Opinion

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The underappreciated art of creating publication-quality figures

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The first thing I do when I open the PDF file of a publication is scroll down to the figures. You shouldn't judge a book by its cover, but you can darn sure judge a paper by its images. Sharp, clean, creative, and accessible figures often reflect strong science—or, in the very least, well-communicated science—whereas fuzzy, awkward, and careless figures are frequently a sign of deeper flaws lurking beneath the surface. Although some of the top journals employ professional graphic designers for figure production, most of us are left to our own devices when developing images and diagrams for peer-reviewed articles. And we have more gray hairs and lost sleep because of it.

I can still hear the groans of old supervisors: "David, you've made a great start to an awful figure. Leave this task with me and start formatting the references." And the angry cries of former lab mates: "Who does she think I am, Picasso? I'm here to do science, not arts and crafts." Occasionally, I wake up in the middle of the night imagining I just received an email from the editorial office: "I'm sorry to inform you, Dr. Smith, but your images still don't meet journal regulations. Your manuscript has been returned to ScholarOne for your immediate attention." "What can it be this time?" I scream into the dark. "It can't be the file format; I've already changed it three times! Good god, tell me it's not the resolution…" But like it or not, the hard work pays off.

If a picture is worth a thousand words, a good figure is worth 10 times that. The problem is learning how to make one. Graphic design and Photoshop are not normally covered in a Bachelor of Science, meaning the fine art of figure development is something we must learn on the fly. Nevertheless, there is no shortage of online advice. For example, a thread on ResearchGate titled "What is the best software for making and editing scientific images?" currently has 168 posts, but you'd be forgiven if reading these only leaves you more confused. Scrolling through the front half I counted recommendations to more than 30 different programs, many of which I've never heard of. The Authors' Guidelines section of journal websites typically provides detailed instructions on figure production, but in my experiences these statements usually tell researchers what not to do rather than providing constructive advice for crafting strong illustrations—apart from saying things like "the use of red and green in figures may cause difficulty for color-blind people." Great point, how about neon pink and a very light shade of gray?

Ultimately, when making a scientific diagram for publication you should ask yourself two key questions: What am I trying to communicate? And what is the most accessible, direct, and attractive way to depict this? Everything else comes down to creativity, experience, time, effort, feedback, and the resources available to you. Consequently, there are a plethora of approaches and styles for creating quality images.

There are the pros who have mastered hi-tech, play-to-play applications like Adobe Illustrator and CorelDRAW; the purists who sit behind a Linux operating system using R and other open-source, command-line driven programs; the hipsters who sip espresso and make their figures using only the newest and most esoteric of software suites; the no-fussers who buy a license for BioRender and get on with it; and the hackers, like myself, who somehow survive—and can even thrive—with PowerPoint or Keynote. Whatever the strategy, most scientists eventually come to the same conclusion: There are no shortcuts. Great figures require sweat, tears, and sacrifice.

I try to leave my work at the university, but there are a handful of figures that I've printed, brought home, and gently placed on the kitchen table for my wife to admire over a glass of wine. "Do you know how many hours this masterpiece took me to make?" "It's very pretty, honey, but shouldn't the word antarctica be capitalized?" Graduate students will sometimes ask me where I sourced the various components of detailed illustrations. "No sourcing," I reply. "I did it by hand in Keynote," which usually elicits a blank look. "Yes, I entered every line, dot, square, squiggle, colour gradient and textbox myself." "That's crazy," they say.

But don't confuse complexity with function. A great figure need not have hundreds of parts. Take Watson and Crick's 1953 paper describing the structure of DNA. The article has a single image at the bottom of the first page: a simple yet elegant hand-drawn double helix with no letters or numbers; the only annotations are two small arrows. Contrast this with circus plots. These beautiful images with their colorful rainbows connecting one chromosome to another have become the centerpiece of genome papers over the past decade, but no matter how many times I stare at these impressive diagrams, I am left scratching my head trying to figure out what's going on behind all the intricacy. Sometimes simple is best, and if you need to go old school and use a pen and paper to make your point, go for it.

Whatever you do, don't plagiarize someone else's image. Even if you have

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permission from a journal and the original authors to reproduce a figure, I'd argue that it is still better to start from scratch and design your own diagram. You might be surprised at how much you learn about your results in the process. Exceptions to this rule include photographs or microscopy images of specific organisms, for instance, which may not be easily accessible.

Figure legends are an entirely different beast. Do not underestimate their importance and give them the respect and energy they deserve. I have seen authors cram half a manuscript into the legend, which isn't a good thing. Others have left the legend so wanting that I've stared at their figures hoping that if I blurred my eyes just right some secret code would pop out. My advice: If the illustration is self-explanatory, don't repeat the details in the legend; a simple title and description will suffice. However, if the figure is complicated, with many parts, use the legend to guide the reader through the key points, but use your words sparingly.

At the end of the day, most scientists can be divided into two camps: the table people and the figure people. I'm happy to count myself among the latter. Tables are fast and easy, but they lack nuance and beauty. Figures, on the contrary, require a lifetime to master. When they are done well, there is no greater reward in science, for it is the figures that most readers will see first and return to time and again. And quite often, they may just look at the figures without reading the whole paper.

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