Data Analysis and Visualization

Universität Konstanz

Information Visualization

Visualization Foundation



Dr. Johannes Fuchs

Which visual variables do you know?

(i.e., what visual characteristics of objects can be used to encode some values?)

Position

Mark/Shape

Size (length, area, volume)

Brightness

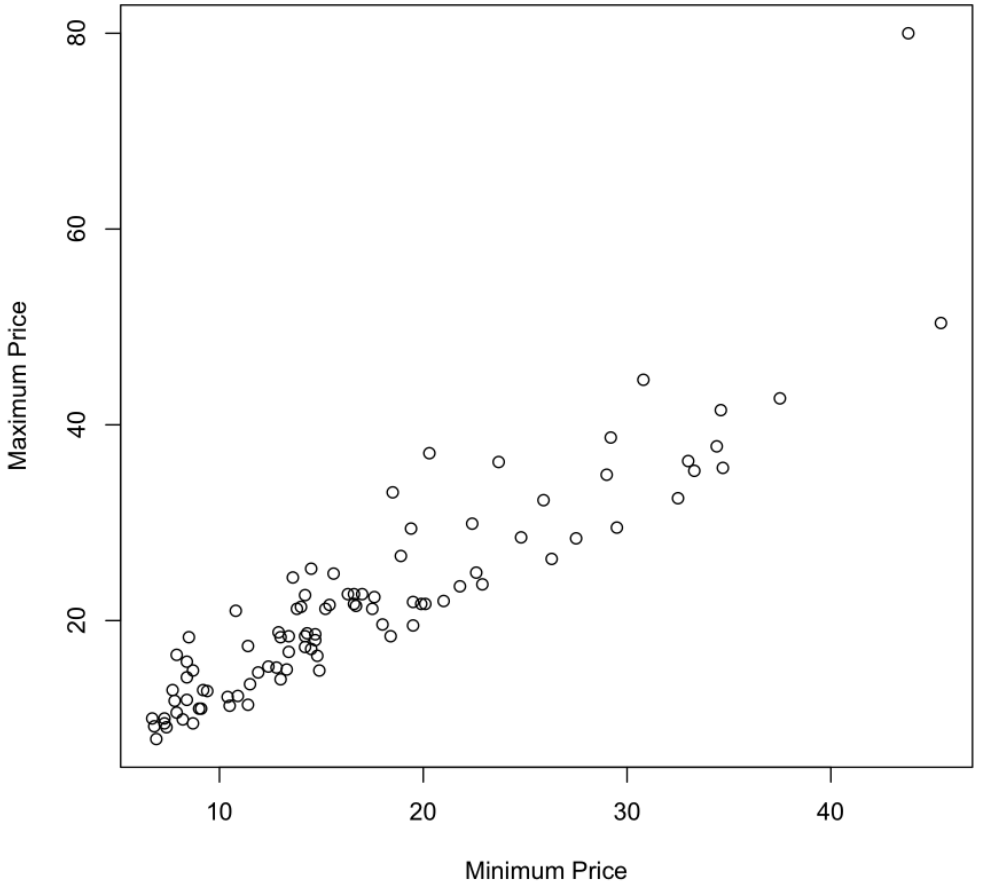
Color

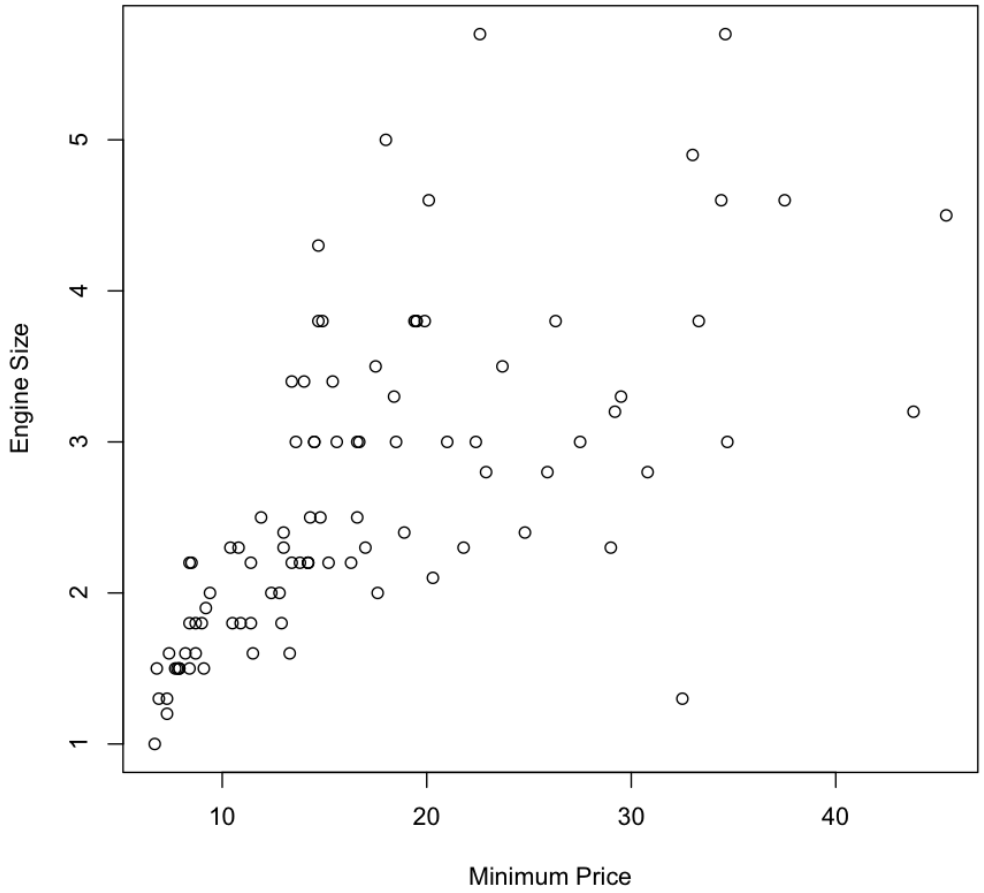
Orientation

Texture

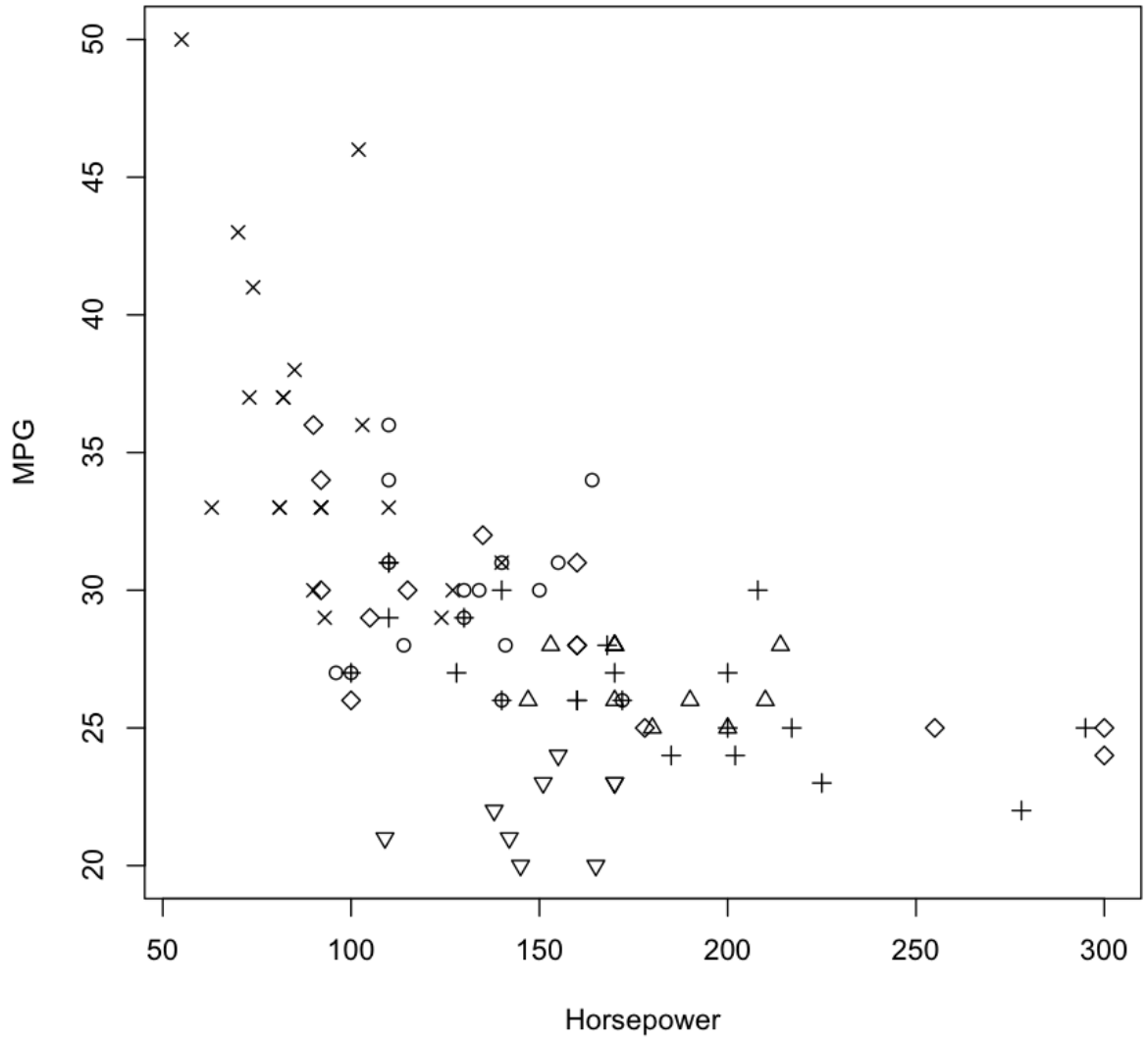
Motion

Visual Variables

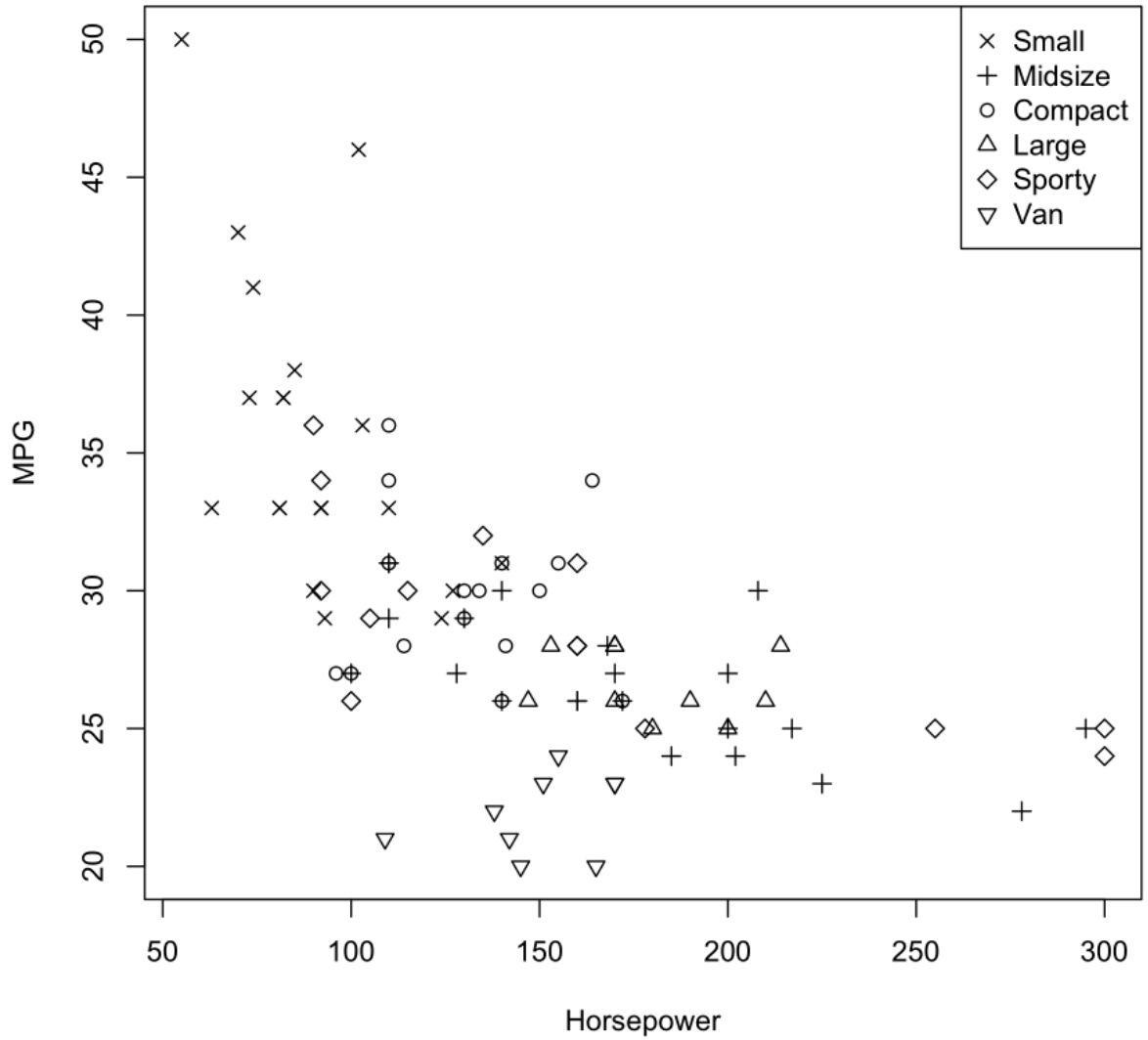




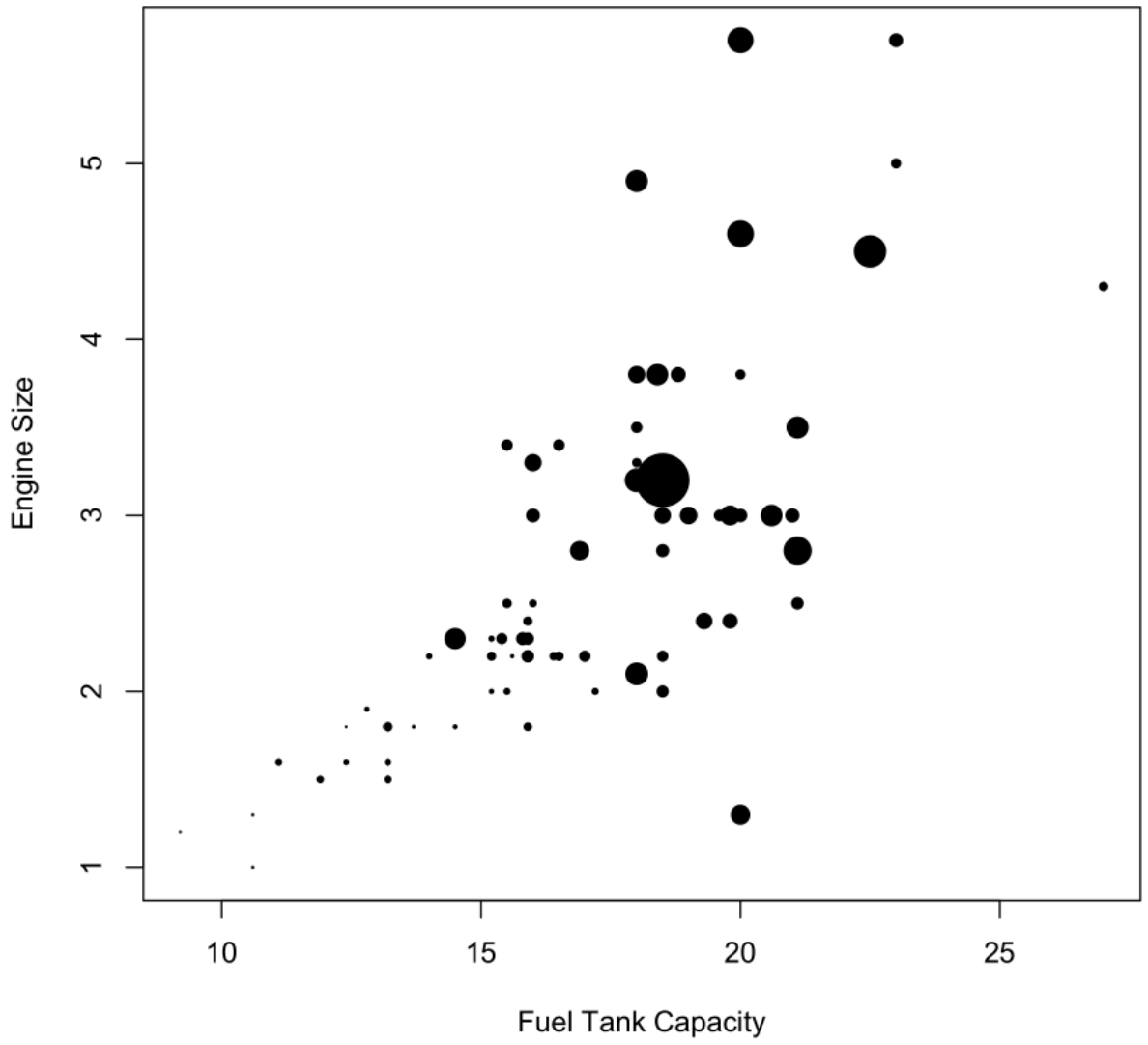
Visual Variables - Position



Visual Variables – Mark/Shape



Visual Variables – Mark/Shape



Visual Variables – Size

Position

Mark/Shape

Size (length,…)

Brightness

Color

Orientation

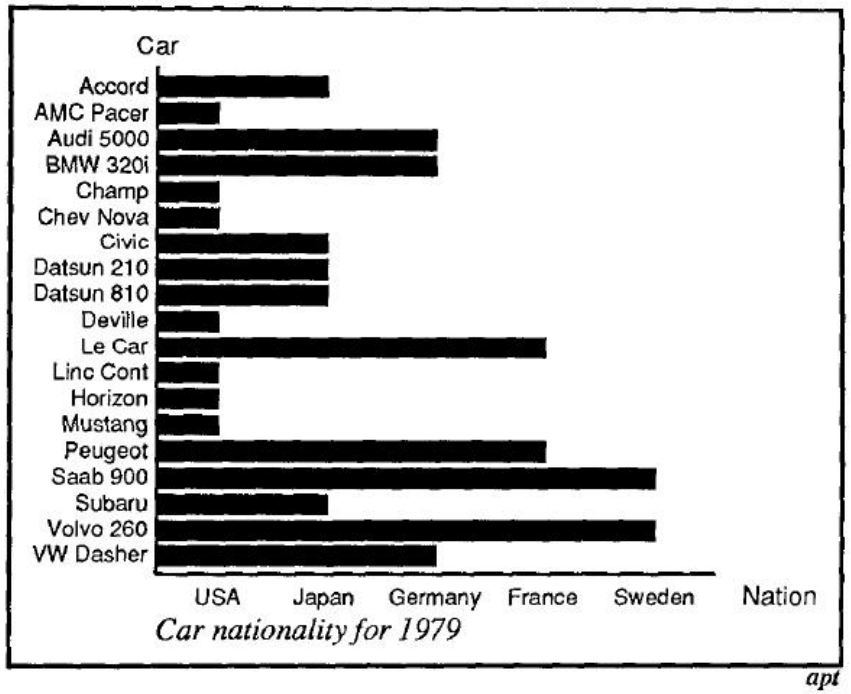
Texture

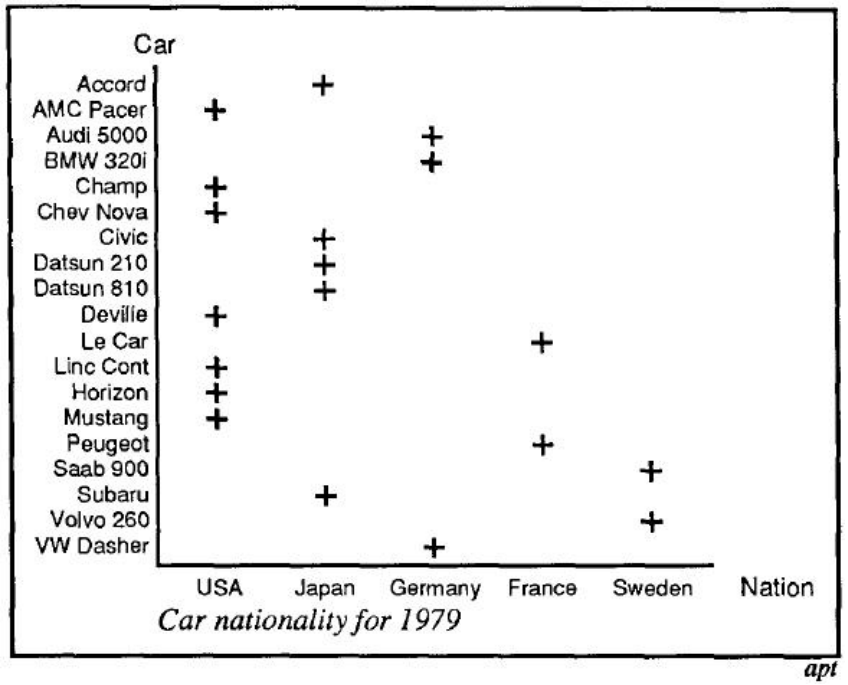
Motion

Visual Variables – Data Types

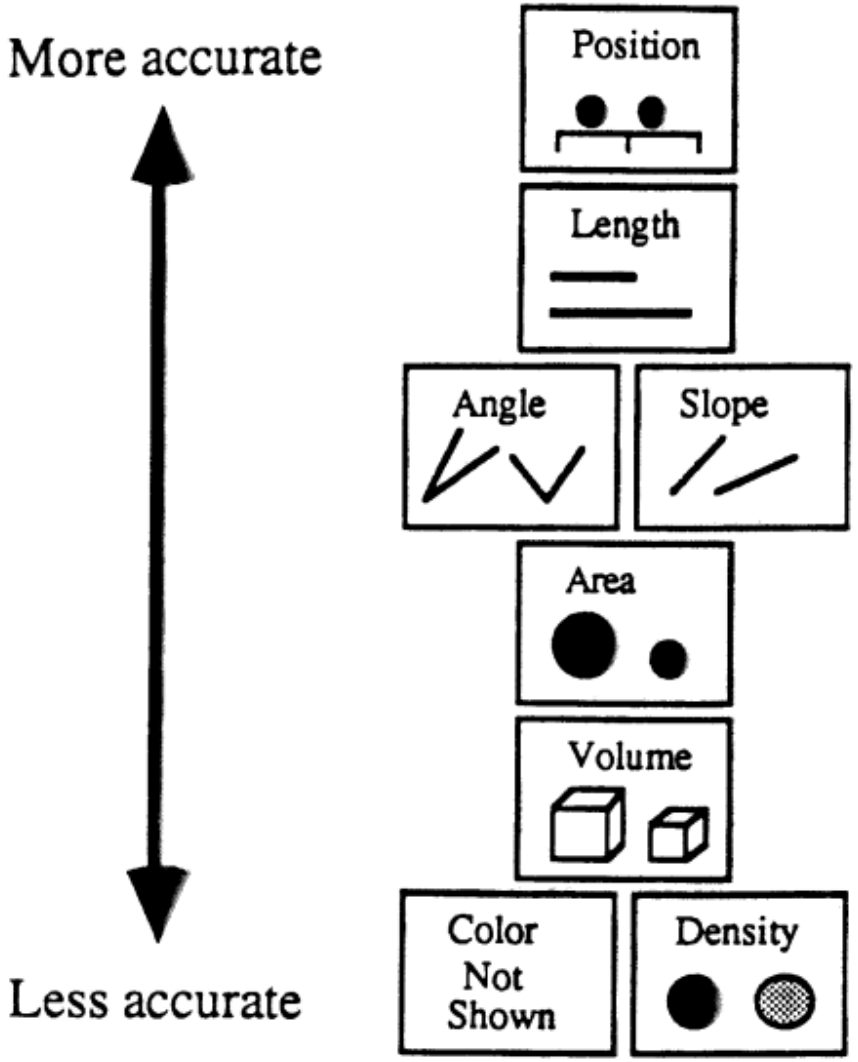
Position	(numeric)
Mark/Shape	(nominal)
Size (length,…)	(numeric)
Brightness	(ordinal)
Color	(nominal)
Orientation	(numeric)
Texture	(nominal)
Motion	(ordinal)

Visual Variables – Data Types





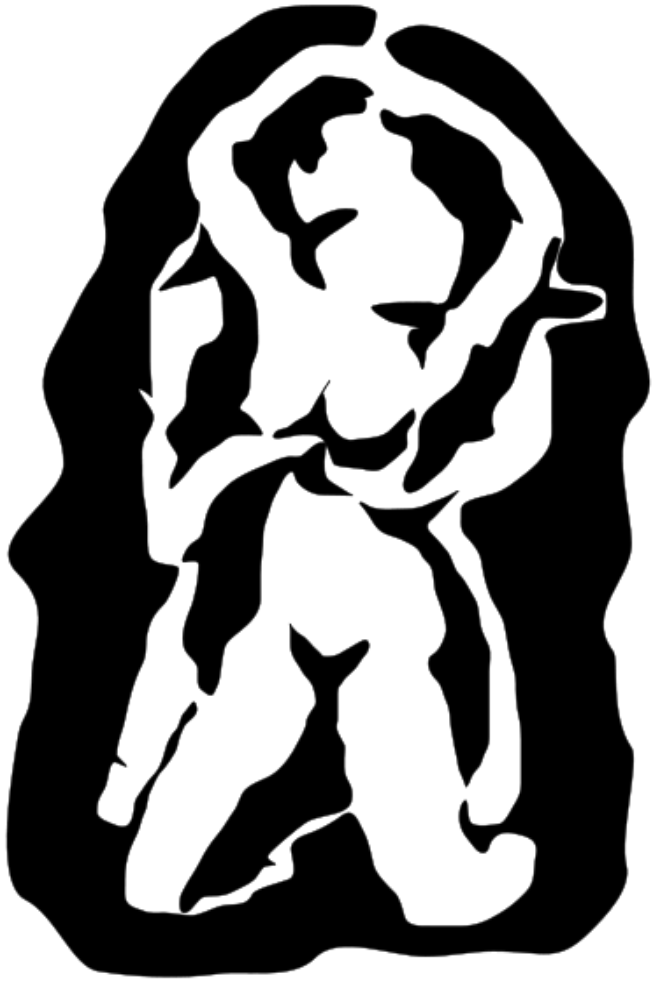
Visual Variables – Data Types



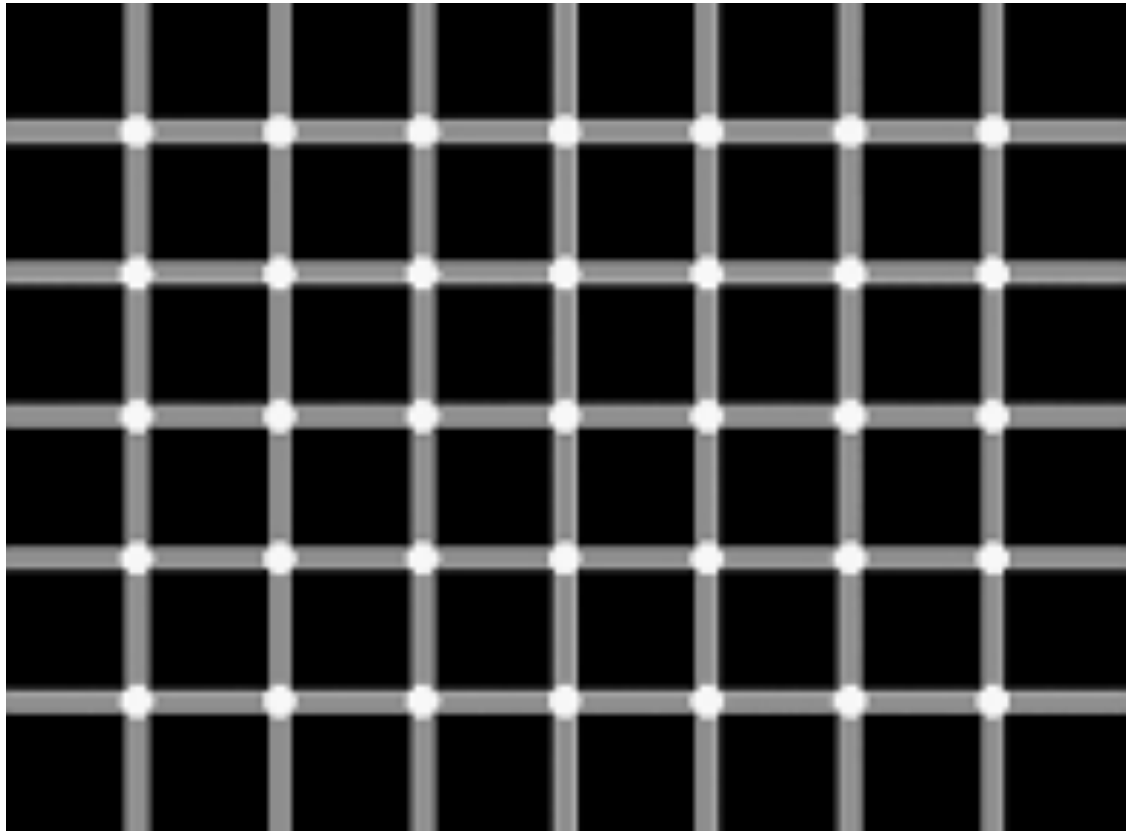
Visual Variables - Ranking

Cleveland & McGill, 1984

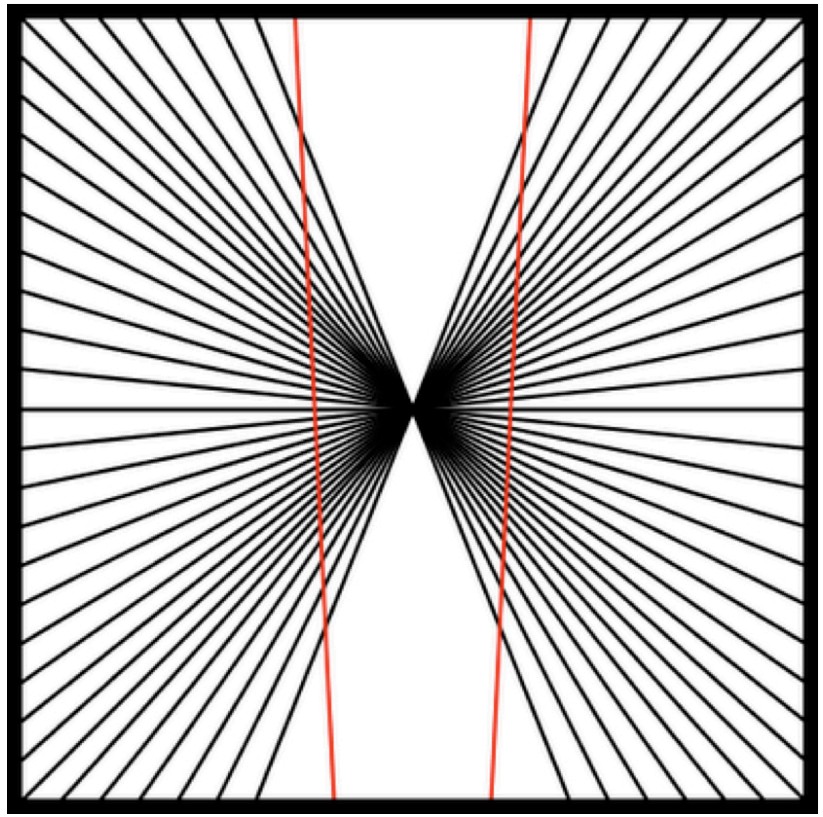
Perception



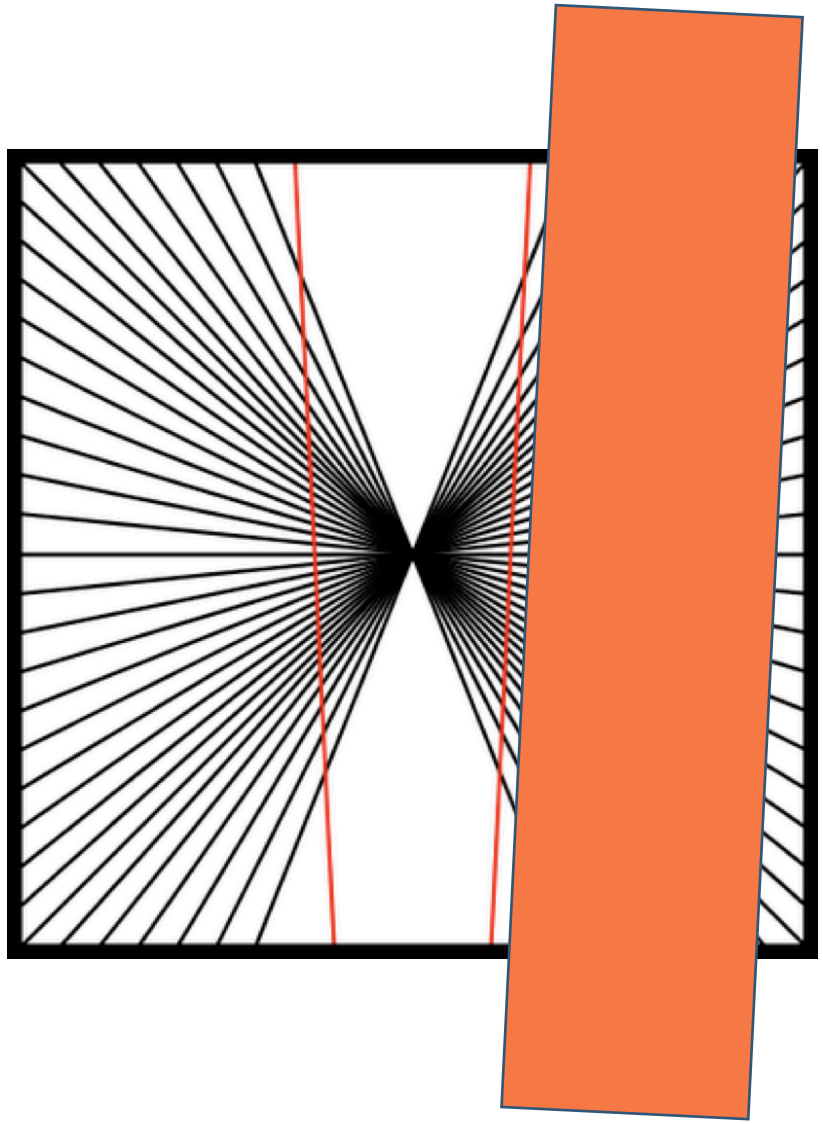
Perception



Perception



Perception

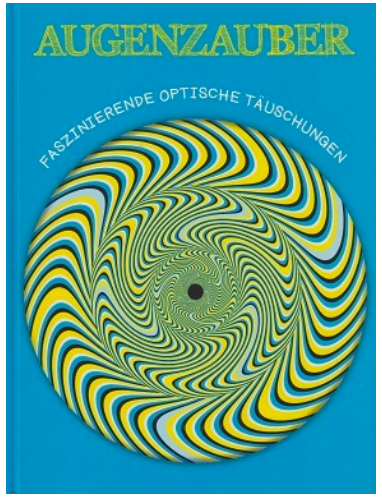


Perception

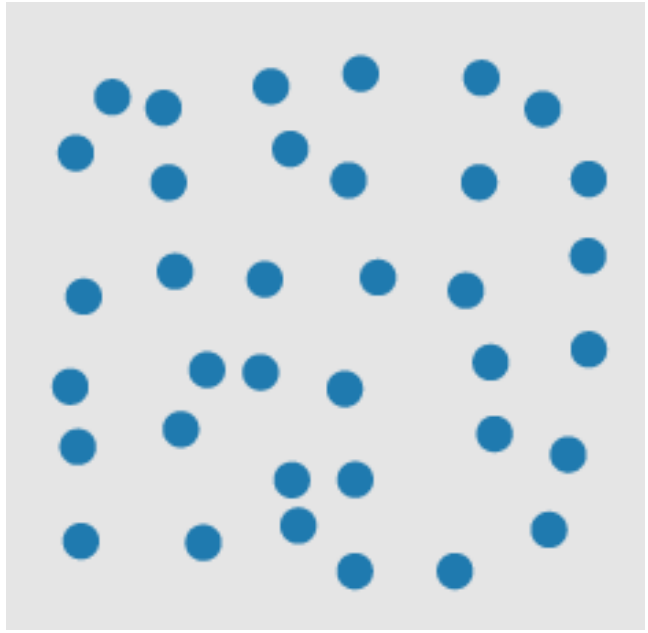
Dr. Stephanie Zysk,

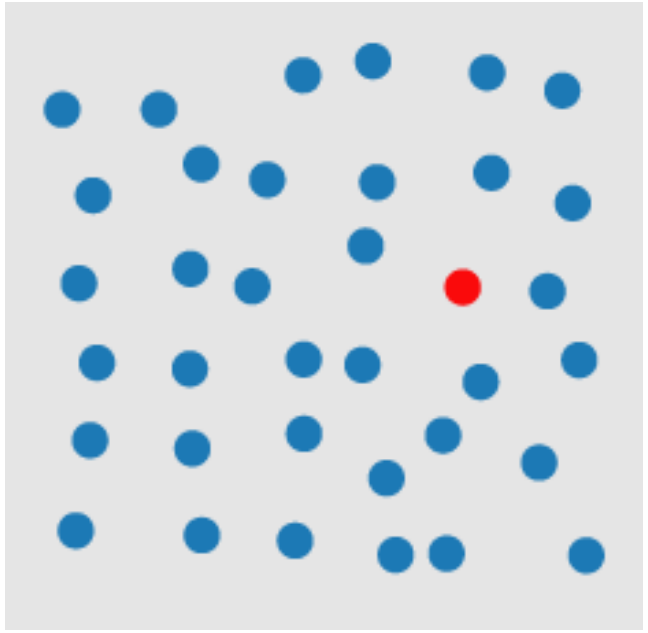
„Augenzauber – Faszinierende optische Täuschungen“,

Compact Verlag GmbH

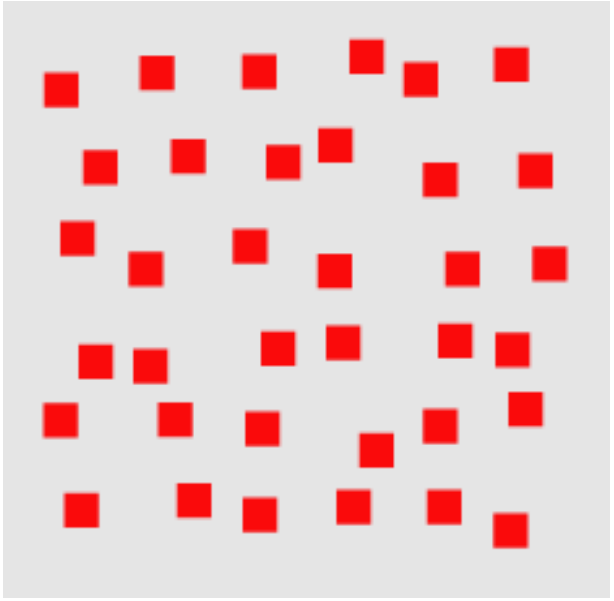


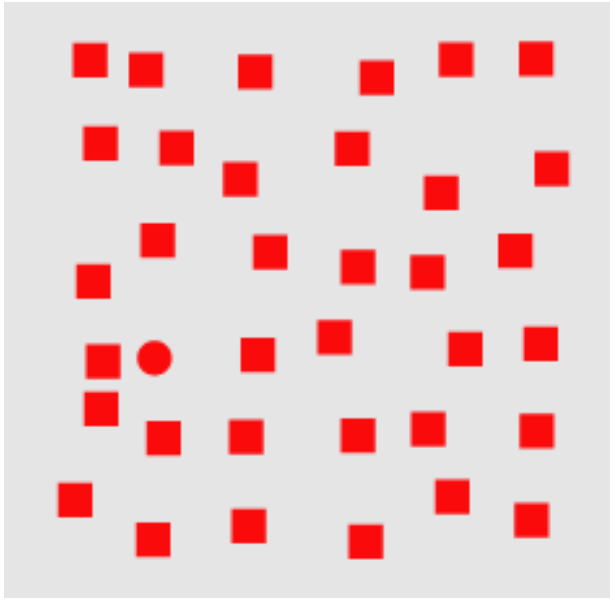
Perception



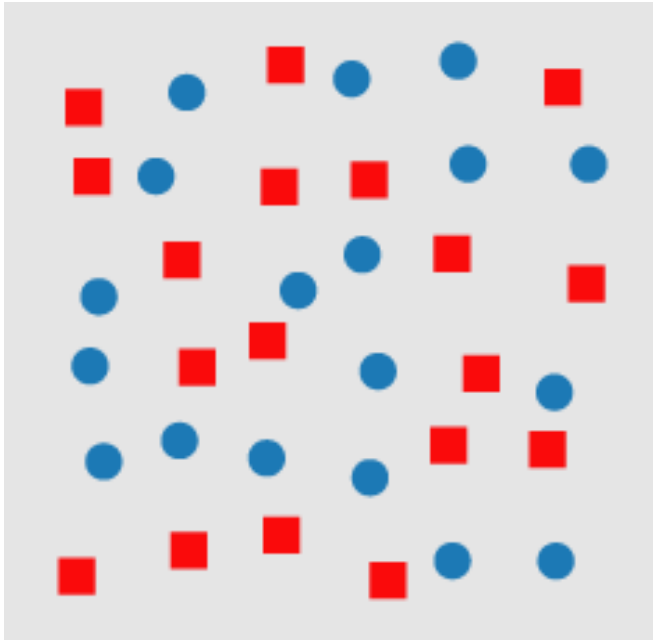


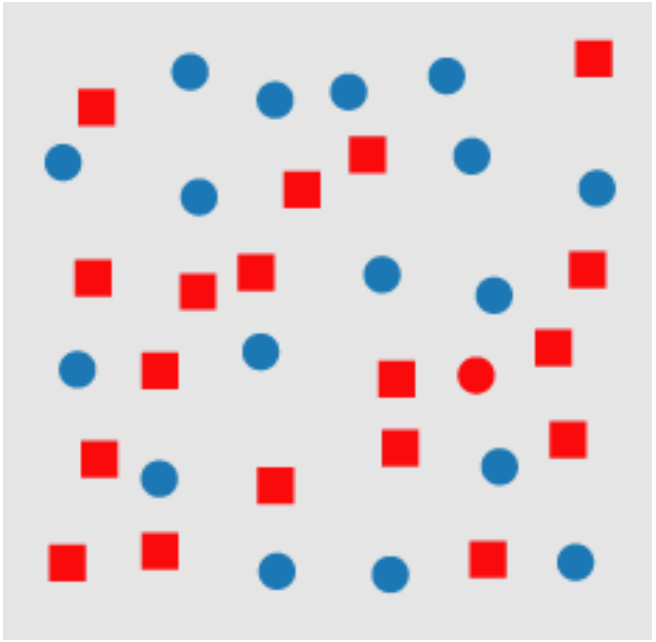
Perception - Pre-Attentive Processing





Perception - Pre-Attentive Processing



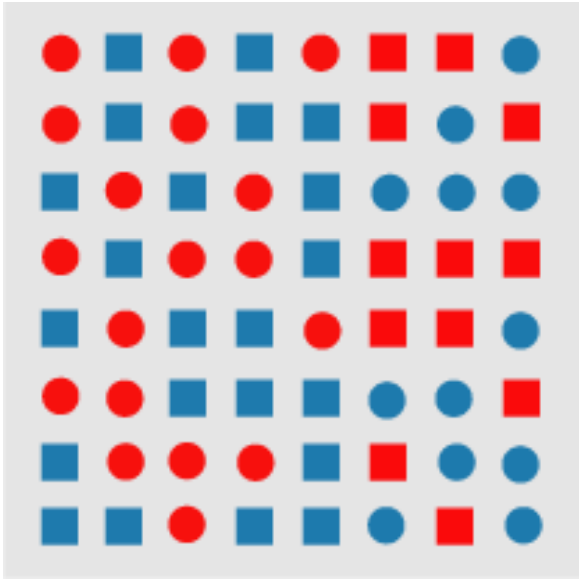


Perception - Pre-Attentive Processing

Online Demonstration:

http://www.csc.ncsu.edu/faculty/healey/PP/index.html



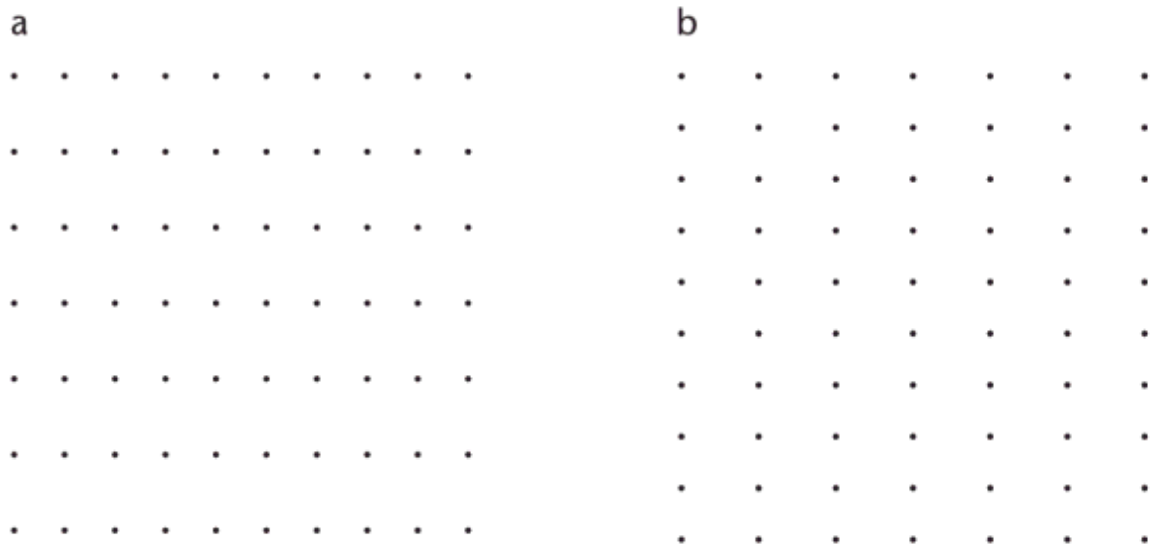


Perception - Pre-Attentive Processing

Gestalt Laws:

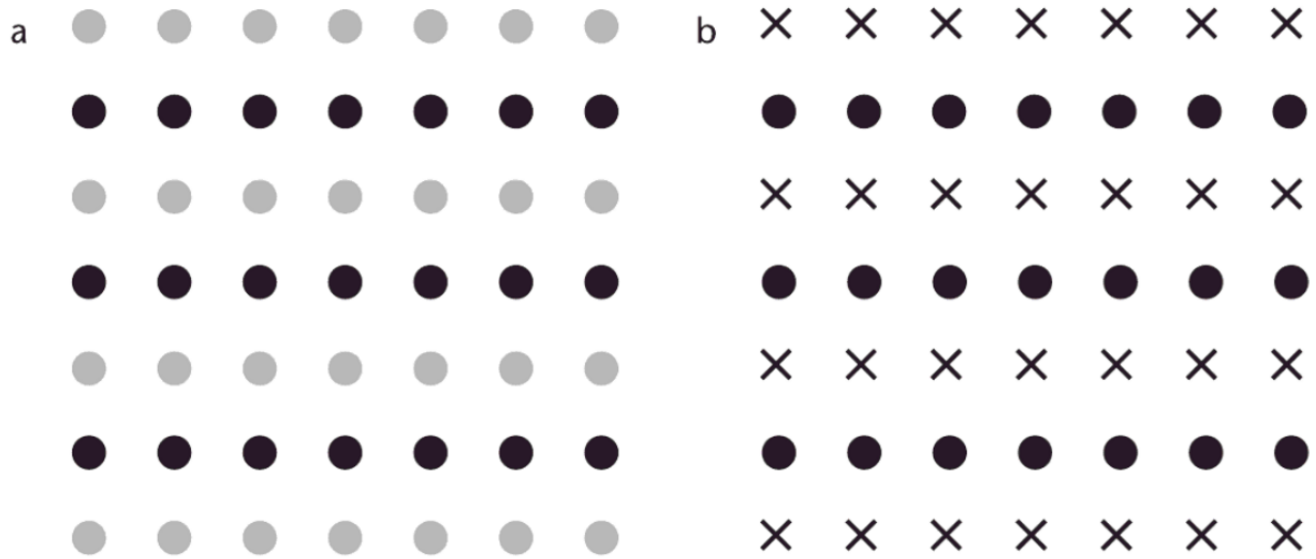
- Perceptual laws about how we group visual objects together to form visual entities.
- Gestalt School of psychology: founded by a group of German psychologists in 1912.

Law of Proximity:



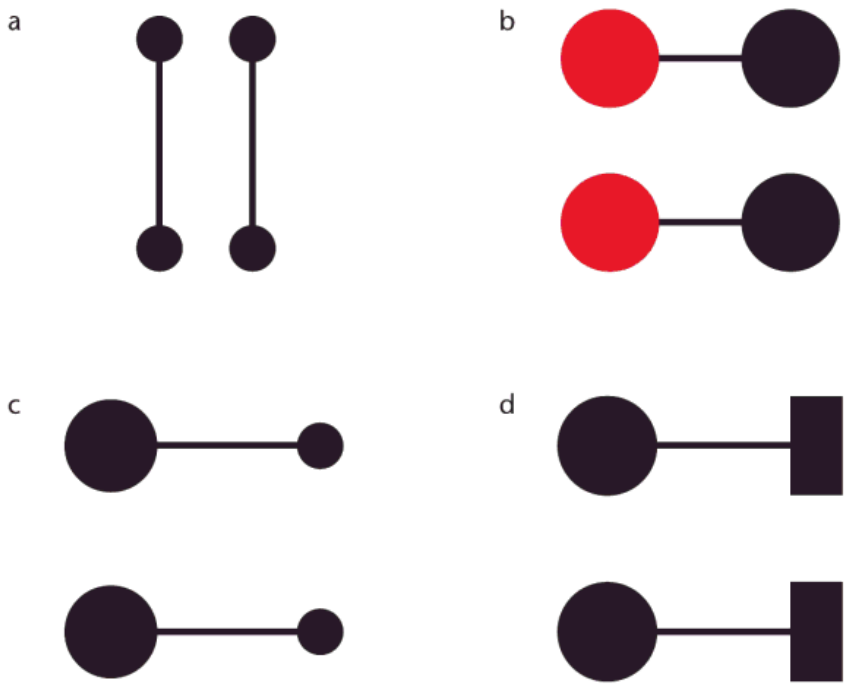
Colin Ware, Information Visualization: Perception for Design, Morgan Kaufmann

Law of Similarity:

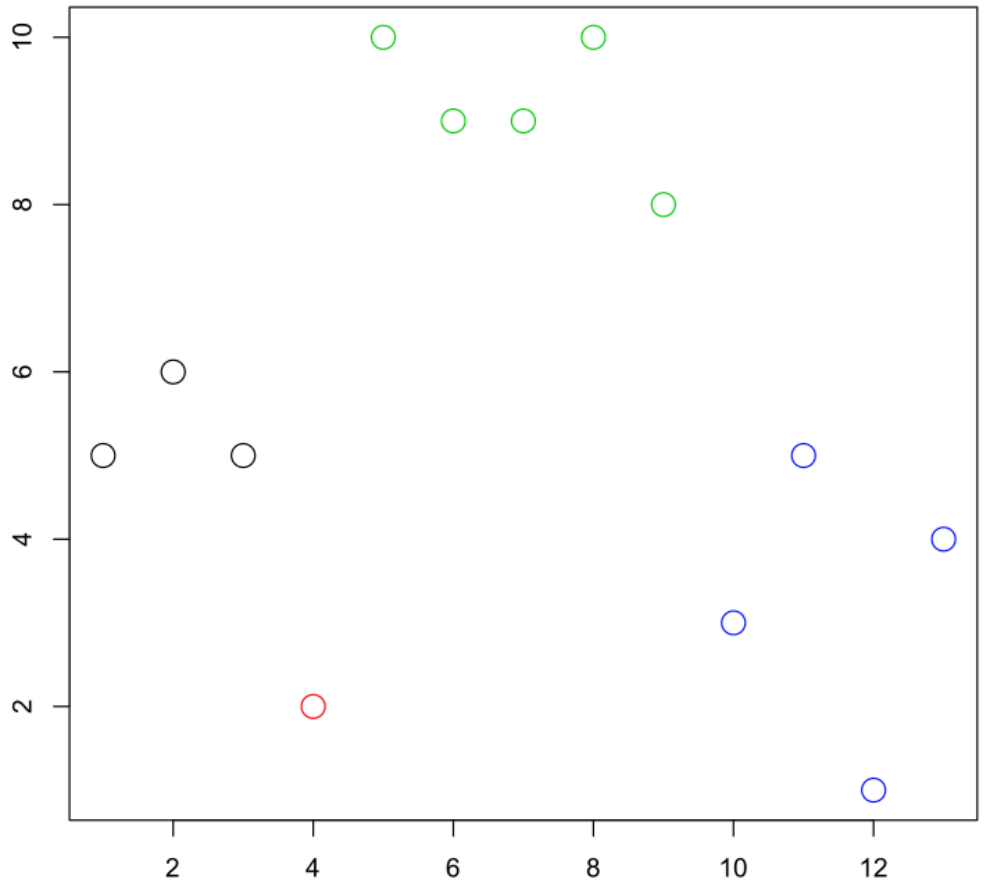


Colin Ware, Information Visualization: Perception for Design, Morgan Kaufmann

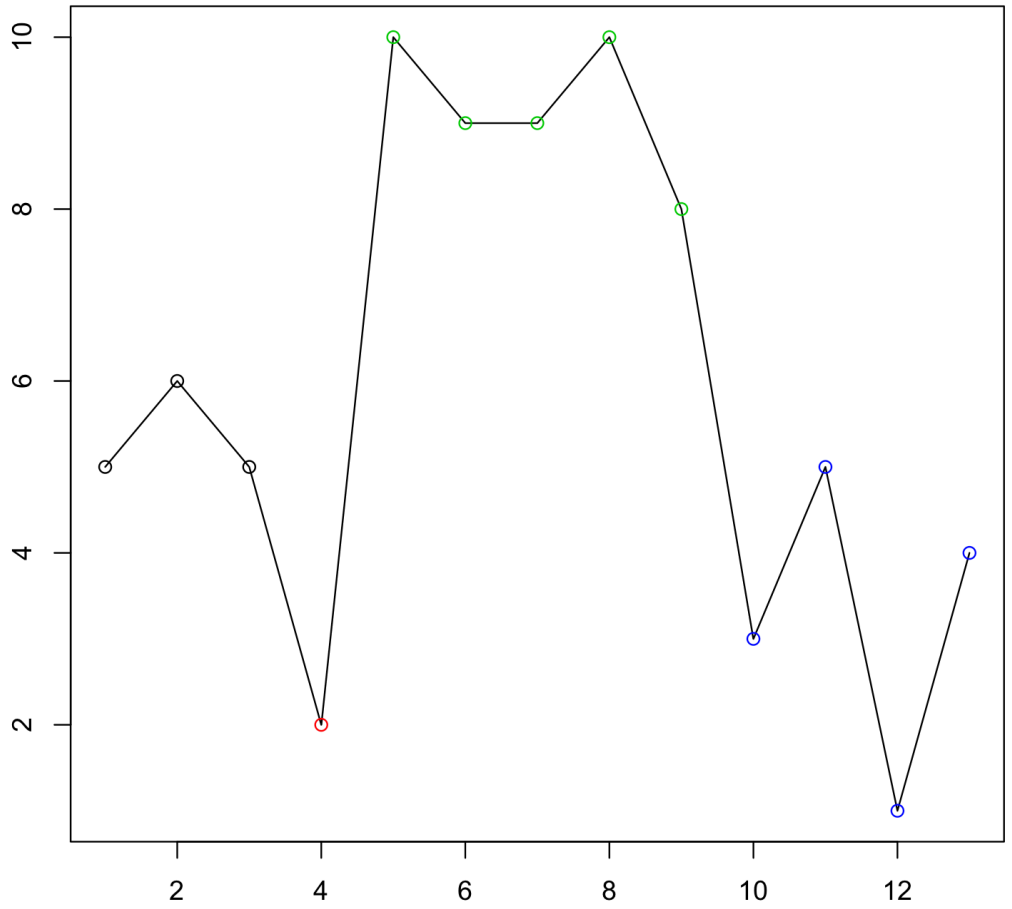
Law of Connectedness:



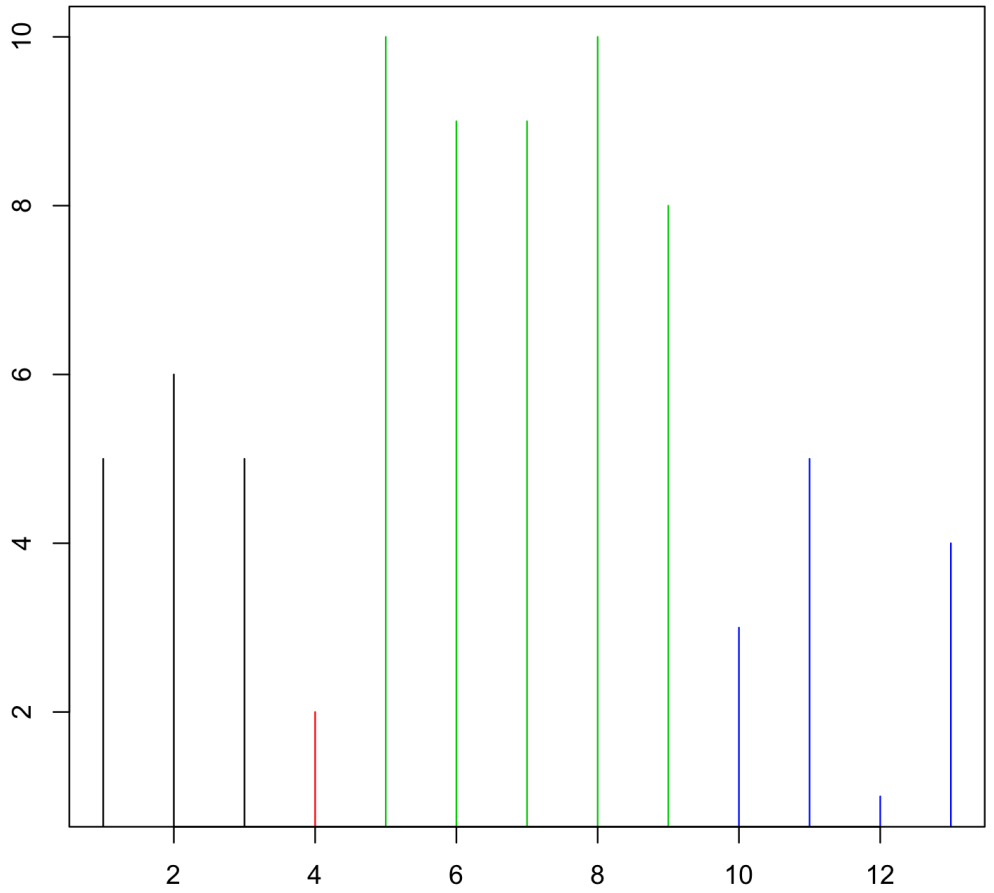
Colin Ware, Information Visualization: Perception for Design, Morgan Kaufmann



Perception - Example



Perception - Example



Perception - Example

Perception





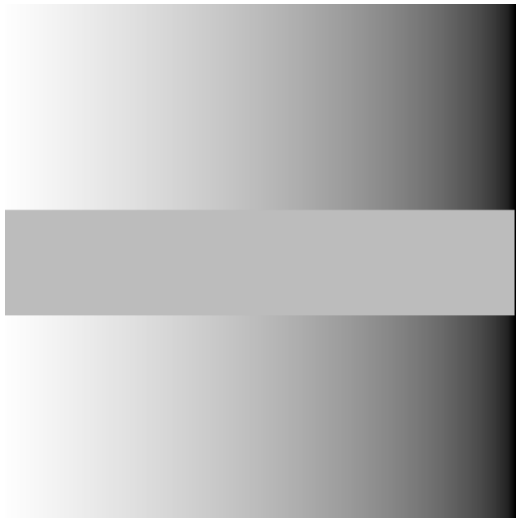
Change Blindness

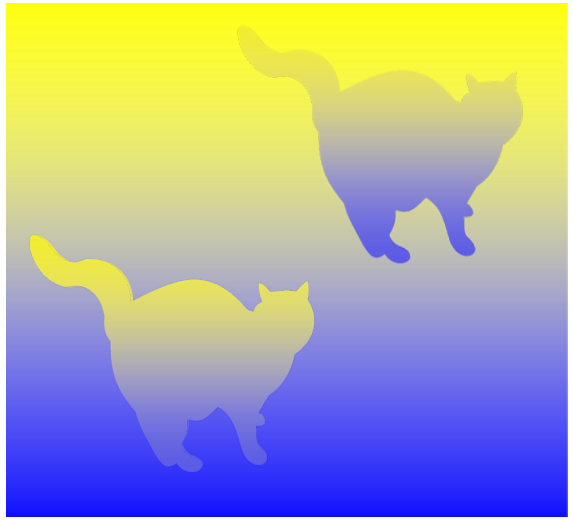
- If our focus gets interrupted, we might be unable to see significant changes that occur in a scene.
- The phenomena could happen because of inappropriate attentional guidance.

https://www.youtube.com/watch?v=ubNF9QNEQLA

https://www.youtube.com/watch?v=uO8wpm9HSB0

Is really powerful!
Be careful!

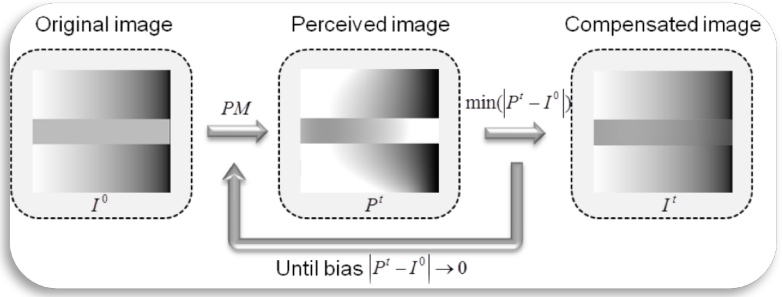




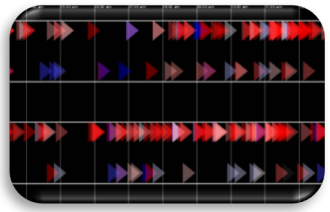
Perception – Color

- Compensating contrast effects:

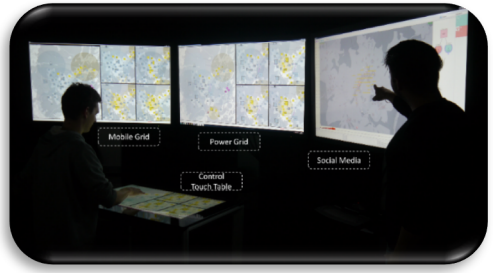
Pixel-based optimization algorithm for compensating contrast effects…



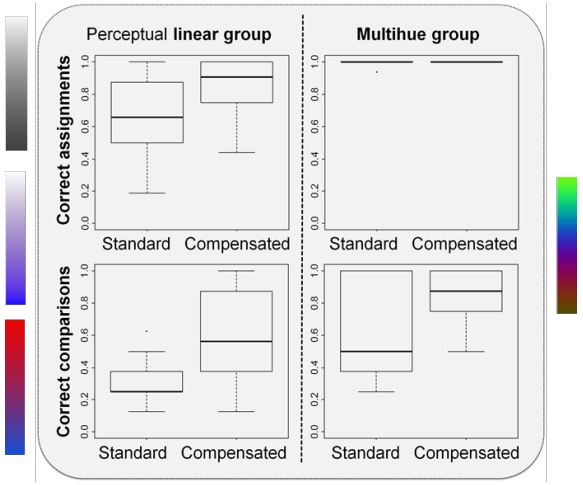
…which is an **application independent** post-processing technique for images or visualizations.





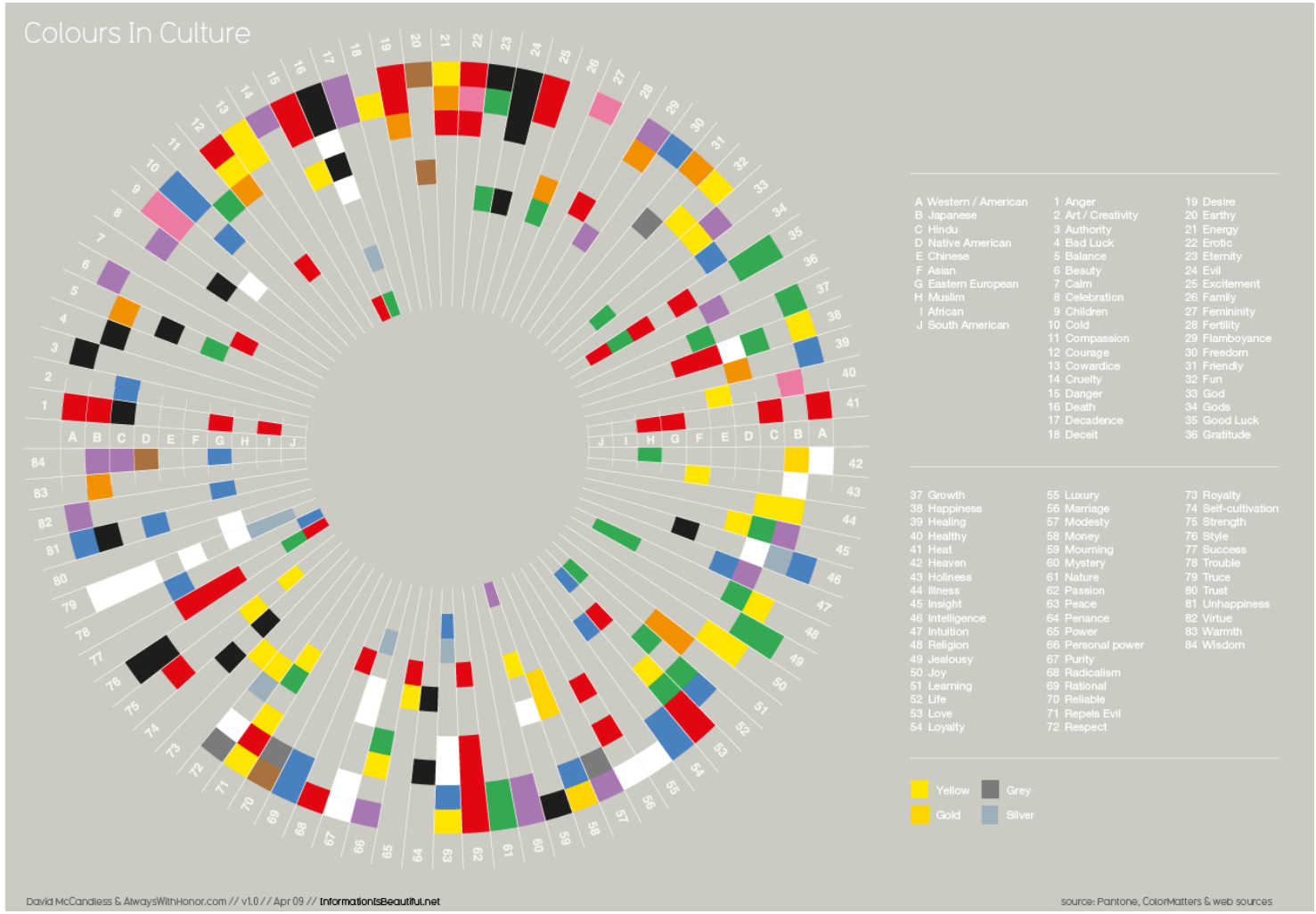


Quantitative evaluation of the compensation method.

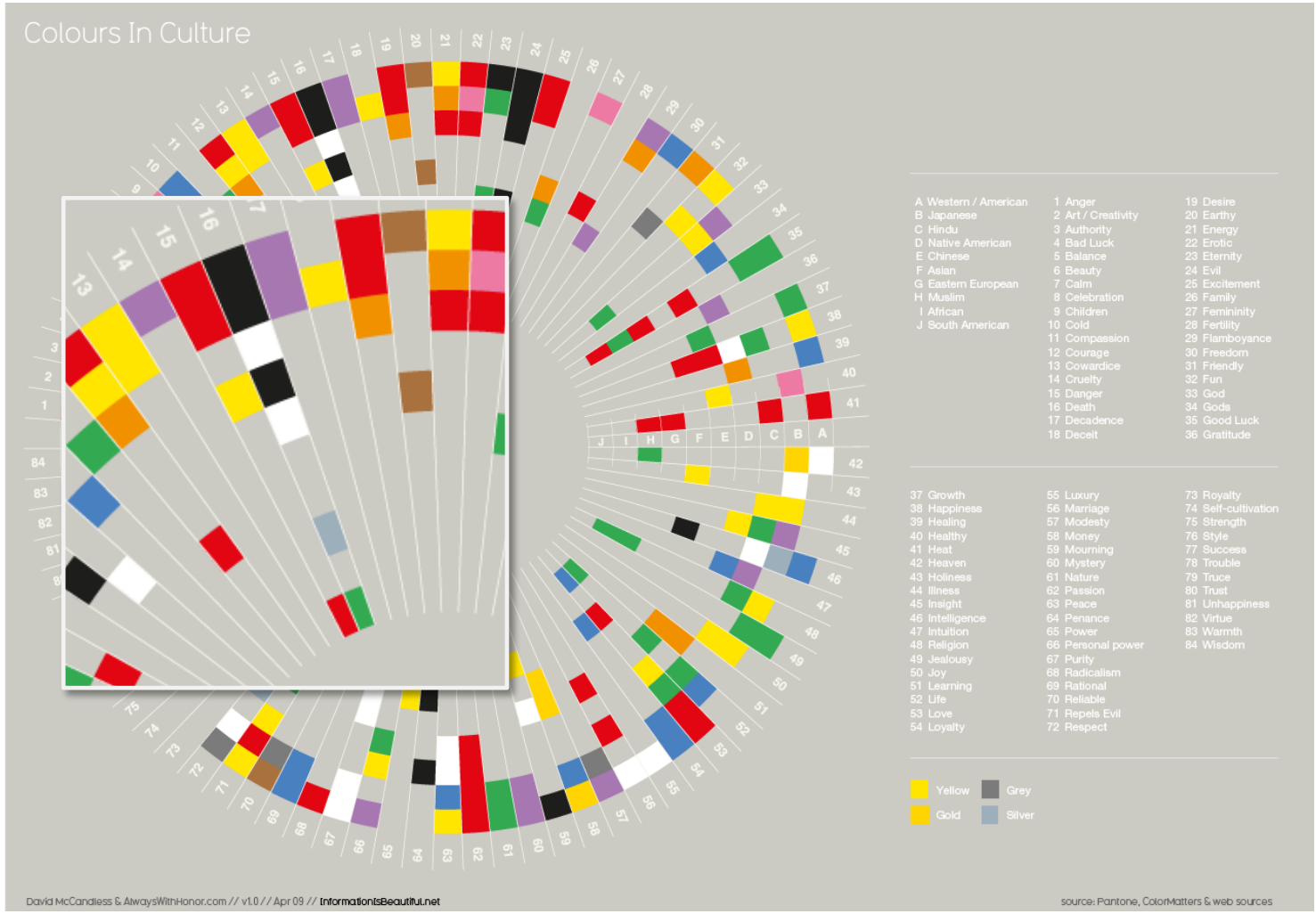


Perception – Color

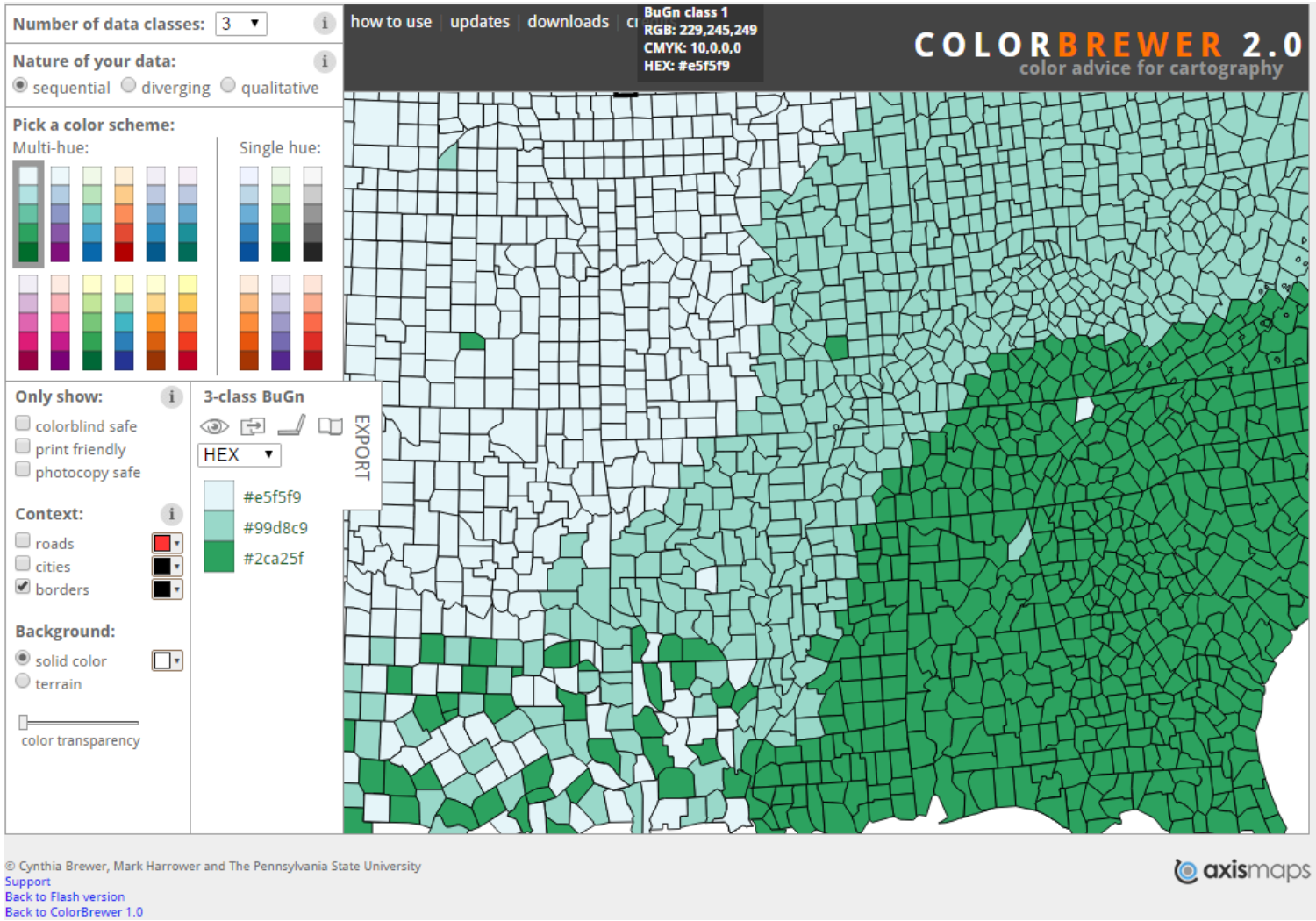
Mittelstädt et al, 2014



Perception – Color



Perception – Color



Perception – Color

www.ColorBrewer2.org, by Cynthia A. Brewer

- Take color deficiency into account
- Consider mental model of users (e.g. red = high values, blue = low values)
- Use diverging colormap if meaningful midpoint exist (e.g. to indicate coastline on a map)
- Sufficient space is needed to encode color
- Consider different tasks
- Consider the separability of used visual variables
- Use contrast effect compensation

Guidelines – Color Perception

- Carefully map the visual variables to the underlying data types.
- If possible take pre-attentive processing into account to highlight outliers etc.
- Gestalt Laws can be used to group elements
- Avoid change blindness by guiding the user if necessary
- Be careful with color

Guidelines – Visualization Foundation

References

Cleveland & McGill, 1984
Graphical perception: Theory, experimentation, and application to the development of graphical methods
Cleveland, W., and McGill, R - Journal of the American Statistical Association, 1984

Mittelstädt et al., 2014
S. Mittelstädt, A. Stoffel and D. A. Keim.
Methods for Compensating Contrast Effects in Information Visualization.
Computer Graphics Forum, 33(3):231-240, DOI: 10.1111/cgf.12379, 2014.