Making Publication Quality Figures

Your figures should be able to tell the story without the text. Often, busy people will read your figures first to determine whether they want to read the text. If your paper is presented to others or the subject of reviews, your figures will be the part of your paper that is reproduced for everyone to see. For all of these reasons, figures should be clear, readable, and attractive. At the same time, you want to prepare your figures in the most time-efficient manner possible.

General Advice

1. Get as much specific information about the figure requirements of the target journal. I actually write the specifics out for a specific publication project as a reminder and quick reference.

    a. The journal will often declare limits on the overall print space that your figures can occupy and the options you have about dimensions (e.g. 1 column wide or two columns wide). This is absolutely critical because it will determine the final magnification of the figures you submit, which will be one of the two biggest factors in determining their readability and the impact of their appearance.

    b. The journal will often also place restrictions on the way that color can be represented. The most important distinction is whether they use CMKY or RGB. The former is used for printing presses but it tends to mute the green channel compared to RGB. However, if you prepare your figure in CMKY mode, you can make adjustments to the gain and contrast of the green channel to help restore some of its original contrast resolution and impact. On the other hand, if you prepare your figure in RGB mode and then change it at the last minute, you will be disappointed. Likewise, a figure prepared in CMKY that is switched to RGB can appear gaudy. Since color costs extra, you may have to defend your use of color for a particular figure. Since people still use B&W photocopies, its also in your interest to only use color when you have to.

    c. The journal will often encounter limits on the type of electronic file that you can submit. Remember that TIFF files are large making them difficult for electronic submission but are among the best formats for retaining high-resolution information. JPEGs are considerably smaller but the size reduction comes with some loss of information from the original image. In fact, if you make a JPEG of a JPEG, you will lose more information, so never work on your images (repeatedly opening and closing your file) as JPEGs. Still, JPEGs are often very good facsimiles of the original image and it can be difficult to see the information loss compared with the TIFF image. Many journals require that you submit JPEGs for the reviewers and then submit TIFFS once the manuscript is submitted. Not all JPEG engines are alike – my

favorite is the “Save for Web” engine in Photoshop. In any case, you should always do your image processing on a TIFF file. Leaving the creation of a JPEG file from the TIFF as the last step.

2. Make your figures the exact size that they will appear in the journal

    a. Before the advent of powerful electronic tools, there used to be practical reasons for making figures larger than they will appear in print. However, inattention to the journal's space restrictions (see 1a) and generating figures that are too large and need to be reduced by the publisher can create two very bad problems. The most common is that the figure must be shrunk to fit and although the figure looked great when it was created, shrinking creates major problems. Lines that were thin can disappear altogether. Depending on the software that does the shrinking, objects within the image can be differentially shrunk producing weird, sometimes gaudy appearances. Second, if the figure's width starts out between one and two columns, the publisher will have to either shrink it or expand it to fit their printing format. Shrinking can cause the problems above and expansion may use up precious print space that you had allocated to another figure.

    b. I also believe that, all things being equal, submitting manuscripts with text and figures that are approximately the right size for publication increases your chances with the editor because it gives them a better sense of the final product.

3. Crop. Crop some more. Crop it again.

    a. Remember, the point of a figure is to demonstrate something and the physical space you have available to do so is extremely limited. Careless inattention to space usage will reduce the impact of your figure because the critical part that you want to show will necessarily occupy a smaller fraction of your figure to make space for parts of the figure that you included but are less important. At a minimum, this can make it difficult for the reader to "see" the feature you are trying to highlight. The non-contributing parts of the figure can also distract the reader from the main point. This is especially true of photomicrographs.

    b. Start the figure making process by thinking carefully about what it is that you want to show and then think ruthlessly about ways that you can make clever use of space to make the central point as large, as clear, and as readable as possible and to shrink or jettison the parts that don't contribute.

4. Use a (bold) sans serif font for text in your figure. Serif fonts like Time Roman vary the width of the line that forms the letter. The width can become so narrow in parts of the letter that it will disappear altogether in print if the letter is small enough and it becomes difficult to read. Sans serif fonts like Helvetica, arial, Verdana, keep a constant width.

5. Create your figures to have a uniform appearance. Try to be modular as much as possible.
    a. The advice about uniformity deals with the overall appearance of your manuscript. You may have seen publications where the figures and text vary significantly in size and readability from figure to figure or even panels within figures. I think it looks amateurish. I think a well-crafted manuscript does better with reviewers, in general. A poorly crafted paper surely does worse.

    b. The advice about modularity helps with uniformity but it also is a huge time saver. What do I mean? Well, nowadays most figures have multiple panels. If you can create the pieces of your panels so that they at least start out approximately the same size, it: a) makes it much easier (i.e., it takes much less time) to move figures around during the draft stage, as you experiment with different organizations to the text; b) it makes it much easier to achieve a more uniform appearance because you can use the same font size and line size for each panel (sometimes you can even re-use the axes of one panel) and; c) if your reviewers demand changes to a panel or two, it won't create an earthquake in the whole figure and will save you a lot of time in preparing the revision for submission. When you run your own lab some day, you will also find that modularity makes it easier to move figures around from manuscript, to talk, to grant, etc…

    c. That said, the point about cropping (e.g., 2b) is ultimately the most important and if the point you want to make could be better made with the available space by making one panel larger and another smaller, you should do it. Still, starting out modular will usually save you time overall.

6. Next

FAQs

1. What graphics program should I use?

To get your photomicrograph panels in publication form, I recommend either using the image-processing program that created them or Adobe Photoshop. PS is extremely powerful with images though more clunky for text. You have tremendous control over the size of the image and the appearance of each pixel. Its especially good for creating the sort of fancy electronic artwork you might want to submit for a cover. To create graphs, to label your photomicrographs, and to create multi-panel figures, I recommend Adobe Illustrator. In contrast to PS which uses bit mapping to give you control over each pixel, Illustrator uses vector mapping. With vector mapping, you give up control of each pixel but you gain the ability to scale all or parts of your image with no affect on image resolution.

2. The statistical program that I am using creates graphs but they aren't really publication quality. What do I do?

3.

I recommend essentially recreating the figure in Adobe Illustrator. This is what our own graphics department does and what we have done on many an occasion. Most software programs that create graphics give you options file format options for exporting the graph. Adobe Illustrator will allow you to import a variety of formats but you may want to test different exported formats to see which you like best. Once you have imported the graph into illustrator, you can "place" it on the workspace and manipulate its scale or x-y dimensions (though you can't usually edit its parts). I usually manipulate its scale or x-y dimensions to optimize the way the data portion of the graph fits within the modular template that I have for my other panels. Then you can "lock" the imported graph on your work space so that you don't accidentally select it with your mouse and you can begin to trace the data portion of the graph within the context of your template axes so that it is faithful to the original graph but now has an appearance that fits with the rest of your figures.

This may seem like a lot of extra work but if you are certain that a particular graph will be part of your manuscript, then I think its worth the effort. Whenever, I haven't done this, it has usually haunted me, particularly during revision when a reviewer wants a modification to one of these graphs that can not be easily implemented using the original program.

4. Why don't we just use the Gladstone graphics department?

The short answer is that I am pretty particular about figure presentation and I feel like we do a better job, at least with figures for our primary research papers. When I first arrived and had to deliver my first talk for the scientific advisory board, I was asked to use graphics. They essentially re-created the slide show that I had already finished. In the end, it looked imperceptibly

different than the one I gave them except that it contained a number of spelling mistakes and they charged me about $800. Needless to say, I was unhappy.

To be fair, we have used them once more for Vikram's figures because Vikram had a personal emergency and I didn't have the time to do them myself. Although they did a better job than I expected, I still didn't think they did a very good job with the micrographs (too small to illustrate the most important points). Also, when you are on your own, you may not have access or the funding to use a graphics department but you will always have a need to generate high quality figures. This seems like as good a time as any to learn to do it well.

5. OK, I get the idea behind why you want to crop but can you give some examples of clever uses of space.

The easiest example is the micrograph. You may think your neuron is beautiful because of its gorgeous dendrites or you have two or three neighboring neurons that really add to the overall beauty of the image. However, if the point you are making concerns a few spines on one dendrite of one of those neurons than crop that image so that the spines you are trying to show dominate the final image. Those spines may be easy to see in the context of the other neurons when the image is printed on an 8.5 X 11 sheet but once it is reduced, you will never see them.

Another example with micrographs concerns labeling. I prefer to label every panel rather than using relative references (left, right, top, bottom) in the legend because I think it is clearer. However, it means you have to add lots of letters to the image. Often its possible to put the letter label on the image itself rather than adjacent to the micrograph (e.g., a white letter on top of a dark region of the micrograph prints nicely). This eliminates the "dead" space that would be created by the label and enables you to gett the individual micrographs as close to each other and as large as possible (I like to retain a thin white line separating the panels).

Often, you can also do something similar when you label graphs, enabling you to make the graph itself as large as possible. This applies to graph legends too, which can often be placed on the graph in such a way that they fit within the border created by the axes. You can also crop the graph itself. For example, some people will use scales for the axes that cover ranges in which there are no data. That is a waste of space. Try to use ranges that enable the data to occupy the full graph. Sometimes, you can be creative with the axes themselves. For example, in some of our calcium or electrophysiology traces, the axes can take up more of the graph than the trace that we are trying to illustrate. In those cases, it is really the time or calcium scale that is important, rather than the actual values. We found that it was possible to get rid of the axes altogether and replace them with small time and calcium rise calibration bars that we could put in the corner. In turn, this allowed us to increase the size of the trace so that it was easier to see its features.

6. Next.