

Visual Analytics: What is InfoVis?

Professor Ian Nabney

ian.nabney@bristol.ac.uk

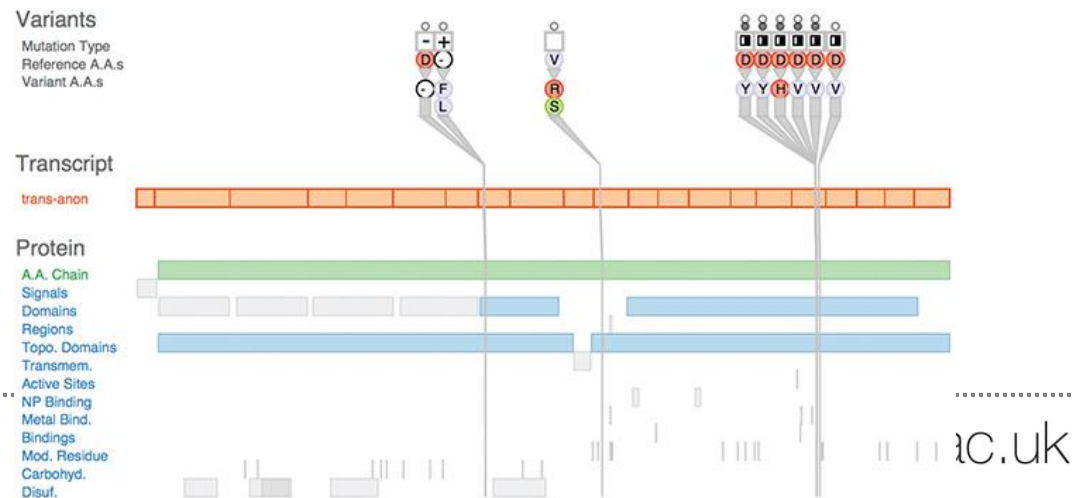


- Reading: Chapter 1 of Munzner (e-book that can be downloaded from UoB library website)
- Understand what information visualisation can do and why we should do it
- Frame this by considering 13 key questions
- A little history of displaying quantitative information

What is Visualisation?

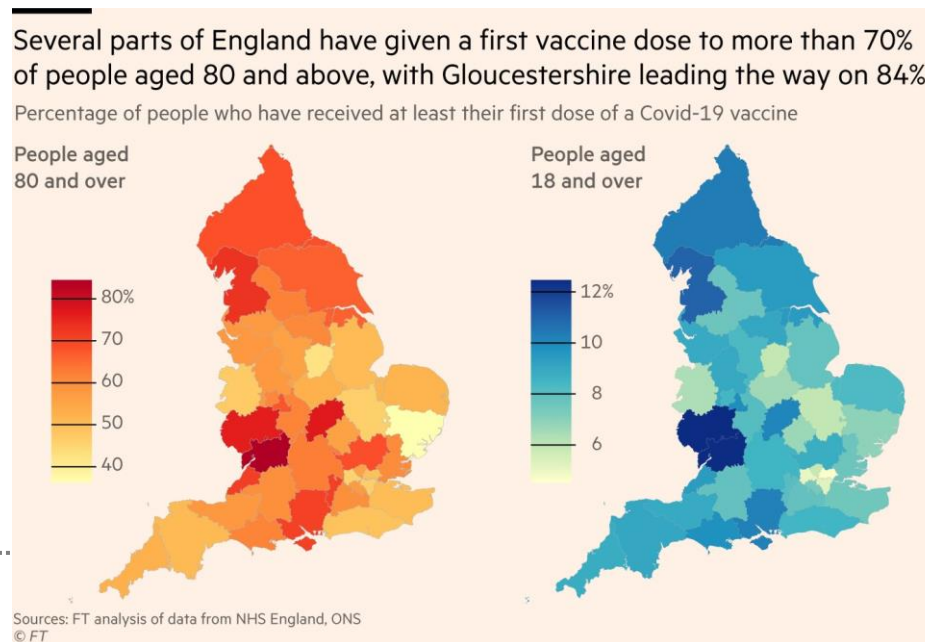
- Computer-based visualization systems provide visual representations of datasets designed to help people carry out tasks more effectively.
- Goal of visualisation is to present data in a human-readable way so that people can take action.
- Structure around 13 key questions

- Vis allows people to analyse data when they don't know exactly what questions they need to know in advance
- Many analysis problems are ill specified – and actually question refinement takes place as part of the feedback
- Transitional use
 - Understand requirements for computational solution
 - Refine computational solution
 - Check automated system
- Long-term use – often exploratory analysis (e.g. for scientific discovery)



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- Scale and accuracy – drawing large datasets by hand is infeasible
 - Dynamic data changes – redrawing by hand has to start from scratch
 - Results can be passed to other computational tools

- User can offload internal cognition and memory to the perceptual system
- Diagrams can be designed to support perceptual inferences
- Search can be sped up by grouping all the items needed for a specific problem inference together
- An external representation can be shared with others



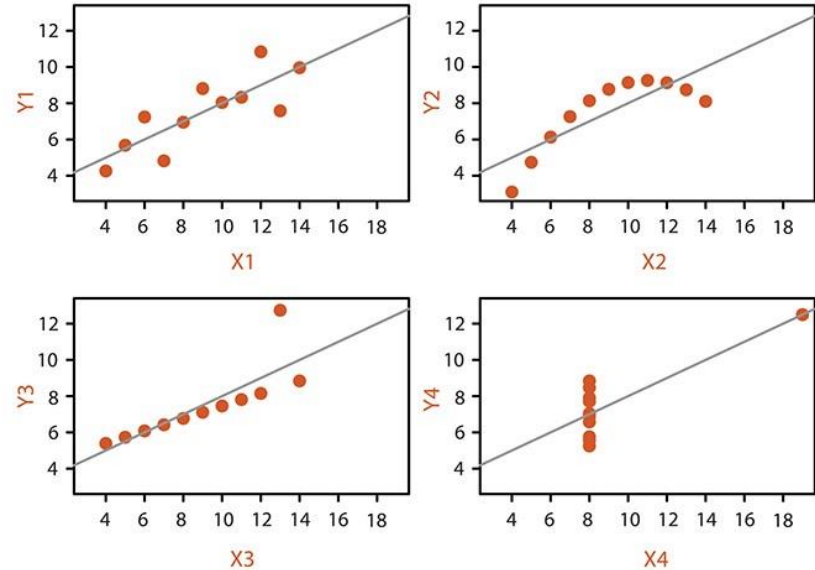
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- Almost half the brain is devoted to the visual sense
 - Active vision means that we should think about graphic designs as cognitive tools, enhancing and extending our brains
 - A significant amount of visual information processing occurs in parallel at the preconscious level – we are leveraging this
 - We only have the illusion of seeing the world in detail: in fact, the brain grabs just those fragments that are needed to execute the current mental activity – we will return to this
 - Sound is poorly suited because it is a sequential stream
 - Taste and smell don't yet have viable recording and reproduction technology
 - Haptic devices only provide a very limited dynamic range

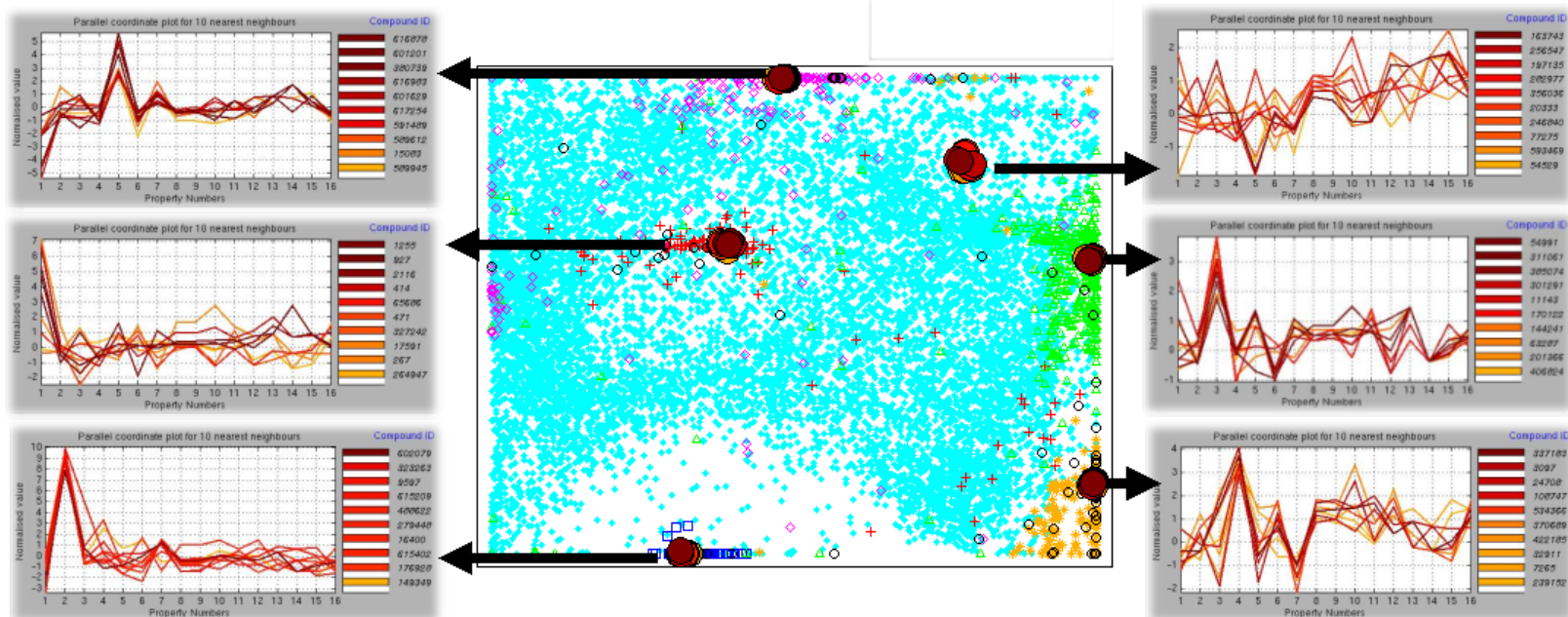
Why show the data in detail?

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- Anscombe's quartet of small datasets
- All have same mean, variance and correlation
- Summary statistics can be very misleading!



- Interactivity is crucial to handle complexity
- It enables the user to take an active part in exploring data and to ask many different queries
 - Multiple levels of a hierarchy
 - Connections between different views of a dataset
 - Big change from Tufte (static graphics on the page)

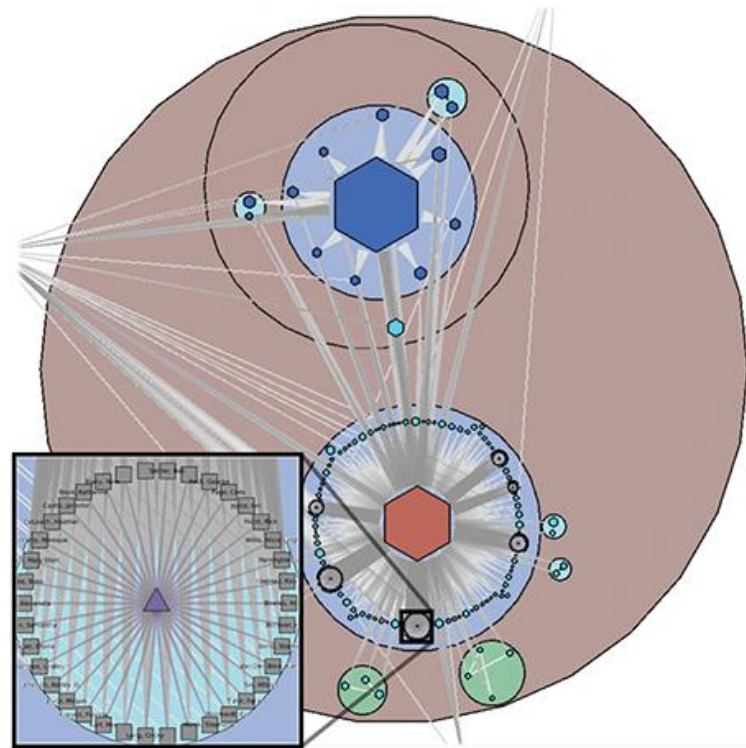


Why is the Vis idiom design space huge?

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- There are a lot of researchers working in the field!
- The design space is bigger now with interaction
- Why we need a framework to help choose the right idiom

Grouse vis tool for incremental layout of a multilevel network



Why focus on tasks?

Why focus on effectiveness?

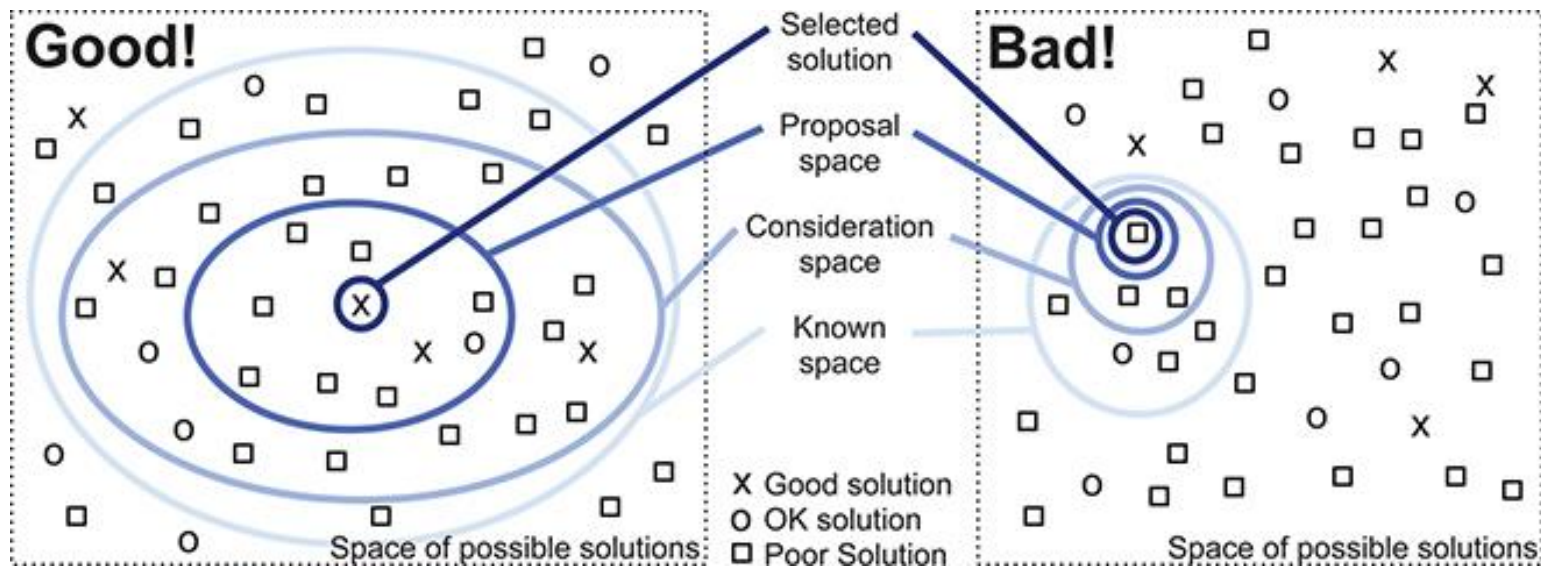
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- Because the point is to help the user solve a problem or understand a challenge, not to draw a picture
 - The choice of the tool and representation depends on what the user is trying to achieve
 - Effectiveness as a measure is a corollary of considering tasks
 - Depicting data is an abstraction – we need ‘graphical integrity’: avoid distorting what the data has to say

Why are most designs ineffective?

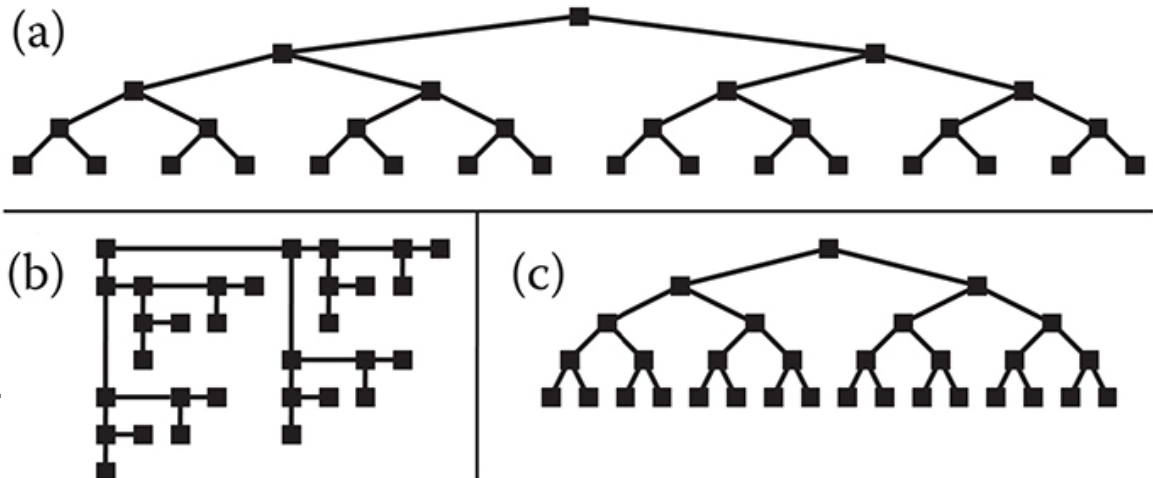
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- Graphic design is hard, the design space is huge, and we need to match the design to the task
- Should consider multiple alternatives (so need to be aware of a range of methods) and then choose the best
- Also need a good technique to evaluate designs

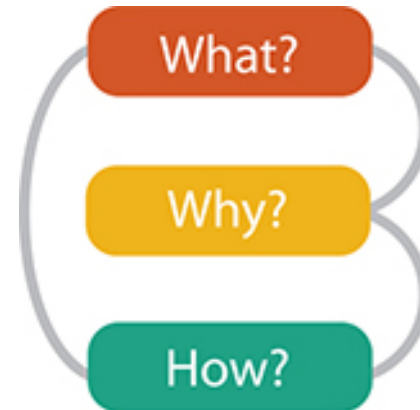


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- Visualisation is an unsupervised problem with no well-defined quality metrics
 - What does 'better' mean?
 - Do users get something done faster?
 - Can they work more effectively (and how do you measure effectiveness?)?
 - How do you measure 'data insight'?
 - Who is the user (expert or novice)?
 - How do you decide the benchmark data?

- Consider computational capacity, human perceptual and cognitive capacity, and display capacity
- Task influences capacity demands:
 - Interactive response requires algorithms to draw a frame in a fraction of a second
 - Dataset size can be larger than core memory
- Human memory for what is not visible is limited: long-term and short-term
- Designers may run out of pixels: information density matters



- The unexamined life is not worth living
 - Analysis supports improved design (up to a point)
 - The analysis framework helps you think about design choices systematically
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- **What** data the user sees
 - **Why** the user uses a vis tool
 - **How** the visual encoding and interaction idioms are constructed



A little history

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- The invention of data graphics required replacing map coordinates with more abstract measures
- This was a surprisingly big step – taken by Johann Heinrich Lambert (1765) and William Playfair (1785) – who invented the line graph
- This is despite Descartes (Cartesian coordinates) – 1596-1650

<https://seeingcomplexity.wordpress.com/2011/02/03/a-short-visual-history-of-charts-and-graphs/>

