sabine's points.*

Sabine, I particularly liked your emphasis on scouring for relevant papers, especially original sources, and especially ones that *contradict* whatever idea you may be pursuing. Science is all about disproving *yourself* on the very points dearest to you. All patting yourself on the head does is stimulate a few chemical receptors in your brain without solving anything.

Google Scholar is an incredible resource! One trick I've found extremely useful for tracking down specific papers is having a tab directly to the Google Scholar "Advanced Search" page. You then copy the title you want into the *second* line that says "with the exact phrase" and click the button "in the title of the article." In most cases, Google Scholar returns exactly *one* reference, with the BibTeX reference text ready to copy, a link to some immediately available free paper copy, and the published journal site. A powerful combo of info, that! The BibTeX entry is convenient if you are serious about getting into the topic since it provides a way to quote the paper to others and keep it in your library.

Also, if you already have a paper reference in standard compact form, which often does *not* include the title, that's even easier to find in Google Scholar: Copy it into the *first* Advanced Search line, the one labeled "with all the words," and just search. That, too, usually returns a single full description of the paper, including the missing title.

Speaking of libraries, get JabRef! It's a fantastic free tool for organizing your research. Yes, it takes some setup, but once configured the way you want, you stop losing key references, can do far more powerful keyword searches, and can make valid references in many formats. Be sure to add links to the online paper copies, at the very least. I also firmly recommend having a local copy for text searches and keeping notes. Having Adobe Acrobat is helpful for that, and in my case, I pay for it, but free alternatives are available. Using JabRef, I currently have a library of almost 2,000 peer-reviewed journal papers available at my fingertips. Folks sometimes wonder how I manage to come up with fully formatted references to relevant papers in the middle of a real-time chat on some intricate physics topic, and that's the answer: JabRef! (Well, that and having *read* the papers and knowing why they are relevant.)

Another technique I always recommend is this: Always take the time to find and *read* the founding papers on whatever topic you are researching. *Don't* assume that everyone who quotes that paper understands it perfectly, no matter how popular it may be. Reading originals is not just insightful but fun since the "aura" of magic that later inevitably develops around a significant paper isn't there yet. Instead, you hear perplexed humans talking first person about a complex problem for which they have an "idea." Reading Einstein's original 1905 papers — his wonder year — is a delight and makes the man behind the papers much more human. How one person could be so insightful on so many topics in one year... wow!

Another excellent reason for reading original papers is quotation drift: A paper gets quoted so often that its original intent and argument get utterly lost. Quotation drift is especially pernicious when the original authors are extremely well-respected, which gives inaccurate quotes of their ideas more heft in later papers and can lead to entire branches of interpretation where everyone quotes *later* papers but never bothers to look back at the originals. The drift is often entirely sincere since the later authors feel they are elaborating on the earlier papers. However, if you want to be a researcher on that topic, you need to assess the validity of that generalization rather than trusting what others say, often decades later.

A particularly spectacular example of severe quotation drift is a paper by Einstein and Rosen in which they proposed what are now called Einstein-Rosen bridges. Ask yourself right now: What is the mental image you get when you hear that phrase? Would you be surprised to know that the original ER bridge was a relatively weak attempt to model massless neutrinos as tiny and incredibly short pinholes in the fabric of spacetime? I say "weak" because this is what Einstein and Rosen said about the viability of their idea as a general model for particle physics: "For the present, one cannot even know whether regular solutions with more than one bridge exist at all." (And how did I quickly get that quote? My JabRef library! Again, if you are serious about researching some deep topic, getting a JabRef library together is handy.)

Speaking of "reading the paper," folks often read papers inefficiently. I read advice on that from some well-known physicist — it may have been Sir Roger Penrose — and whoever it was, they emphasized this order: (1) Abstract; (2) *Conclusions;* (3) Table of contents; (4) Selected key sections, now getting into details. I would add to that this: Make sure you have a fully searchable copy locally available so you can do any arbitrary search on some critical keyword that helps clarify some points you found in steps 1, 2, 3, and 4.

Those are the easy parts. The next part is a tough one for many folks, I know, but this has to be said: You *must* take the math to heart, especially for papers that are about modeling reality (also known as "physics.") You may need to learn entirely new topics. It's worth investing time and even a few courses if you care about the topic. Khan Academy is a great free starting point and one you can use to "get your feet wet" to see if you want to dive in deeper and pay for courses of some type. As advertised here by Sabine, Brilliant is an amazing learning tool with spectacular animated graphics that can make a seemingly complicated topic suddenly click into place to the point where you suddenly say, "Hah! I already *knew* that but didn't realize this was another way of doing the same thing!"

Another important point when reading math-intensive papers is this: Even in well-done and deeply insightful papers, only a few of the equations in a math-intensive paper typically help you understand the critical concepts. For example, a typical (and sound) style in many papers is to review all the derivation steps so reviewers and expert readers can verify the conclusions. That's why steps 1, 2, 3, and 4 are helpful: Until you reach a point where you genuinely understand *what* that math is trying to do, going through the details may end up confusing you more than before. Even worse — and it pains me to say this — some papers use math not to clarify but to impress. In that case, the idea is that with enough math, even seasoned peer reviewers give up and stop checking whether the math is even internally consistent. They don't have the time! So again, making sure you know *what* the authors are trying to say first helps you better assess whether it's worth your time to get into the more time-consuming math details.

My final suggestion is this: Recognize that as finite folks with limited time, it's inevitable that, at some point, we must revert to reverence mode. That's when you say, "Well, [this person] said it, so it *must* be true, right?" In its more severe forms — and I mean this seriously, not as a joke — scientific reverence mode becomes psychologically indistinguishable from faith-based theology and religious dedication, meaning that *any* questioning of [this person] evokes a visceral and often angry response.

The critical point about reverence mode is not to avoid it entirely — that is impossible because we are finite with finite resources and need foundations upon which to stand — but to be aware of it and know when to consider alternatives. My reverence point in physics is Richard Feynman, who, to my way of thinking, was the clearest-minded and most honest physics thinker of the last century. But I am also consciously aware of my bias on this point.

To end: Sabine, thank you for an excellent video with lots of superb advice. I apologize for giving this long answer to your request for additional suggestions. When I started, I expected my answer to be two short paragraphs long.

I seem to have a habit of underestimating such things... :)