**Universidade de Aveiro
Departamento de Electrónica,
Telecomunicações e Informática**

ECIU

An Introduction to
Data and Information Visualization
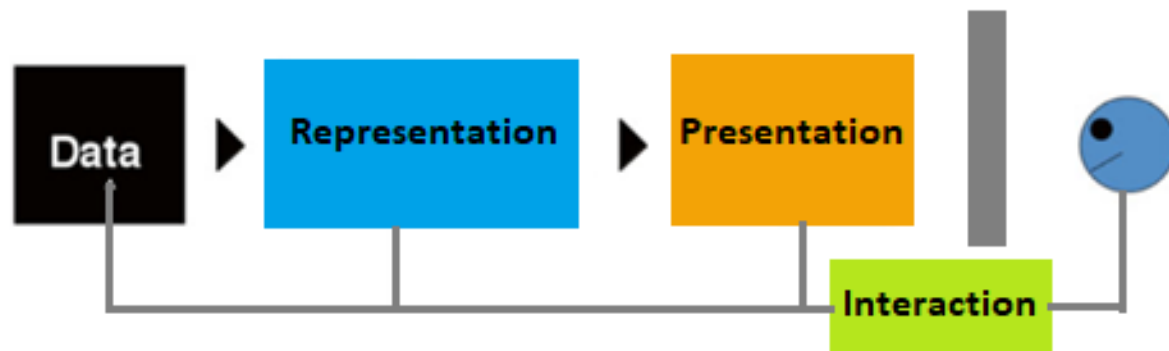
Creating a Visualization

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October/ 2021

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The process of creating a Visualization

(Spence, 2014)

How can we produce a Visualization?

- It is a "wicked problem"

https://www.interaction-design.org/literature/article/wicked-problems-5-steps-to-help-you-tackle-wicked-problems-by-combining-systems-thinking-with-agile-methodology
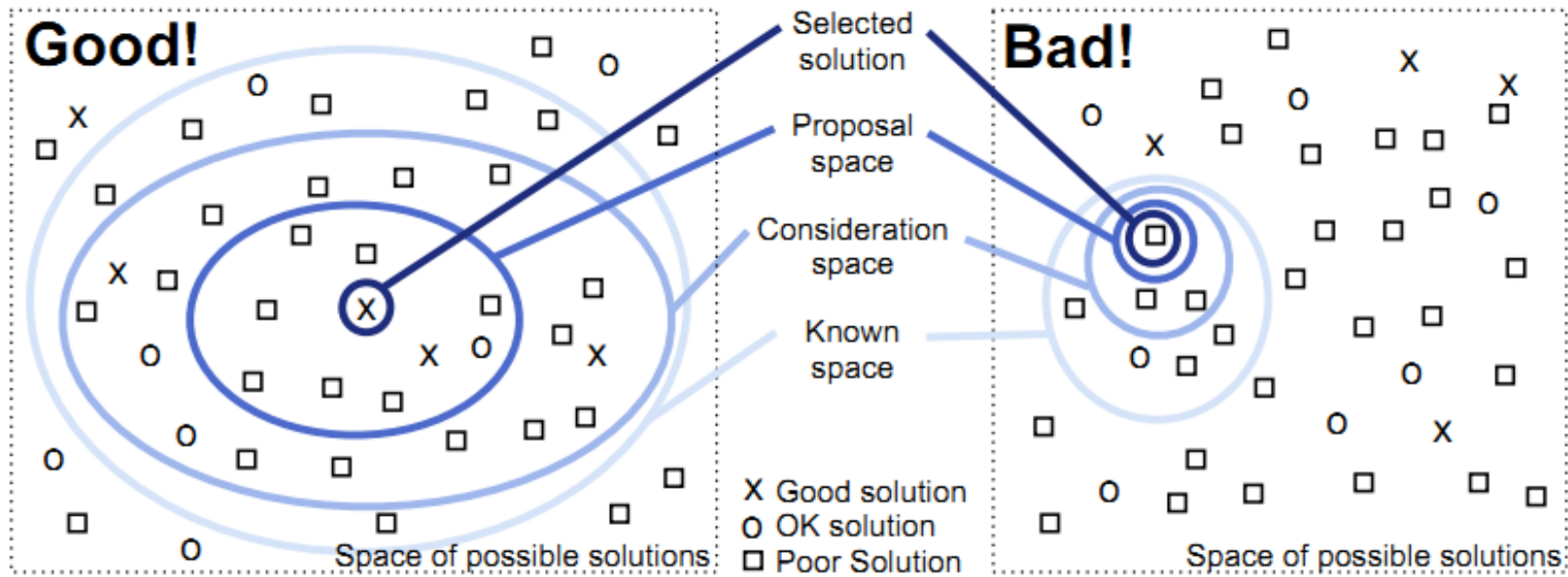
Visualization usage can be analyzed in terms of:
- Why the user needs it
- How the idiom is designed
- What data is shown

WHAT?

WHY?

HOW?

Visualization Analysis & Design

(Munzner, 2014)
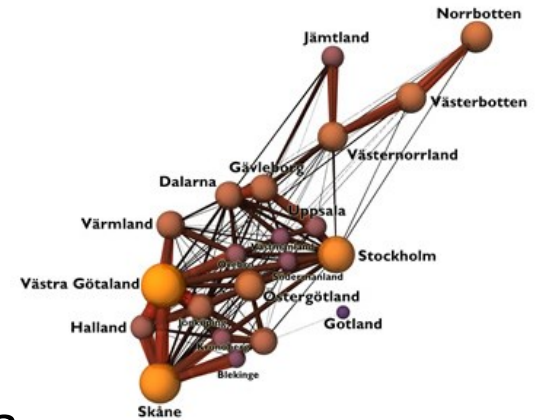
The problem of Visualization design

(Munzner, 2014)

- Only a very small number of possibilities are reasonable … most are ineffective

Consider multiple alternatives and then select the best!
**(based on evaluation …)**

Representation - Visual mapping

- It is necessary to decide:

  - which visual structures use to **represent** the data

http://www.Visualcomplexity.com

  - their location in the display

- Some types of abstract data can be easily mapped to a spatial location

Cancer Mortality Rates by County (Age-adjusted 1970 US Population)
Lung, Trachea, Bronchus, and Pleura: White Males, 1970-94

- Examples:
. data with a topological or geographical structure

- Many types of data don't have an easy correspondence with the dimensions of the physical space around us
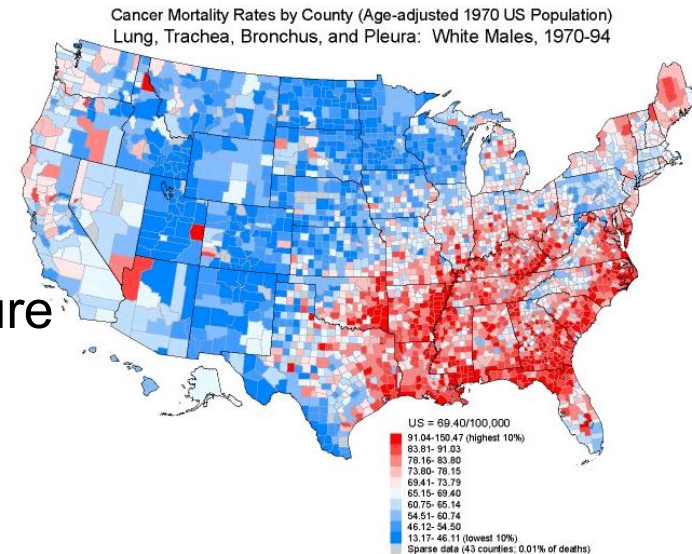
Three **structures** must be defined in the **visual mapping/encoding**:

- spatial substrate

- graphical elements
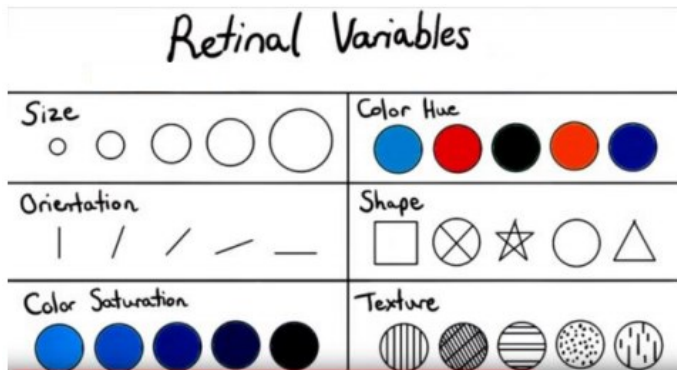
- graphical properties

- **Spatial substrate** - dimensions in physical space where the visual representation is created (can be defined in terms of axes and type of data)

- **Graphical elements** - anything visible appearing in the space points, lines, surfaces, volumes

- **Graphical properties** – properties of the graphical elements to which the human retina is very sensitive - **retinal variables:** size, orientation, color, texture, and shape

- **Spatial substrate** axes (x, y, …)
type of data (quantitative, ordinal, categorical)

- **Graphical elements** points
lines
surfaces
volumes

- **Graphical properties** retinal variables:
size,
orientation
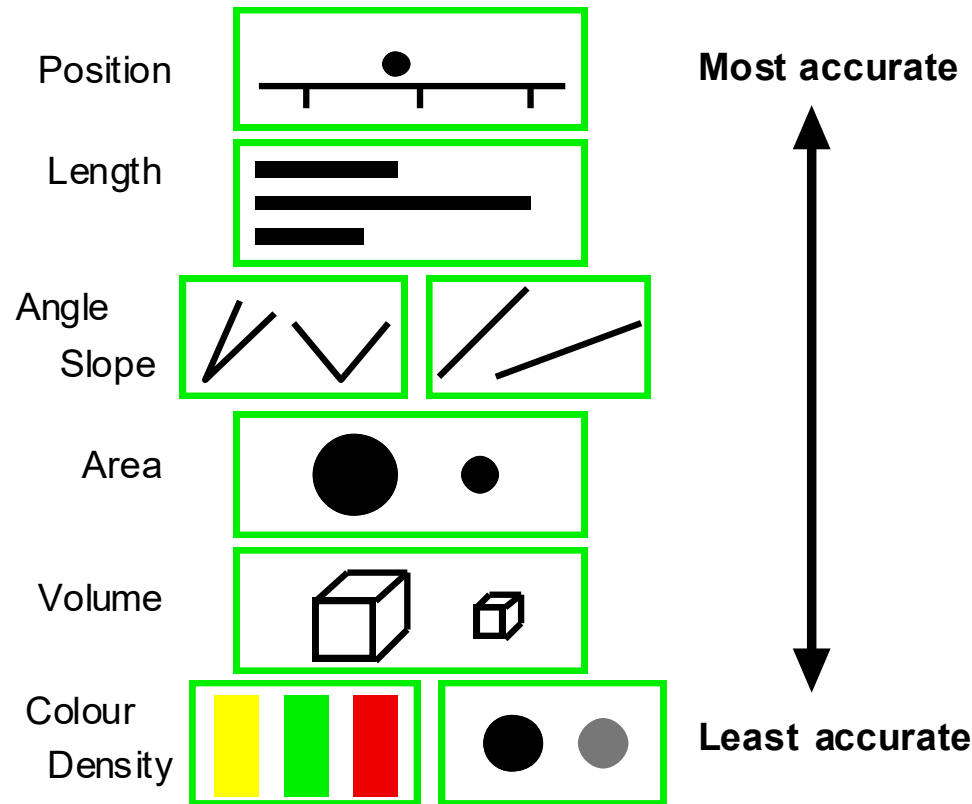color (depends on physiology and culture)
texture
shape

Retinal Variables

Size
Color Hue
Orientation
Shape
Color Saturation
Texture

•

	Association	Selection	Order	Quantity
	The marks can be perceived as SIMILAR	The marks are perceived as DIFFERENT, forming families	The marks are perceived as ORDERED	The marks are perceived as PROPORTIONAL to each other
Size				
Value				
Texture				
Colour				
Orientation				
Shape				

Interpretation of Bertin's guidance regarding the suitability of various **encoding methods to support common tasks** (Spence, 2007)

Note that **only size is adequate to represent quantity accurately**

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How to select visual encodings to accurately represent quantity?

Position

Length

Angle
Slope

Area

Volume

Colour
Density

Most accurate

Least accurate

The relative difficulty of **assessing quantitative value** as a function of encoding mechanism, as established by Cleveland and McGill (Spence, 2007)

In a nut shell:
Do you have a lot of data?

- Visualization may be the solution (or part of it)

- Creating a Visualization has several phases

- Visual mapping is core

- There are several possible visual encodings

- But,

    How to select techniques ? → next topic

What?
Who?
When and where?
How?