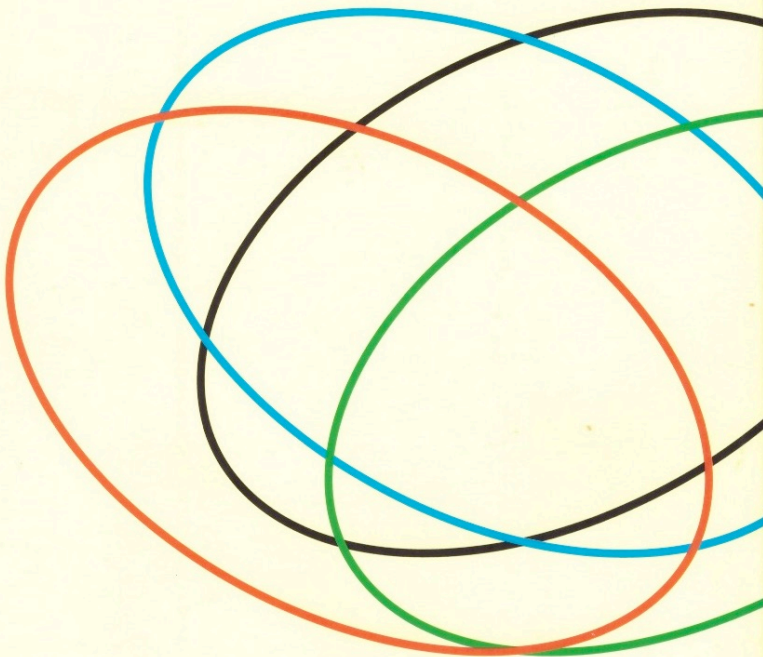


Per Mollerup

# DATA DESIGN

Visualising  
quantities, locations, connections



B L O O M S B U R Y

## Basics

### Gestalt principles of perception

The Law of Prägnanz (German for pithiness) says that our minds tend to refine what we actually see to create order in our impression and understanding of a cluttered world.

Gestalt principles describe some of the ways our minds organise what we actually see.

The designer of visual displays can use gestalt principles in two ways: to create effective solutions, and to check a design for possible unwanted reactions. How will the reader see this display?

- Laws of
- closure
  - similarity
  - proximity
  - symmetry
  - continuity
  - common fate

#### - The law of closure

We tend to replace what seems to be missing. The law of closure describes how we connect separate visual fragments to create a visual whole. This happens particularly in the case of simple, easily recognisable, geometric patterns, e.g. circles. We tend to see a circle formed by unconnected elements before we see the individual elements separately. The reader completes fragments to create a visual whole. In visual displays this is probably of less importance than in logo design.



19

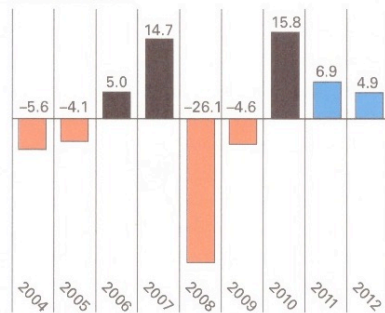
**Figure 19** Walker with missing legs. The law of closure: we see Johnnie Walker of the eponymous whisky even though the walking legs are missing; our mind fills in the blanks. Courtesy of Diageo

Gestalt principles of perception

– The law of similarity

We tend to group similar objects together to see them as a family. This is what happens when we watch sports games where competing teams are dressed in different colours. In visual displays the principle can be used both to group and diversify different kinds of information. The principle points to an economy of means: changes in form should be used only to communicate changes in content.

Airlines results  
in billion dollars



20

**Figure 20** The vertical bar chart shows the financial results of international airlines. In printed accounts, negative profits are traditionally printed with red figures. When showing financial results on a bar chart, it is a good idea to keep this colour coding; the law of similarity at play. It is also a good idea to make a colour distinction between realised and expected results. Data sourced from *Frankfurter Allgemeine Zeitung*, DE, 21 Sep 2011

– The law of proximity

We perceive things located near each other as belonging together, and things located far from each other as separate. In cars, we expect to find all the instruments and buttons for the radio next to one another. In visual displays, this principle says that labels should be placed closer to the entity they identify and describe than to any other.

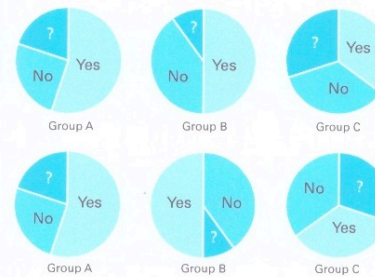
See note on the design of *Data Design*, p8

– The law of symmetry

Symmetry is about recognisable repetition. In visual displays, the same type of elements can be used in the same ways to enable easy reading. Readers recognise and recall certain types of information better if they are treated in similar ways.

Do we need more police on the streets?

? = Don't know



21

**Figure 21** According to the law of symmetry, it is easier to compare three pie charts if the parts are organised in identical order (top) rather than different order (bottom).

Gestalt principles of perception

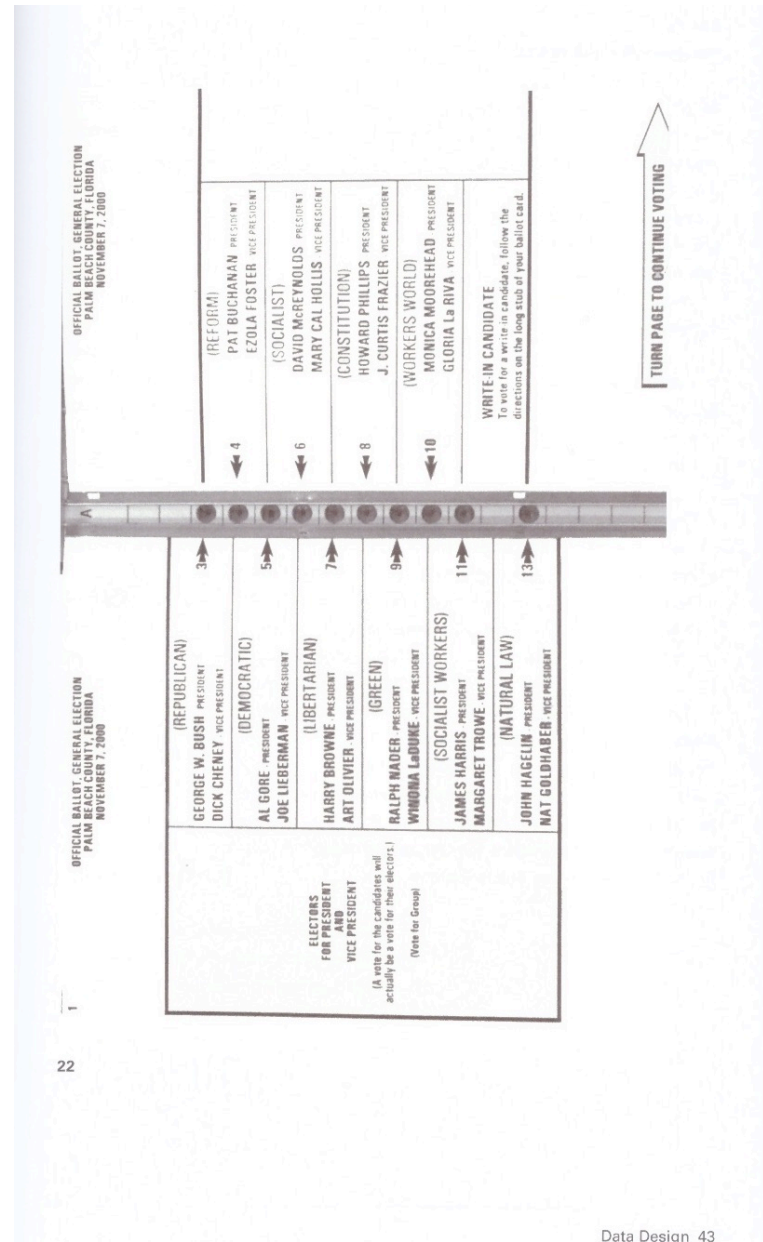
- The law of continuity

We tend to see elements that are aligned as belonging together in one whole. In designing visual displays, the law of continuity tells us to align graphic elements with purpose and care.

- The law of common fate

We perceive objects that move in the same direction as belonging together. As far as visual displays are concerned, the law of common fate is relevant in dynamic displays in digital media. The law tells us to move information that belongs together at the same time and in the same direction, and to avoid movements not doing so.

**Figure 22** Ballots from the 2000 presidential elections in Florida. Ballots not respecting the law of continuity (bad alignment) resulted in many voters being confused and consequently giving their vote to an unwanted candidate. By mistake, they voted for Pat Buchanan instead of Al Gore and thereby helped George W. Bush to win. In the public domain



### Psychological principles

Stephen M. Kosslyn describes eight psychological principles that lie behind the way we perceive and comprehend visual displays. Kosslyn calls all visual displays *graphs*. Designers should know the eight principles and use them to establish and check the functionality of their visual displays. Kosslyn's eight principles are summarised below.

– *The principle of relevance*

Keep the purpose of the visual display in mind. Don't confuse readers with irrelevant details.

– *The principle of appropriate knowledge*

Know the audience and address it appropriately. Don't talk down to intended readers, or talk over their heads. Use language and concepts intended readers are likely to know.

– *The principle of salience*

Make new parts of the display more visible than old, already-known parts. In a geographic map showing a proposed coast-to-coast railway across North America, the outline of North America is the old part, while the suggested railway line is the new part.

Stephen M. Kosslyn  
*Graph Design for the Eye  
and Mind*,  
Oxford University Press,  
New York, NY, 2006

– *The principle of perceptual organisation*

Perhaps the least operational of Kosslyn's eight principles, this deals with the ways our mind organises and interprets what we see. Sometimes we see two-dimensional phenomena as three-dimensional, sometimes we fail to isolate one visual effect but combine it with others, and sometimes we group elements in ways that influence our impression. The best advice concerning the principle of perceptual organisation is to test visual displays for usability.

– *The principle of discriminability*

When parts must be distinguished, make the visual difference between these parts as clear as possible.

– *The principle of compatibility*

Let visual displays represent the facts of the world in a logical way. Represent high prices by high curves. Show left-wing politics on the left side of a visual display and right-wing politics on the right.

– *The principle of informative changes*

Show differences in meaning by difference in form. Restrict changes in form to show changes in meaning.

– *The principle of capacity limitations*

Readers are only human. Keep the limits of readers' perceptive and cognitive capacities in mind when designing visual displays. Know the readers and don't overload them.

Basics  
Colour

Colour is used to represent all three subjects of *Data Design*: quantities, locations, and connections. Colours can be described in several ways, but here we shall describe colours as we see them. They include three elements: hue, value, and saturation.

– Hue

Hue is what most people normally understand as colour. All hues are found on the colour circle, also called *the colour wheel*.

– Value

The value of a colour concerns its blackness or whiteness. It stands for the amount of black or white added to the hue found on the colour circle.

– Saturation

The saturation of a colour is defined as its absence of white and black. The maximum saturated hues are found on the colour circle. The more we move away from the colour circle to approach grey, the less saturated the colour is.

– NCS

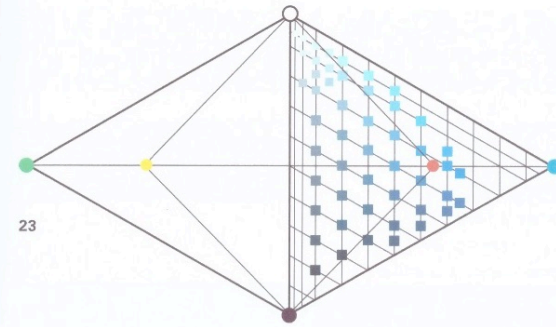
The NCS Natural Colour System<sup>®</sup>© describes how the three colour dimensions play together.

The NCS facilitates understanding of the colour properties. For working specifications, designers use CMYK for print, RGB for screens, and hexadecimal values specifically for web design.

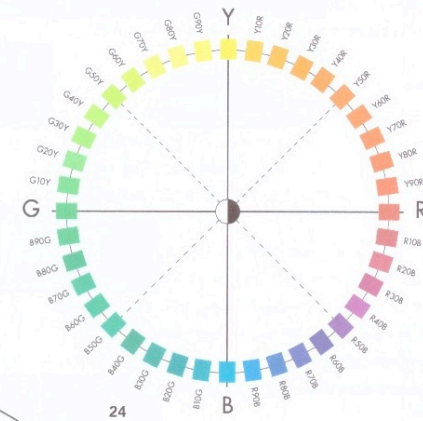
**Figure 23** The NCS Colour Space. A double cone, where all maximum saturated hues constituting the colour circle are found on the ‘equator’ and black and white are found on opposite poles. Courtesy of NCS

**Figure 24** The NCS Colour Circle. A horizontal section through the ‘equator’ of the NCS Colour Space gives a circle with all hues on its periphery. Courtesy of NCS

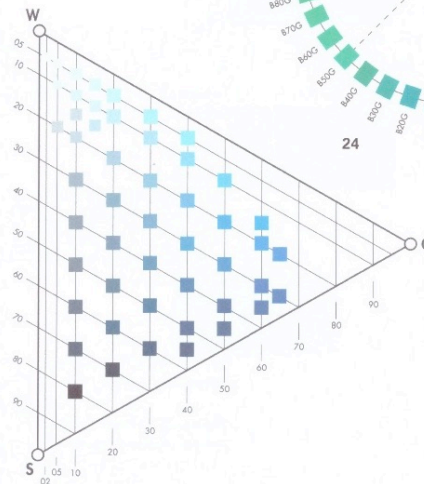
**Figure 25** The NCS Colour Triangle. A vertical section from the centre of the NCS Colour Space gives a triangle with a maximum saturated hue at one point (‘equator’) and black and white on the two remaining points (poles). A straight line through the cone from pole to pole is a pure greyscale. Courtesy of NCS



23



25



Learn more about the NCS Natural Colour System<sup>®</sup>© at [www.ncscolour.com](http://www.ncscolour.com)

## Colour

### – Use of colour

The first role of colour in visual displays is to differentiate and convey meaning. The second role is to make the displays attractive. To fulfil the first role, colour must change to represent changes in meaning, and only then.

The kind of change in colour should reflect the kind of change in meaning. Semantic colour use can sometimes build on standard colour conventions. For example, bars in bar charts can change from black to red, when financial results become negative. Other uses of colour in displays may be culturally conditioned.

Semantic colour use can also build on analogy: one element represented with outstanding colour is also outstanding in importance. Similar, but not identical, colours stand for similar, but not identical, entities.

As a general rule, colour should be used with restraint in visual displays. Too much colour emphasises nothing. It is a good idea to work with a limited palette, a small selection of systematically chosen colours, and stick to them throughout a project.

**Figure 26** Greyscales with ten, five, and three steps.

**Figure 27** Single hue progression from low to maximum saturation with ten, five, and three steps.

**Figure 28** Bipolar hot/cold progression with seven steps.

**Figure 29** Bipolar bad/good progression with seven steps. See *Dorling cartograms p135*.

**Figure 30** Spectral colour range with six steps.



26



27



28



29



30