Mastering the *show* in scientific show and tells: Creating High-Quality Figures for Publications

"A picture is worth a thousand words": This is particularly useful when faced with a tight word count for a manuscript. Carefully constructed figures are an effective way of communicating complex ideas and results. They tend to be the first thing you notice when skimming through a paper and can even be what draws you towards reading it carefully or moving on (to another paper). They are, therefore, a critical part to consider when preparing a scientific report.

The initial stage of creating figures can be the most difficult as you try to decide the type of plot to use or the structure of your illustration. While this can be a trial-and-error process, taking the time to determine the key message you want the reader to take out away from your figure can make this process significantly easier. Figures can include a multitude of different messages; however, an indicator of a good figure is that you can identify the central message.

Given the importance of figures for communication and for "marketing" your work, it is easy to get excited about new "cool" plots that may look impressive but are challenging to read or do not convey much information. It is, therefore, important to remember that simple and clean figures are often more effective. A good assessment of this is showing your figure and caption to a colleague working on a different project and asking them what they think your takeaway message is. If they struggle to understand it, then that is your cue to edit it. A figure, along with its caption, should convey the message without relying on the main text.

Much time can be spent on sorting data and editing plots, making it easy to make mistakes such as mislabelling the axes or units when reusing codes to create the plots. Other pitfalls to avoid include using small fonts that are illegible in print or saving the image file in low resolution, resulting in pixilated plots when zooming in. Before finalising the plot, it is important to double-check the choice of colours, keeping contrast and clarity in mind. It is often preferred if your plots are readable in greyscale.

In addition to plots, illustrations can be used to explain processes or structures. This can either be an illustration of the method followed, the mechanism in which a reaction occurs, or a molecule's shape. The time and effort required to create such illustrations can vary depending on the level of detail desired and the tool used. The simplest option is to use Microsoft PowerPoint. Still, some may opt to use more specialist software such as ChemDraw, BioRender or Adobe Illustrator.

Just as any other skill, creating plots and illustrations develops with time, practice and constructive feedback. The more you produce, the easier it becomes and the more templates you have to modify and reuse!

Tips for postgraduate students:

- It can be useful to pick a colour scheme at the beginning of your studies and use it in figures and illustrations throughout. This saves you time in the end when trying to have a common theme throughout your thesis or dissertation.

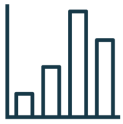
- Think about how others might see your work (*e.g.* individuals with colour blindness). There are some online tools that can help with that such as http://www.colororacle.org/, and https://michelf.ca/projects/sim-daltonism/.

- When creating figures either have a script saved to recreate it or save them in an editable format in case you need to edit them or use them for a slightly different purpose.

DATA VISUALISATION

1 WHICH PLOT(S) SUPPORT YOUR MAIN MESSAGE?

DISTRIBUTION



Histogram

+ statistics

Box plot

RELATIONSHIP

Scatter plot

3 variables?

Bubble plot

Enough data points

Line plot

+ regularly distributed data

Heatmap

COMPOSITION

Pie chart

Comparing datasets?

Stacked bar chart

2 PLOT CHECKLIST

- ☑ Are the axes labelled?
- ☑ Are the units specified?
- ☑ Is the space used appropriately?
- ☑ Are different datasets labelled?
- ☑ Is the font size used appropriate?
- ☑ Are the colours used accessible?
- ☑ Is the resolution high enough?
- ☑ If using a grid of plots, are the axes matching, if not, is that clearly mentioned?
- ☑ Is the data accurately represented?

3 CAPTION CHECKLIST

- ☑ Did you include a short title that captures the main theme?
- ☑ Did you describe how you got the data presented?
- ☑ Did you explain the differences between datasets?
- ☑ Did you explain all labels/ features?
- ☑ Did you cover each plot (for multi-plot figures)?

REMEMBER

The reader should be able to understand the figure using the caption without having to refer to the text.

Further reading:

- Rougier NP, Droettboom M, Bourne PE. Ten Simple Rules for Better Figures. Vol. 10, PLoS Computational Biology. Public Library of Science; 2014. p. e1003833. (DOI: 10.1371/journal.pcbi.1003833)
- O'donoghue SI, Baldi BF, Clark SJ, Darling AE, Hogan JM, Kaur S, et al. Visualization of Biomedical Data. Annu Rev Biomed Data Sci. 2018 (DOI: 10.1146/annurev-biodatasci-080917-013424)
- Franzblau LE, Chung KC. Graphs, tables, and figures in scientific publications: The good, the bad, and how not to be the latter. J Hand Surg Am. 2012 Mar 1;37(3):591–6. (DOI: 10.1016/j.jhsa.2011.12.041)

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