

ACADEMIC SUPPORT TECHNOLOGY & INNOVATION WITH PLYMOUTH UNIVERSITY

Postgraduate Researcher Digital Skills

#06 Data visualisation

Data visualisation is the visual representation of patterns in data. It can serve two purposes:

- ▲ To make sense of data and how they relate to other data as part of the analysis process;
- To **communicate** data and patterns in data to others.

Data visualisation can range from a simple table to an elaborate map of geographic data made by creating a layer in Google Earth, or one of an expanding range of web based tools for analysing social relationships online. Visualisation can be applied to qualitative as well as quantitative data (Wordle, shown above, is probably the best known example). Visualisation has become an increasingly popular approach as the volume and complexity of information available to researchers has increased and as visual forms of representation have become more credible in scholarly communication. As a result, increasingly more tools are available to support data visualisation.

Some tips on effective data visualisation

- △ Decide whether the purpose of a data visualisation is analysis, communication, or both. Analysis requires careful attention to the parameters used. Different parameters reveal different patterns, and it is up to the researcher to determine which are significant with respect to the key research questions, often by comparing subtly different versions. When communicating research data to a non-specialist audience, a simpler representation is likely to be more appropriate.
- Lit is worth piloting representations for communication purposes (i.e. try them on someone else) to be sure they are clear and effective. Consider the needs of different audiences, and do invest time in giving key findings a visual impact.
- Leo, who is writing a PhD in educational psychology, says: 'people often do not consider the target audience they are addressing and may use something too fancy or obfuscate the important message they are trying to put across.'
- △ Diana, a PhD student in psychology says: 'It's important that visualisation is applied when its unique capabilities make it of particular value, such as conveying information concisely or overcoming data overload through dynamic presentation.'

Using graphs and figures

If you are graphing your data using Excel or a similar programme, remember the following guidelines for selecting a graph type:

- A line graph is used to track change over time and to compare change over time in more than one group.
- Pie charts are used to compare parts of a whole or proportions of a total population.
- A Bar graphs are used to compare different groups, and to track larger changes over time. Percentile bar graphs allow more detailed comparisons between groups or options, e.g. proportions making different choices on a Likert scale.
- Area graphs are used to track changes over time for more than one group which make up a whole category.
- ▲ X-Y plots, or scatter plots are used to look at relationships between two variables.





Kelleher and Wagener¹ explain that people are better able to perceive length and position than line width, colour hue or tint and marker size (or area), so length and position should be used when it's important to show the actual values of a data set, while line width, colour, and area should be used to show patterns or relative values

Using Colour

- △ It's usually best to keep grids, axis labels, borders, etc. in shades of grey, to bring attention to coloured data.
- Ensure your use of colour is meaningful in relation to the patterns being discussed. Most visualisation tools will provide options.
- ▲ Two or three colours in varying shades can be more informative and easier to take in than many colours.
- Use contrasting colours to show differences, and similar colours to show analogy.
- If you are using colour to visualise quantitative data, you may want to use a graduation from light to dark, with low values lighter and high values darker

Visualisation tools

Most quantitative and qualitative data analysis software now includes a variety of visualisation options: e.g. Excel can export a wide range of graphs and figures, while nVivo offers a wordle-type tool. Third party apps and tools allow for more elaborate visualisations and the potential for easily sharing them, e.g. Google Earth for visualising geographic data (MapMakerpedia, KoboMap and Google's fusion tables tutorial can help you get started with mapping). Google Charts offers a range of free visualisation tools, the outputs of which can be embedded into web sites, while Many Eyes works on the principle that if you upload your data, other people can generate their own visualisations too.

There is a list of <u>free data visualisation tools</u> from the Guardian, which has pioneered making UK political and social data publicly available and encouraging imaginative approaches to visualisation. Techjaws.com recommend <u>15 free applications to create effective data visualisations</u> and datavisualization.ch has its own <u>selected list</u>. Computer World's <u>30 free tools for data visualization and analysis</u> provides not only a list of tools, but a convenient table which shows what each tool is good at as well as the required skill level, platform, and how it handles data storage.

Web Designer Depot's 50 great examples of data visualization includes tools which connect to social media, music and other web services. For example, TwittEarth shows live tweets covering a 3D globe, while We Feel Fine takes the emotional temperature of the blogosphere. With the rise of digital social networks have come a host of tools for conducting network analytics, e.g. cytoscape, SocialAction and NetMiner, and these are increasingly used for visualising other complex structures such as molecular structures and biological processes. CETIS has collected sample visualisations of social network data and other open/public data.

Infographics require really creative visual thinking so not everyone will be comfortable creating them from their own data, but they do have huge impact. Try <u>visual.ly</u> and <u>creately</u> for some free tools and examples or <u>inkscape</u> for a free drawing tool.

Examples of data visualisation

<u>50 Great Examples of Data Visualization</u> provides examples of amazing data visualisations for a range of uses and audiences.

Many public databases now have visualisation built in so that you can generate new viewpoints on the data as you explore it. GapMinder is an accessible database of global health and poverty statistics and is popular in the teaching of social sciences, while CarbonVisuals provides a map-based interface on the carbon footprint of UK public buildings.

Other research projects that have made innovative use of visualisation tools include:





- connect globally with people who share your research interests
- △ The Fair Trading Project, UK HE research project looking at fair trade.
- Breath, UK, Wellcome Trust funded project.
- Action Science Explorer (US, science research community).

Additional information

As a researcher you should be aware of your responsibilities with respect to, amongst other things, IPR, research ethics, information security, data protection and mobile computing. If you need advice please see the Plymouth University *Research Degrees Handbook* and ask your research supervisor for guidance.

Further information

Kelleher and Wagener¹ offer ten guidelines for effective data visualisation in scientific publications, though their points may serve use for those in the social sciences as well.

Kelleher, C., and Wagener, T. (2011) Ten Guidelines for Effective Data Visualisation in Scientific Publications. In *Environmental Modelling and Software*, June 2011, pp. 822-827.

Stone, M. (2006) Choosing colors for data visualisazation. Business Intelligence Network.

Kosslyn, S.M. (1989) Understanding Charts and Graphs. In Applied Cognitive Psychology, 3 (1989), pp. 185-226.

Few, S. (2010) <u>Data Visualization for Human Perception</u>. In Soegaard, M. and Dam, R.-F. (eds) *Encyclopedia of Human-Computer Interaction*. Aarhus, Denmark.

Cascade project interns' animation about data visualisation

TED Talk with David McCandless about data visualisation

TED Talk on visuals for global poverty statistics



