How Do You Figure?

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We all know that both research *and* editing take time, and we all just want to get it right the first time, don't we? After working in the research community for 12 years and in the editing community for two years, I have witnessed and shared in the confusion caused by lacking or superfluous journal guidelines. My main goal for this article is to share with you the most common areas of author confusion regarding figure guidelines and how clarifying and simplifying journal guidelines can help allay that confusion.

Confusion around guidelines for figure preparation can be distilled into two main themes: terminology and procedure. Whether or not the reader is a native English speaker, terminology such as "line art" and "vectors" can cause great confusion, especially when used without explanation. Most of us have heard that a picture is worth a thousand words, which is why authors include figures in their papers to begin with. So why not help authors by showing examples of figures as your journal would like them to appear?

Even though the example shown in Figure 1 provides a definition of the terminology used, if possible, it is always better to steer clear of the use of obscure terminology. In this example, the journal guidelines ask for vector art when they could simply ask that EPS or PDF files be submitted, thus avoiding potentially confusing the reader, while still communicating exactly what is needed.

Even if an author is familiar with an esoteric term like "vector," they may not know the proper procedure that is needed to convert what they have into what you want for publication. Many authors use statistical or graphing software such as R, SPSS, or GraphPad, and the process for exporting quality vector graphics out of such software may not be readily apparent. One option for supporting potential contributors while also minimizing lengthy guidelines is to provide links
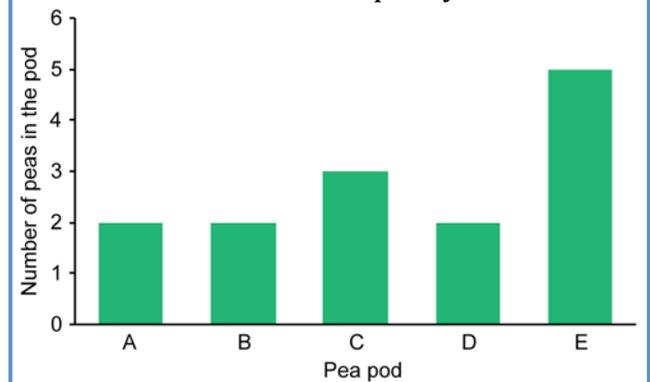

Figure 1. Example of potentially unclear figure requirement wording in journal guidelines.

to reliable online resources. Alternatively, sharing short instructional lists and examples (as seen in the *Journal of Clinical Investigation*'s guidelines at www.jci.org/kiosk/publish/figures) that walk authors through this process is helpful.

In general, a graph created using any of the popular graphing applications should be easily saved or exported in EPS or PDF format.

Once the basics of terminology and procedure have been defined, it's time to start constructing your guidelines. First, when creating figure guidelines, it is important to remember that not all guidelines are created equal. Depending on your journal specialty, it may be wise to focus your guidelines on specific aspects. Basically, let your journal's content be your guide. For instance, medical journals focus heavily on images, and their publications benefit mightily from the inclusion of high-quality photographs. Meanwhile, basic science journals focus more heavily on graphs, flowcharts, and diagrams (line art) or combination-type figures (mixtures of images and line art).

The table below lists the standard requirements print journals tend to lay out for image- and line art–based figures.

Second, breaking down instructions for the sake of clarity and simplicity is hugely beneficial for potential contributors. Authors will become weary of spending valuable time sifting through pages and pages of guidelines to find all of the relevant information they need before submission. This effort can be greatly minimized by breaking down guidelines into separate categories, using lists or tables instead of paragraphs, and (I cannot stress this enough) using examples! After seeing and processing hundreds of guidelines to help authors create journal-compliant figures and tables, we, in the Figure Formatting division of Research Square, have assembled a table of common guidelines.

If there is one thing that you take away from this article, let it be this: asking for JPEGs will almost always result in lousy images that do not reproduce well in print. Why do JPEGs fall into our "does not comply" list? Unlike TIFFs, which use lossless compression, as defined above, JPEG files lose information each time they are saved. Therefore, over time, a JPEG image becomes blurry and pixelated. Accepting files created with Office applications such as PowerPoint and Word can also be hit-or-miss with regard to figure quality, though the reasoning behind this is slightly more nuanced. To save space, PowerPoint and Word automatically compress (or downsample) images that are inserted into them, which basically leads to the same effect that we observe after saving a JPEG file several times. When the images lose information, they become blurry and pixelated. However, there is a workaround for this. When the file extension is changed from .doc (or .ppt) to .htm (*i.e.*, saving as a Web-based file), a metadata folder is generated that

Standards	Image-based figure	Line art/combination-based figure
Resolution	300-600 dpi	1200 dpi
Width	3-5 inches*	
File type	TIFF**	TIFF, native, or vector formats (EPS, PDF)***

*Size helps to ensure the appropriate number of pixels for clear printing.
**Preferred for its lossless compression (data is not lost each time the image is edited and saved, as seen with JPEG files).
***Vector formats allow for limitless resolution and editability.

Parameter	Industry Standard
File type	TIFF
File size	10 MB maximum
Resolution (TIFFs)	Photos: 300 dpi minimum
	Line art: 1200 dpi minimum
	Combination: 600 dpi minimum
Color format	RGB
Font	Arial, Symbol, Courier
Font size	6 pt minimum
Line weight	0.25 pt minimum
Figure width	1 Column: 85 mm
	1.5 Columns: 135 mm
	2 Columns: 175 mm
Panel labeling	12-pt bold uppercase lettering

includes the original images in all their (typically) high-resolution glory. But don't cry victory just yet! This method is not fool-proof, and often even the higher resolution versions found in the metadata are not of sufficient quality for printing (for example, if the original image was a low-resolution JPEG). The safest bet is to ask for TIFFs for images and to ask for PDF or EPS files for line art!

Lastly, we'll touch on an often neglected area of figure guidelines: the use of color. First and foremost, it helps to specify whether your journal has a preference for CMYK (the color space best suited for printing) or RGB (the color space best suited for monitor display). If the color scheme of a figure is important, provide the color palette that should be used or list any colors that you want to avoid, such as yellow, which, as you can see (or not), may not be the most appropriate color choice for displaying data. Color should be used to highlight and emphasize figures, and it can be used to separate and define data or to associate related information. Thus, color should not be used for the sake of using color—a common mistake of which it may help to remind authors. For example, since the bars in the graph shown in Figure 2 are already labeled, having multiple colors only distracts readers from the relevant information.

The message becomes much clearer when using a single color (Figure 3). A simple statement, such as "Please avoid the use of color unless it is critical for the interpretation of the data," may be enough to dissuade authors from the superfluous use of color.

Another frequently overlooked area when devising color guidelines for a journal is color blindness. As seen in Figure 4, individuals with color blindness may have great difficulty appropriately interpreting a figure that has not been designed with color deficiency in mind.

In this example, the control and treatment groups are distinguished using red and green. However, people with certain color deficiencies would see the image as essentially one monotone color, as depicted on the right. Particularly if your journal encourages the use of color in figures,

you may want to include a disclaimer about using certain colors, such as red and green, to distinguish data.

Hopefully, this quick tutorial will help you restructure your figure guidelines, so that you can get what you want from authors the first time. Just remember: be specific, keep it simple, and *show examples*!
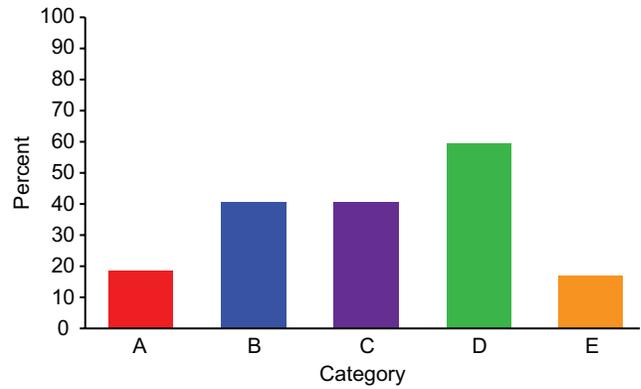

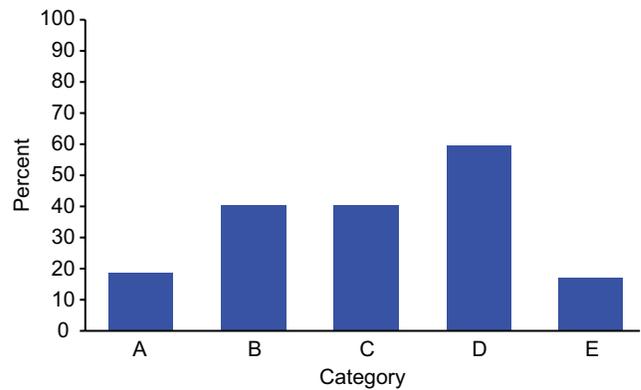Figure 2. Example of a graph with superfluous color.

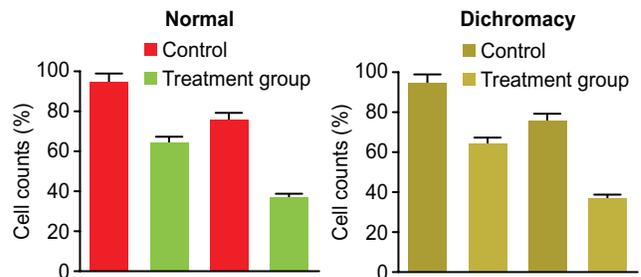Figure 3. The graph shown in Figure 2 without distracting use of color.

Figure 4. Example of a graph with colors difficult to discern by those with red/green color blindness.