

 Tiana_Athriel

 dhuppenkothen

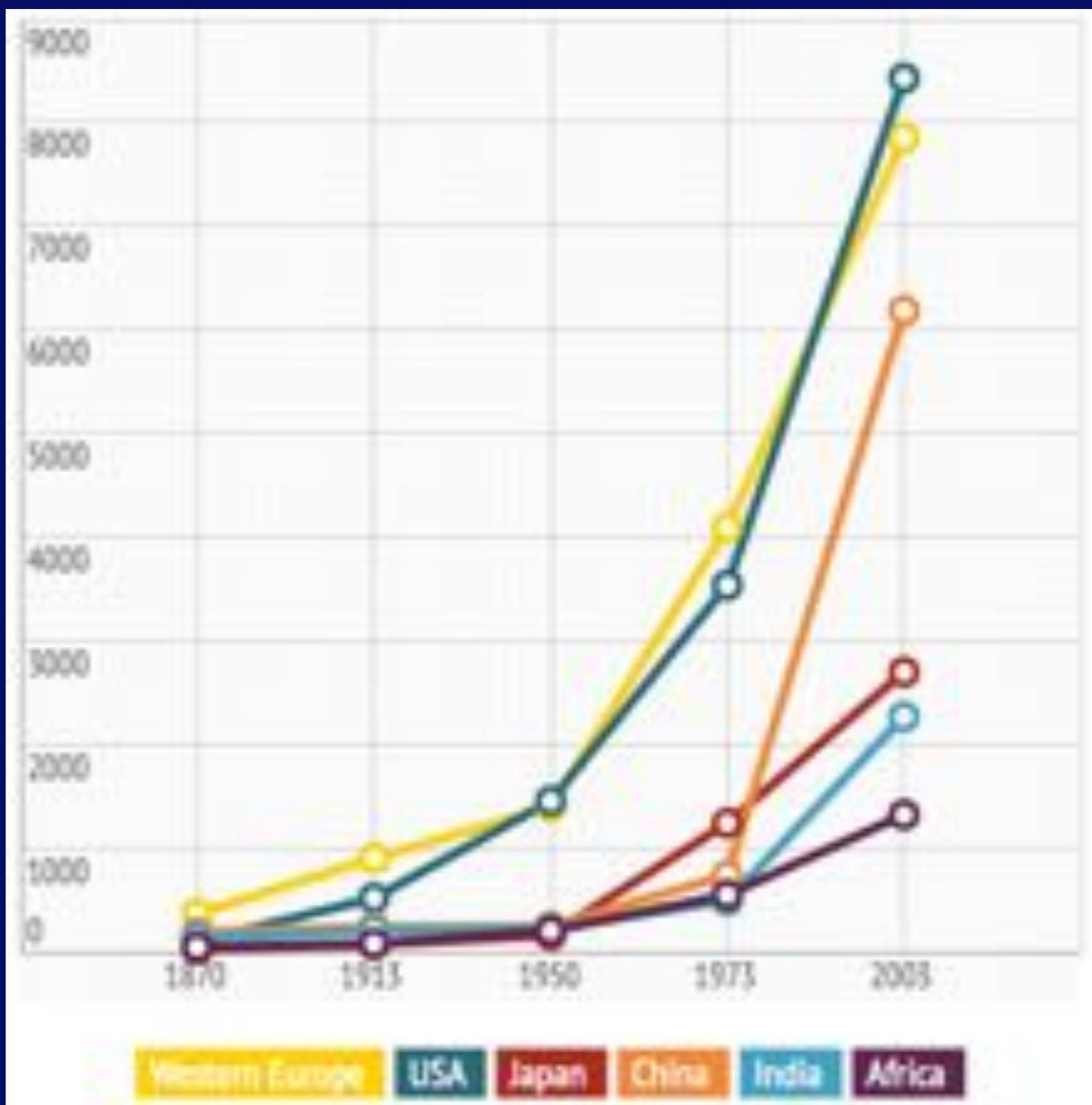
The Why and How of Data Visualization

Daniela Huppenkothen
NYU Center for Cosmology and Particle Physics
NYU Center for Data Science

**Visualization lets you see things
that would rather go unnoticed**

	A	B	C	D	E	F
1	Past GDP	1870	1913	1950	1973	2003
2	Western Europe	367	902	1396	4096	7857
3	USA	98	517	1455	3536	8430
4	Japan	25	71	160	1242	2699
5	China	189	241	244	739	6187
6	India	134	204	222	494	2267
7	Africa	45	79	203	549	1322

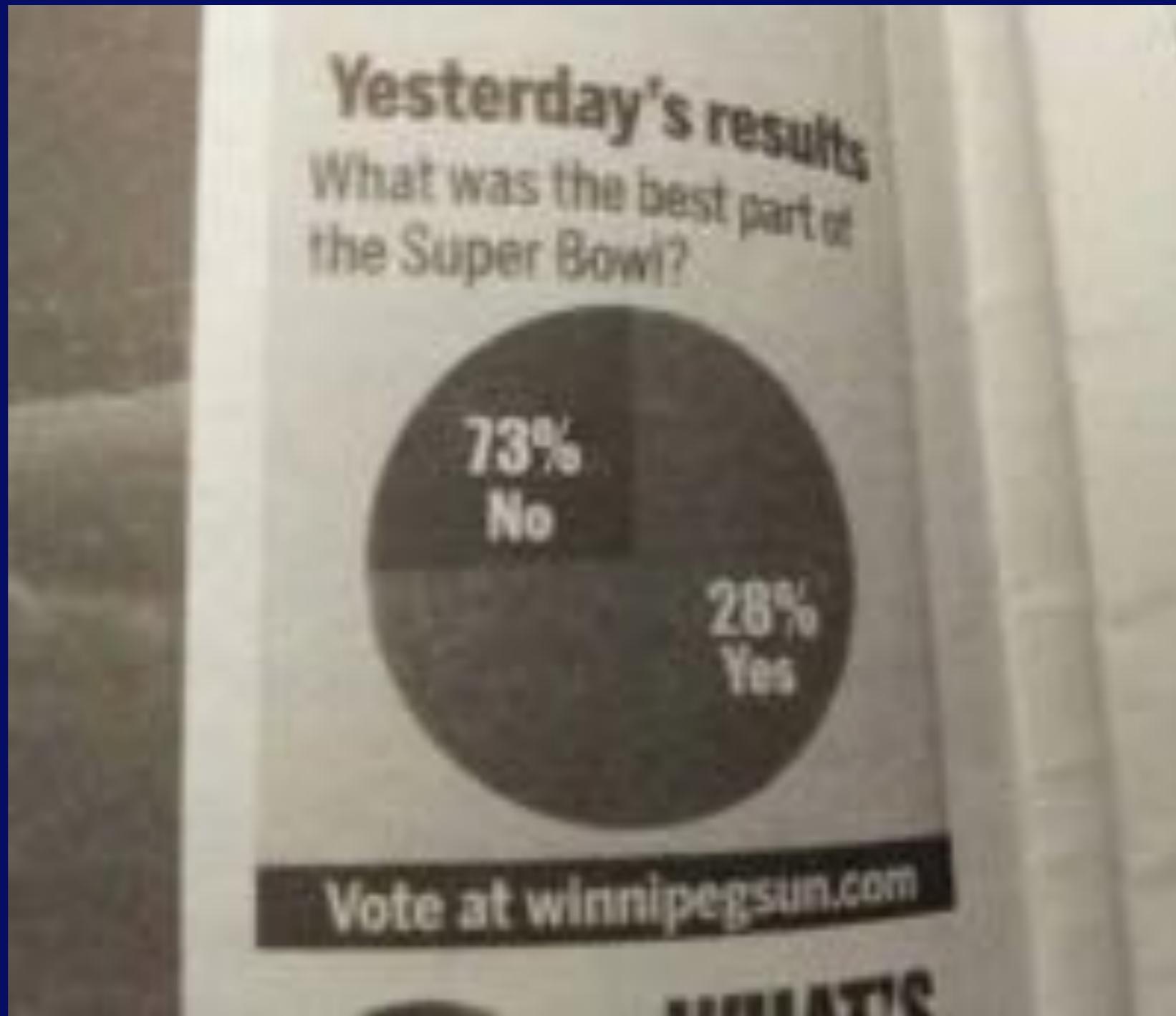
<http://www.mulinblog.com/data-visualization-matters/>



<http://www.mulinblog.com/data-visualization-matters/>

**think of visualization as a new set
of languages you can use to
communicate**

How *not* to do visualization ...



<http://www.businessinsider.com/the-27-worst-charts-of-all-time-2013-6>

Topics:

- space
- colour + contrast
- textures + line styles
- visual hierarchy

A bit of perception ...

[https://www.youtube.com/watch?
v=vJG698U2Mvo](https://www.youtube.com/watch?v=vJG698U2Mvo)

**Visualization is about managing
the viewer's attention!**

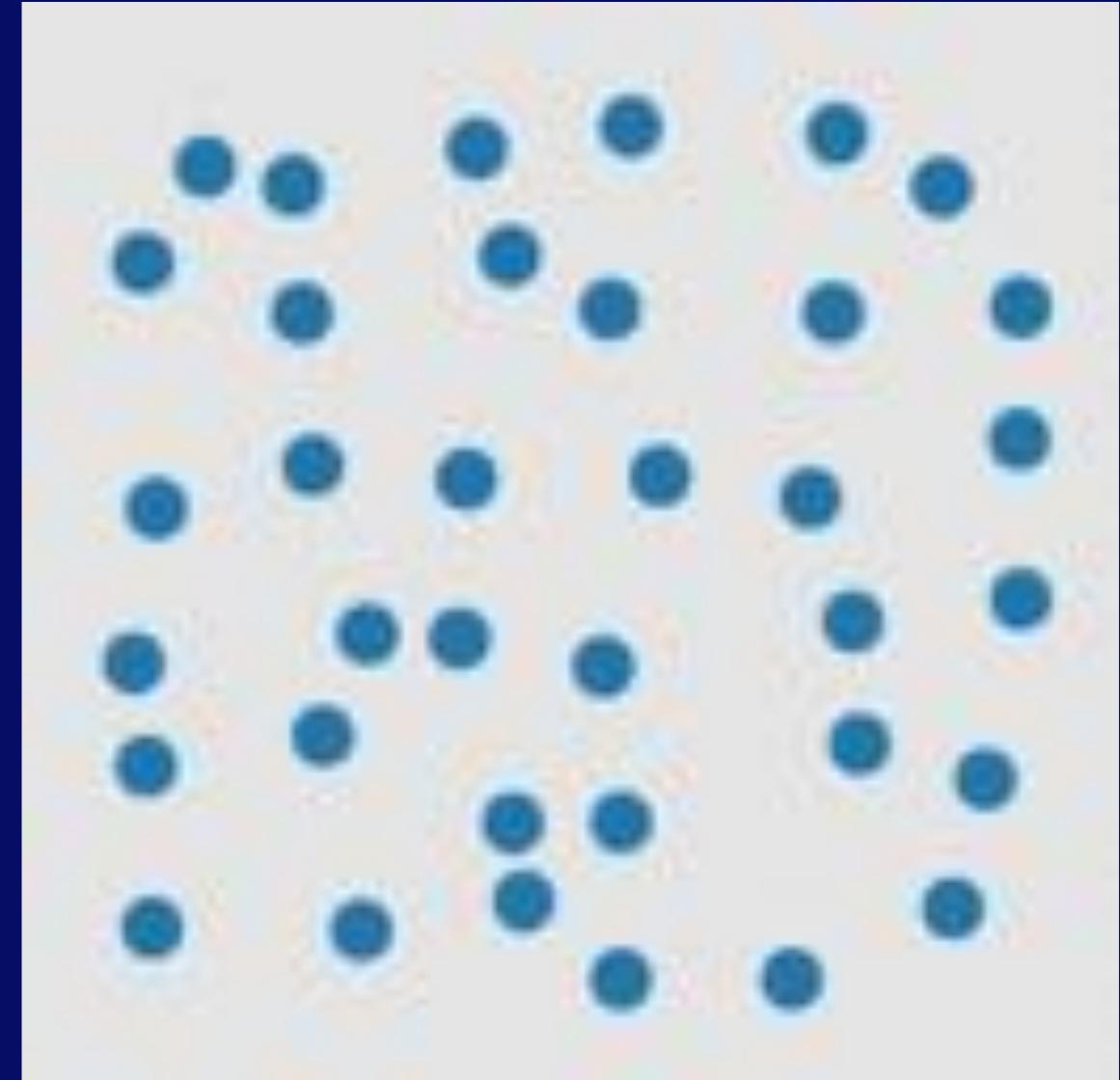
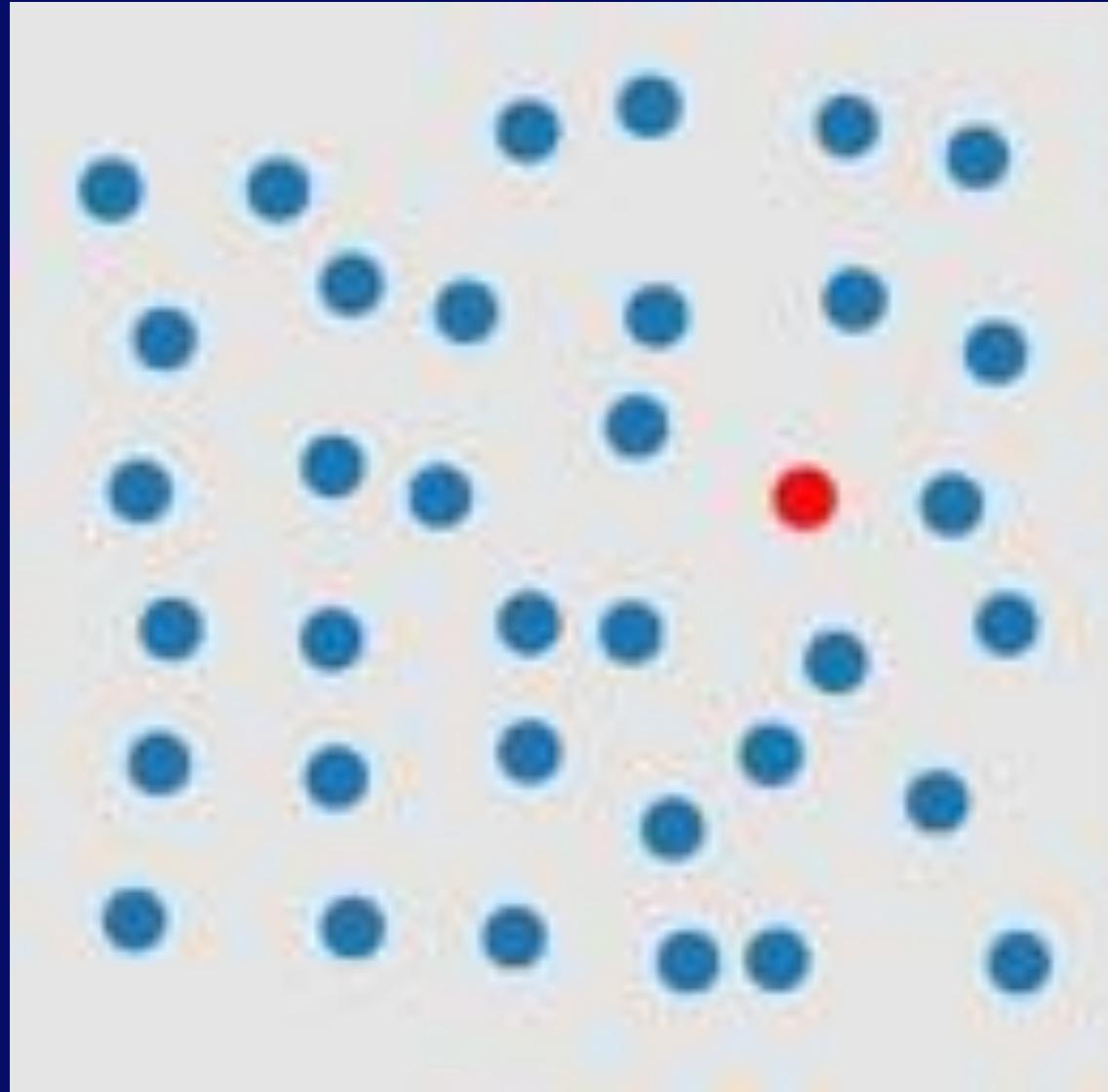


**human vision is not like
photography!**

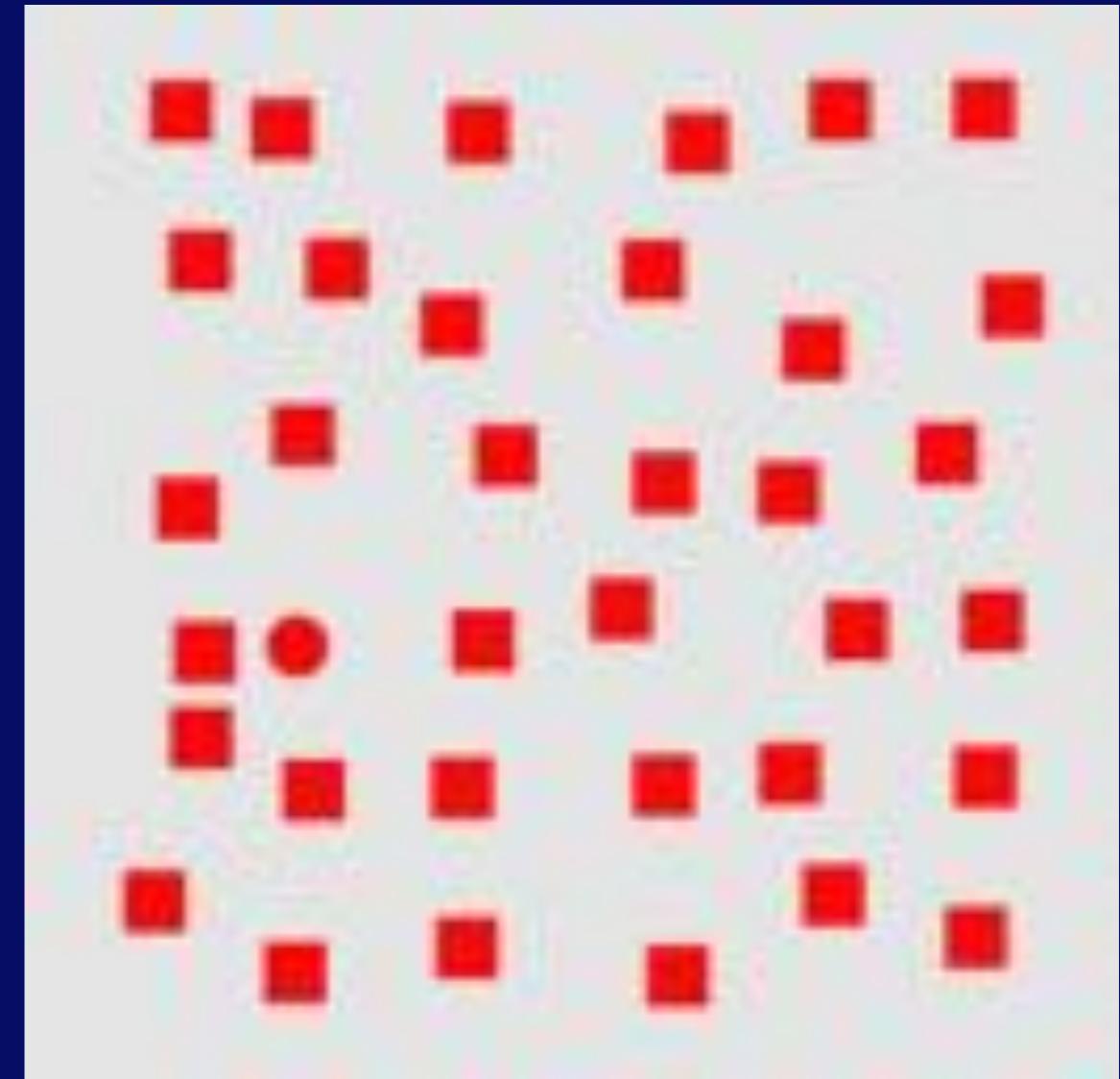
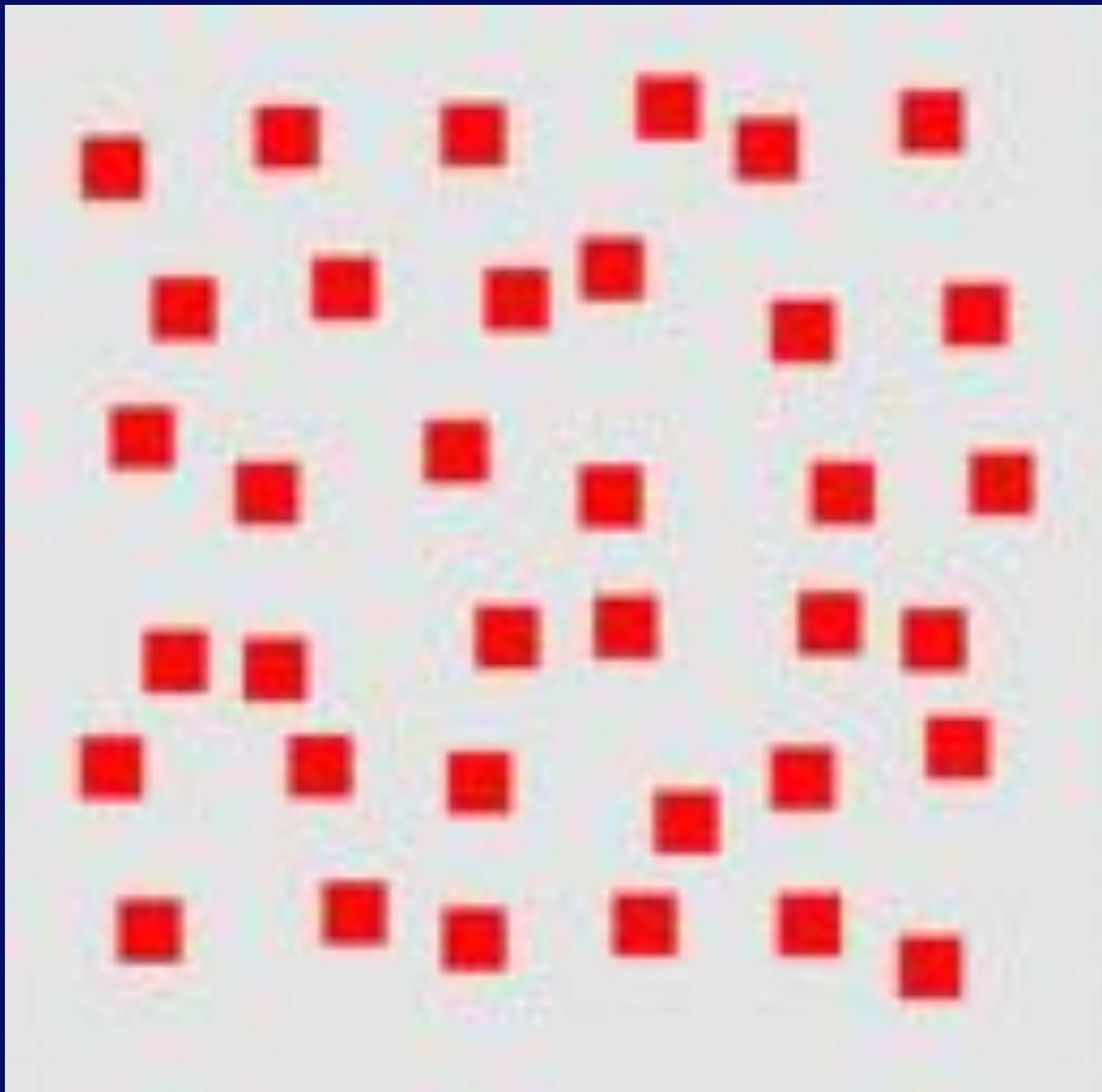
pre-attentive processing

Let's do another experiment!

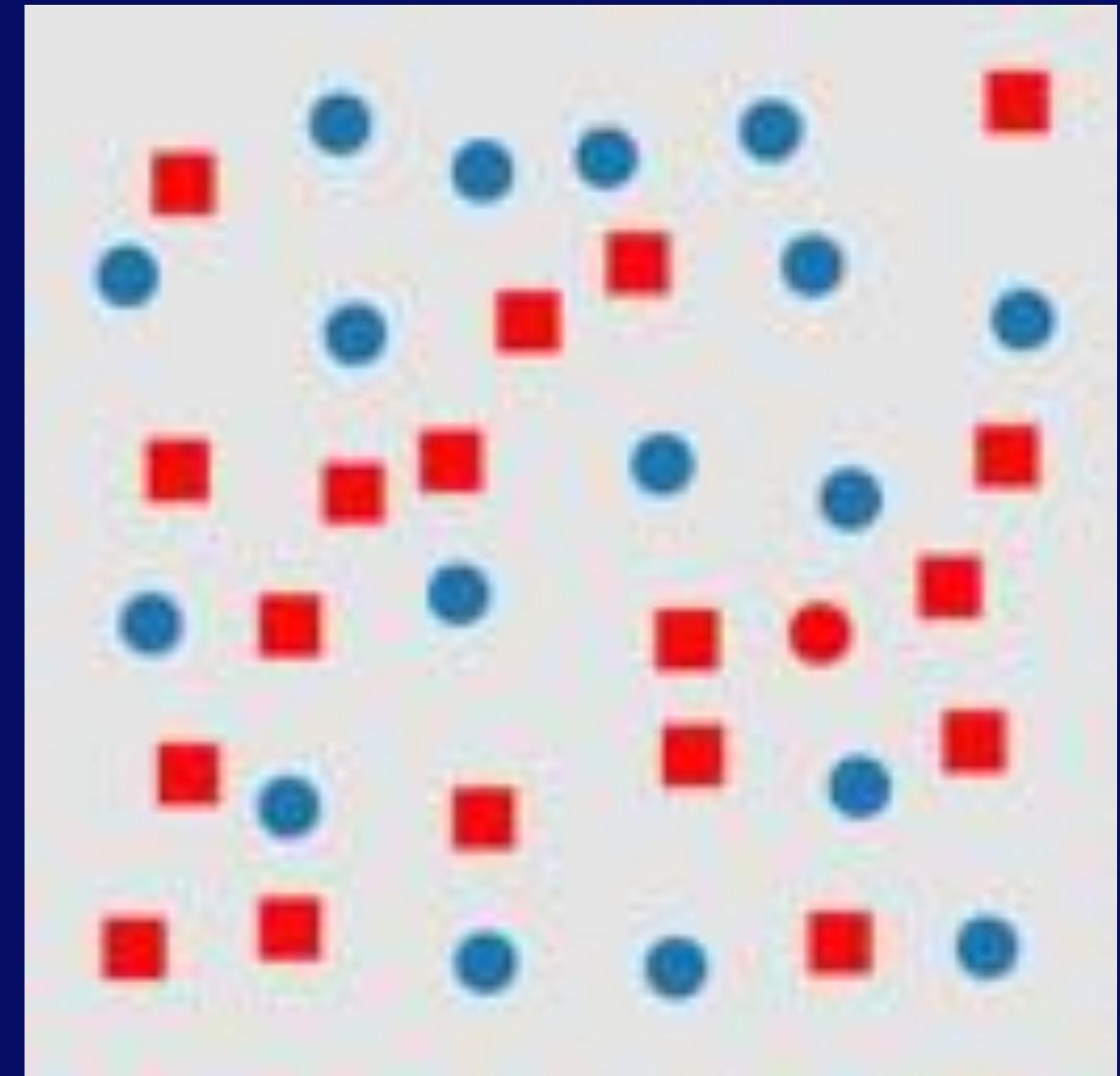
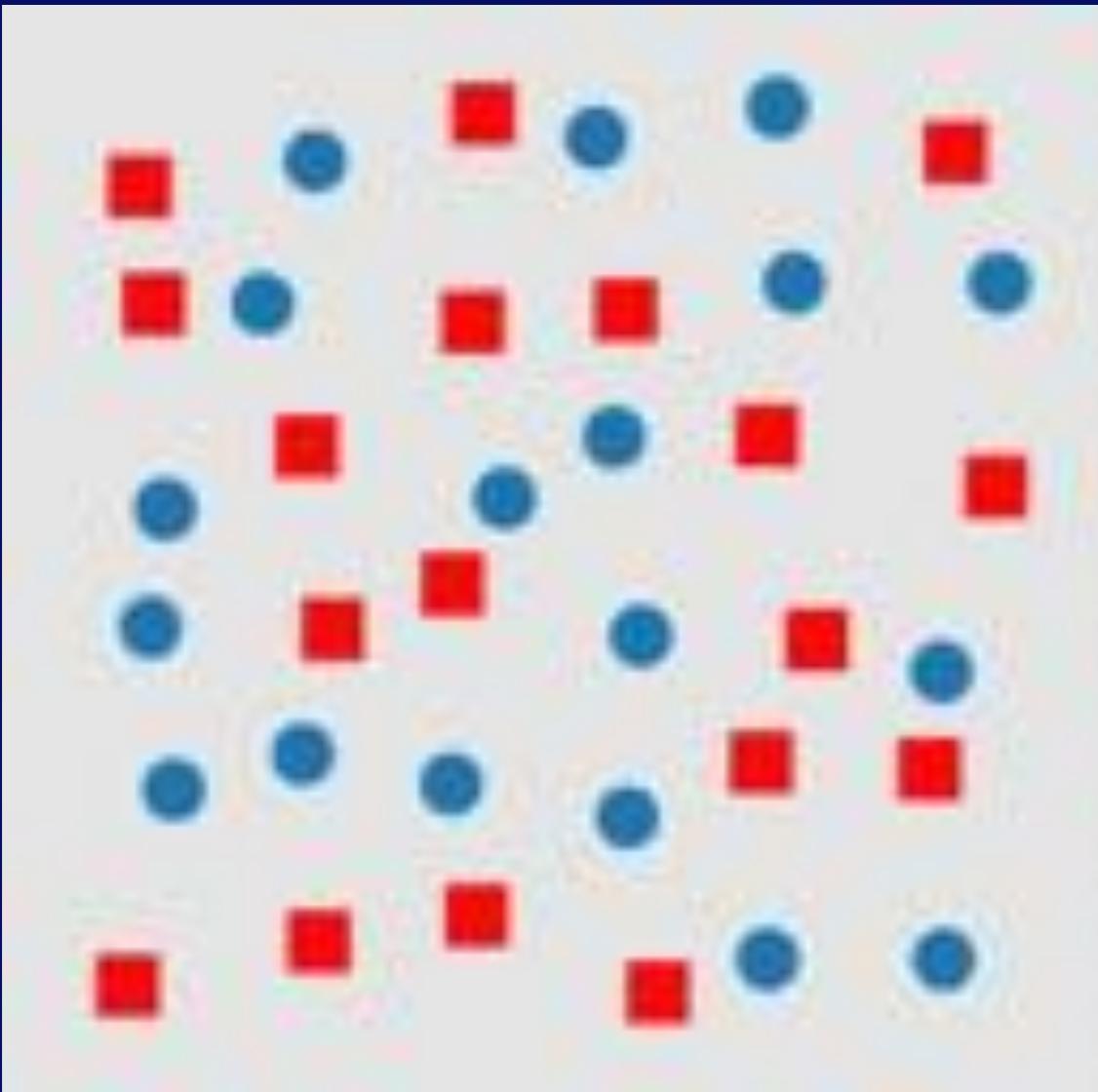
<https://www.csc2.ncsu.edu/faculty/healey/PP/>



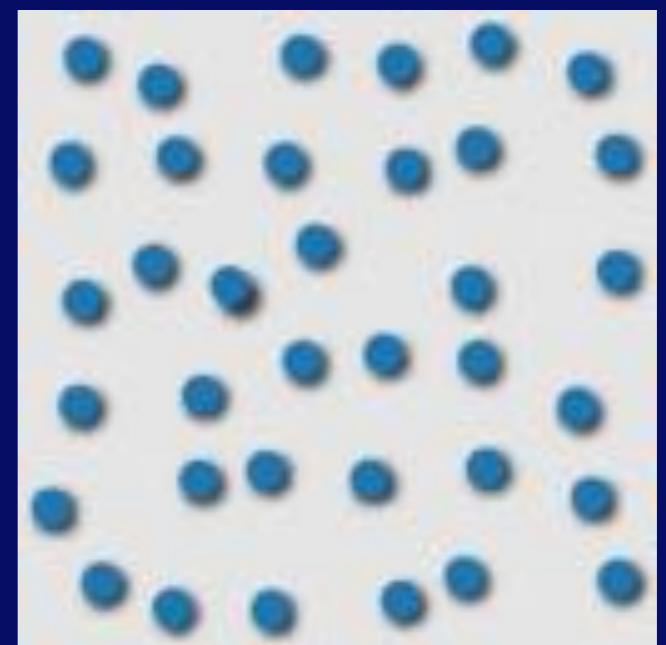
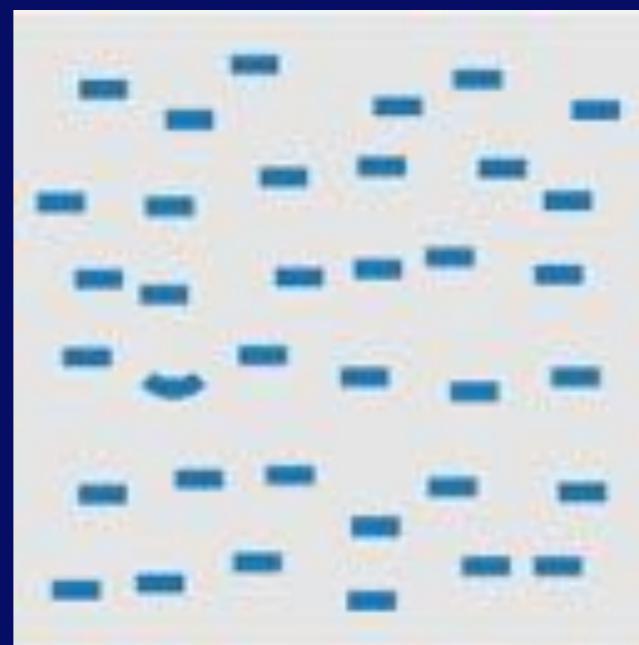
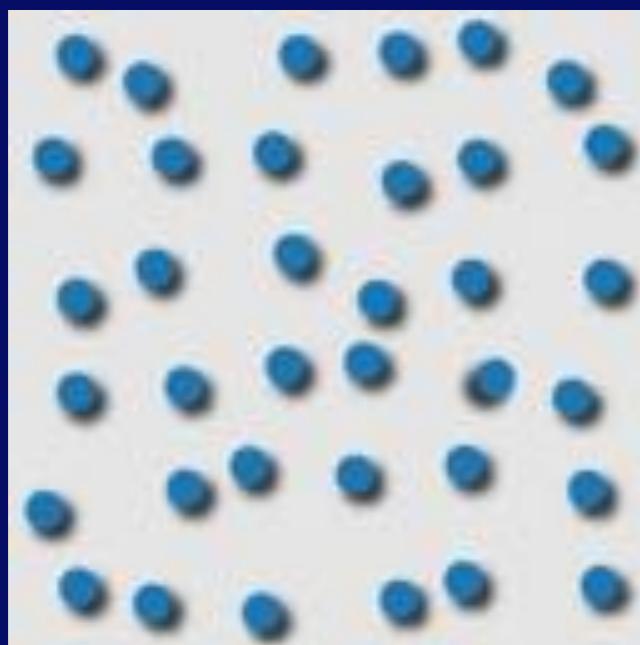
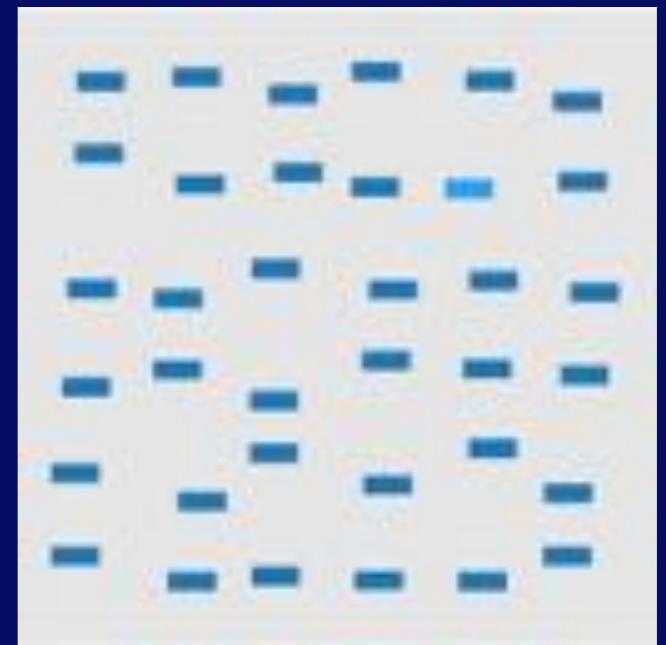
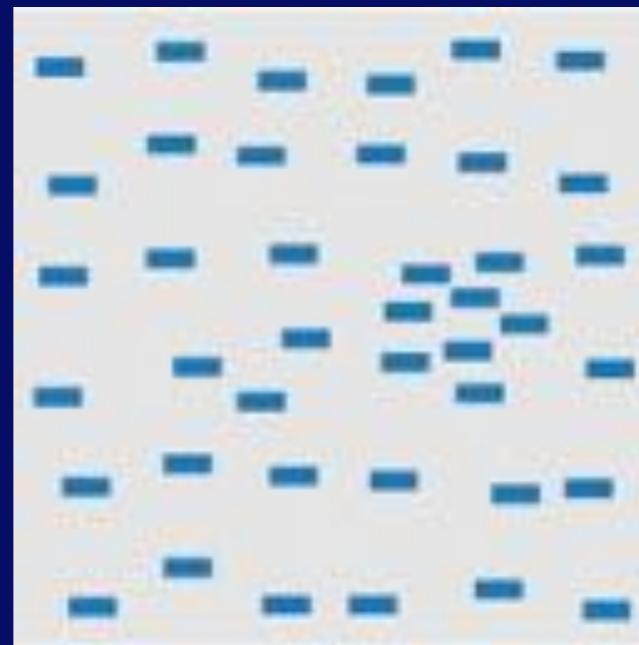
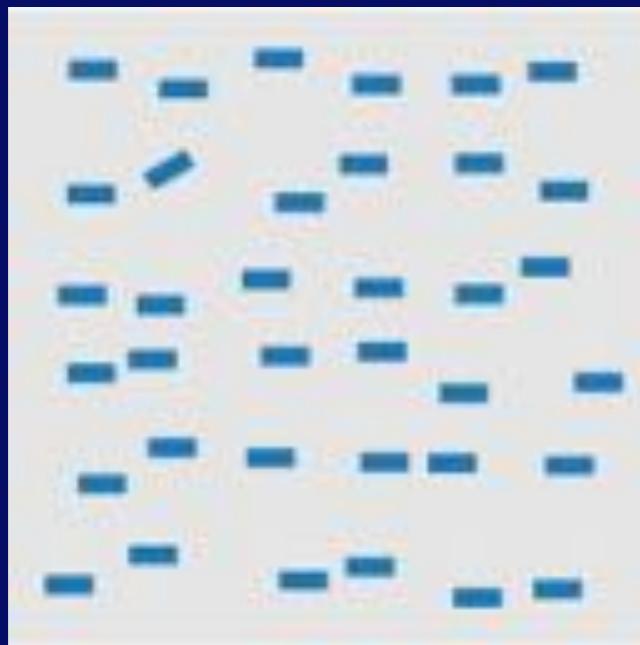
pre-attentive task



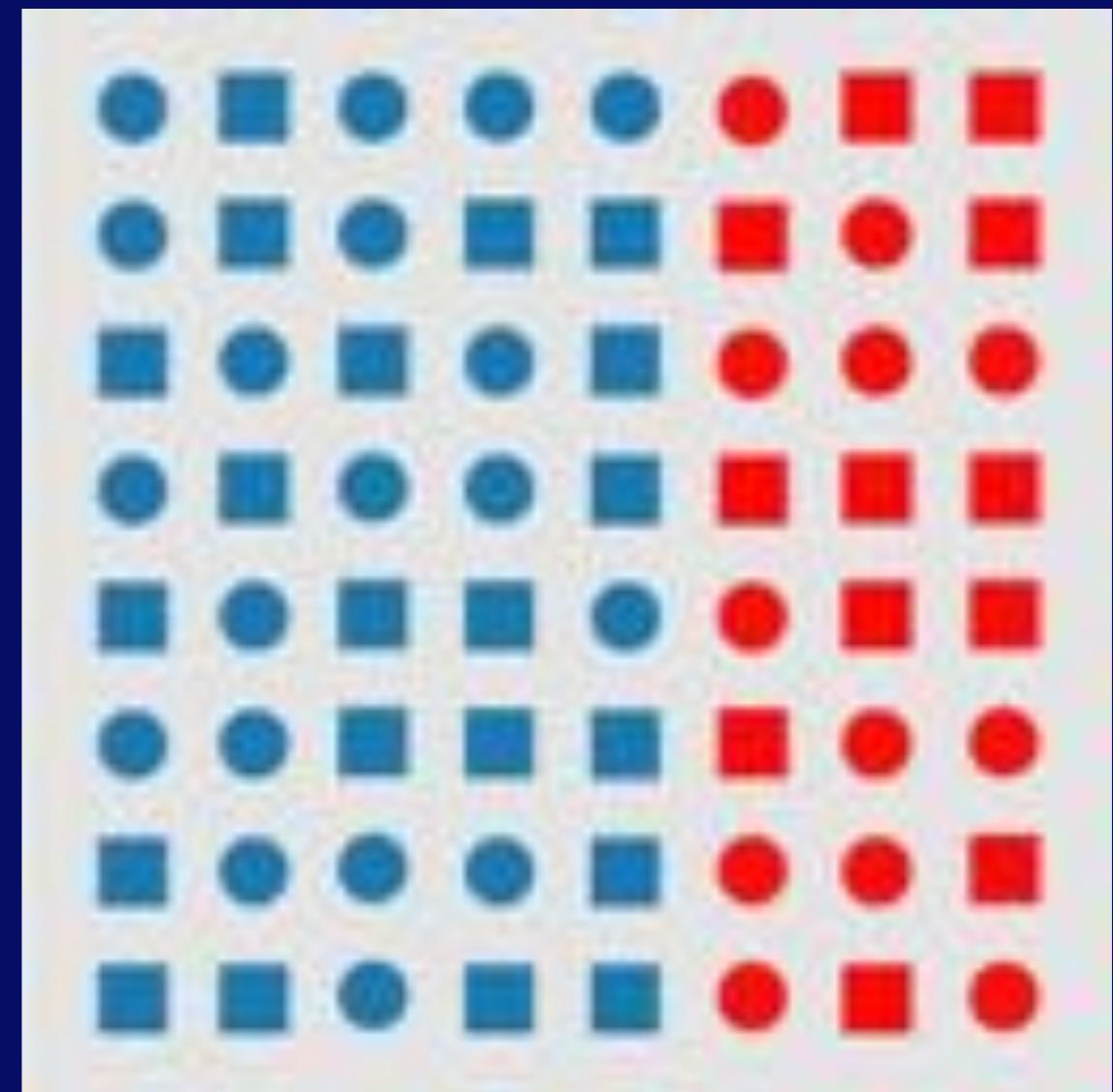
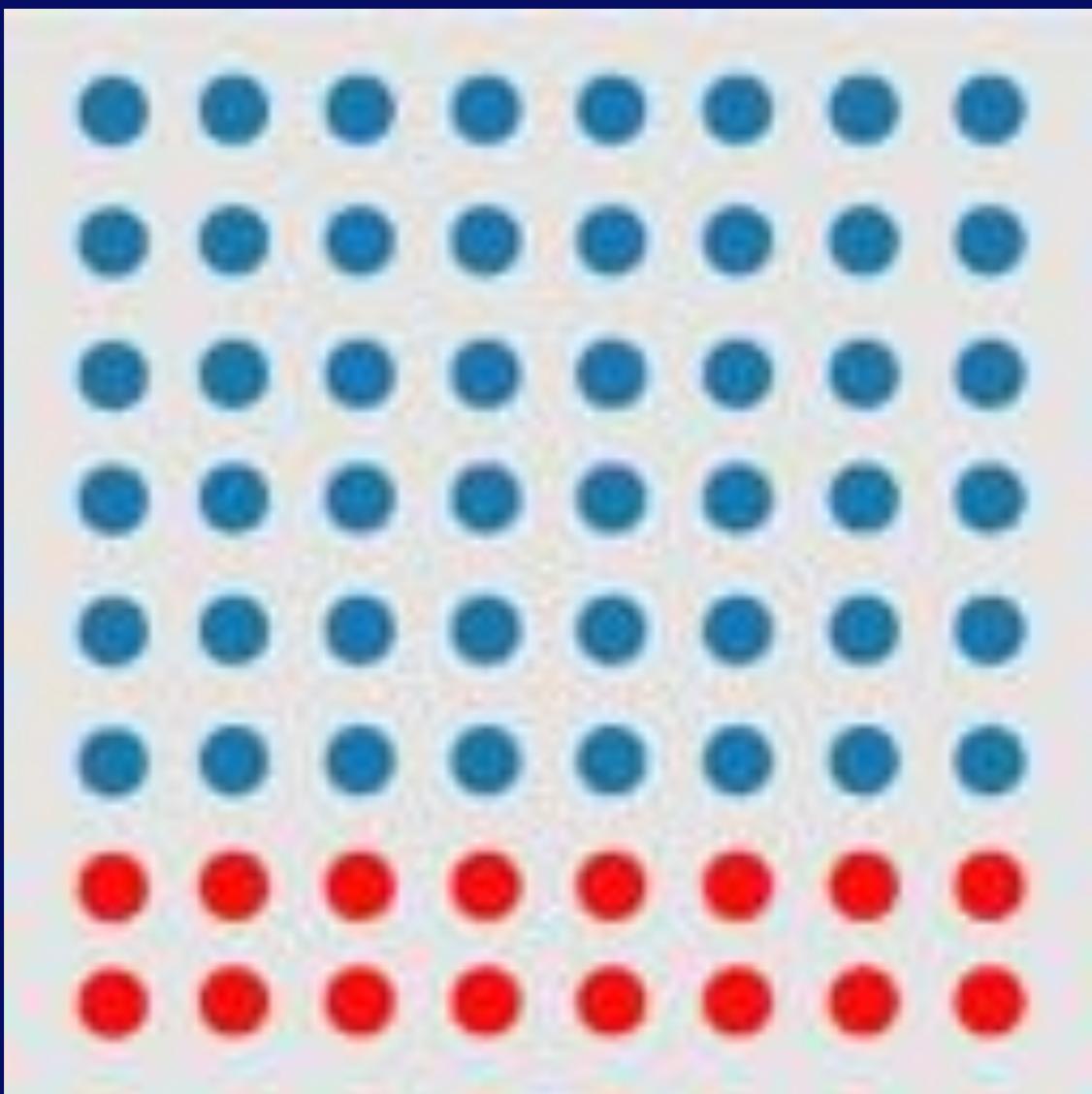
pre-attentive task



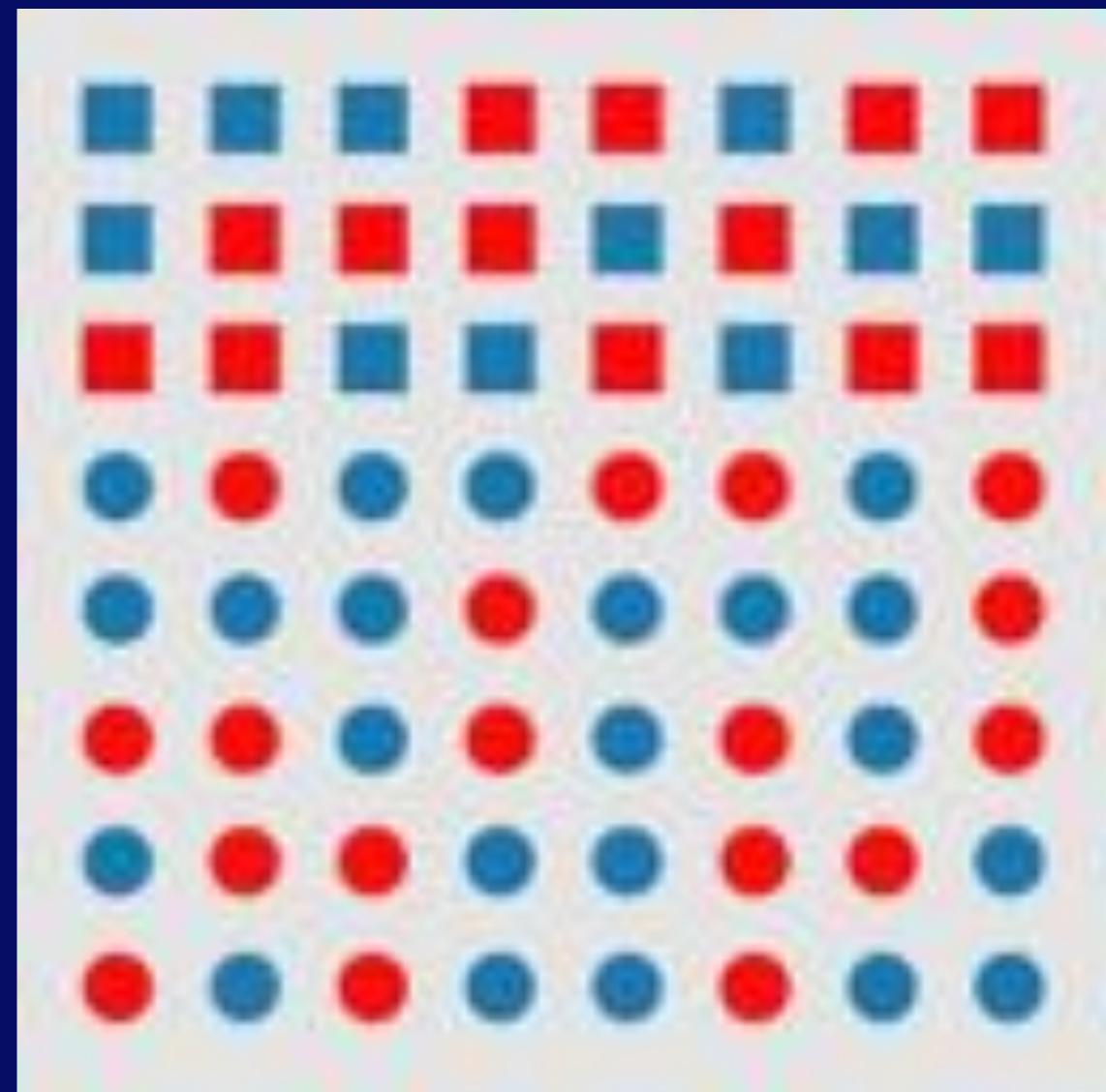
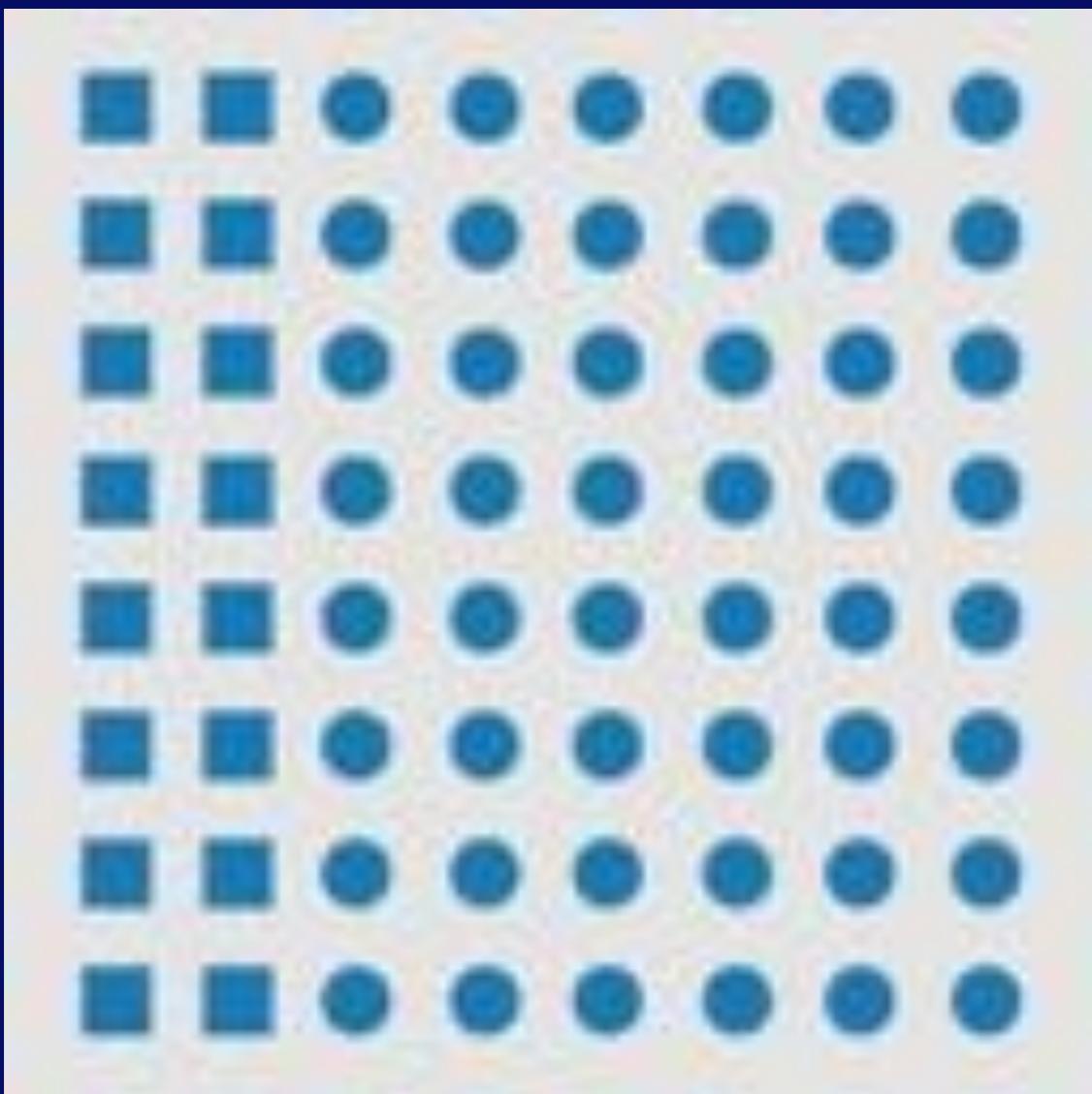
serial search



Feature Hierarchy

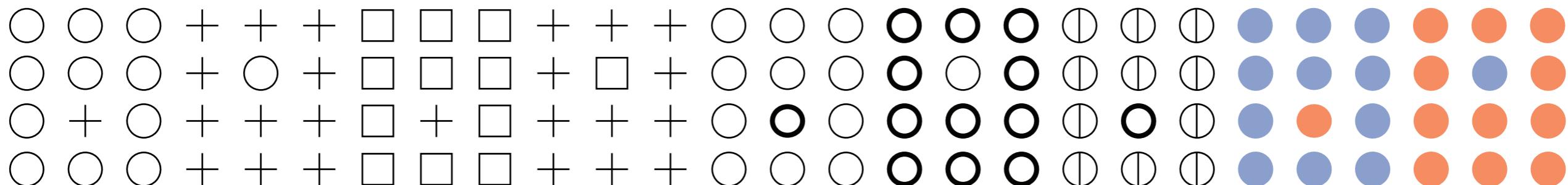


Feature Hierarchy

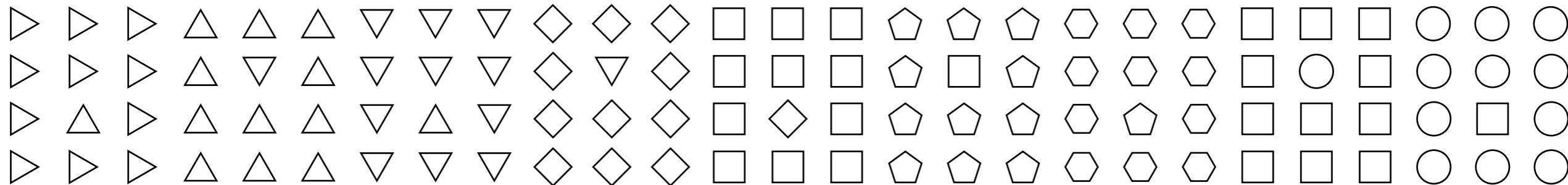


1) Choose strong visual boundaries

Strong visual boundaries

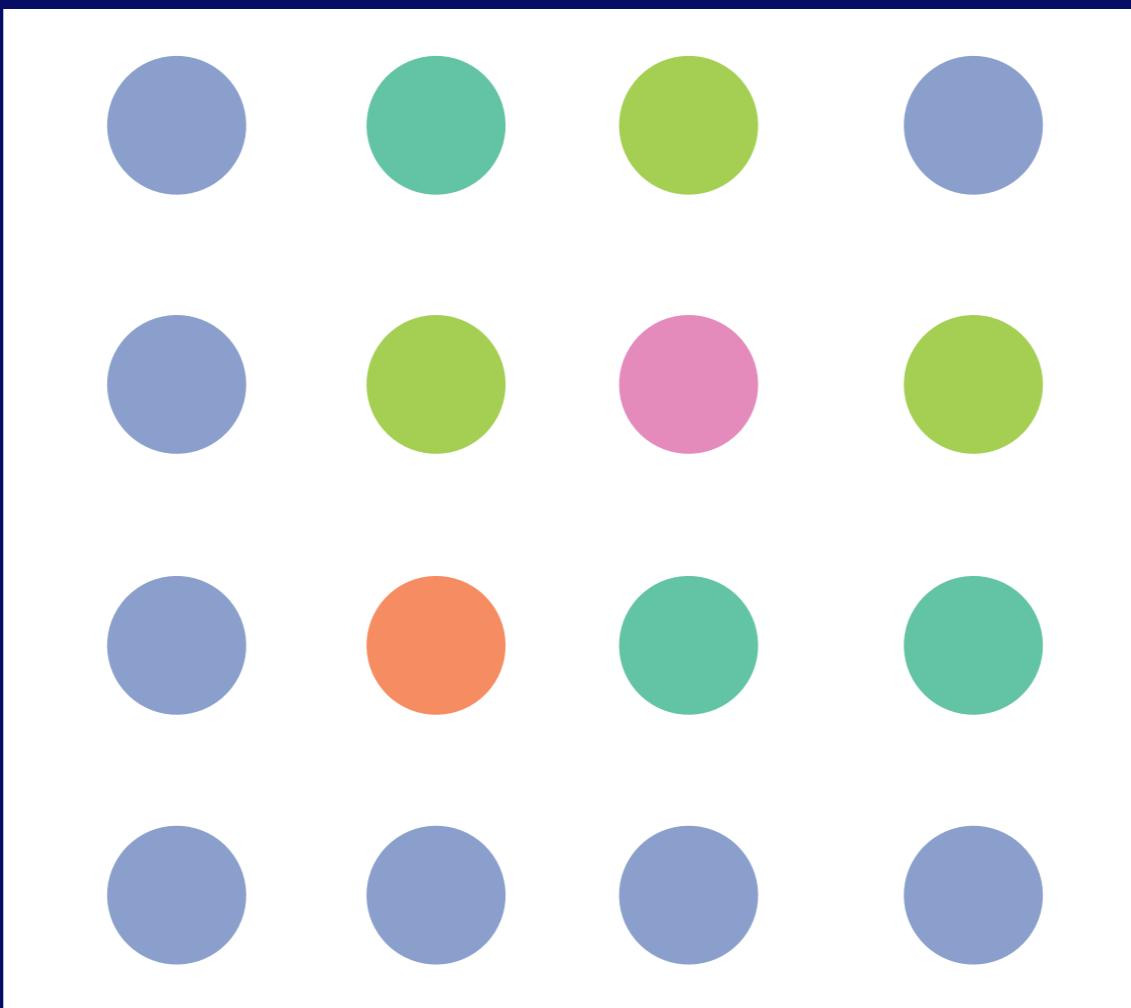


Weak visual boundaries



Krzywinski & Wong, Nature Methods, 2013

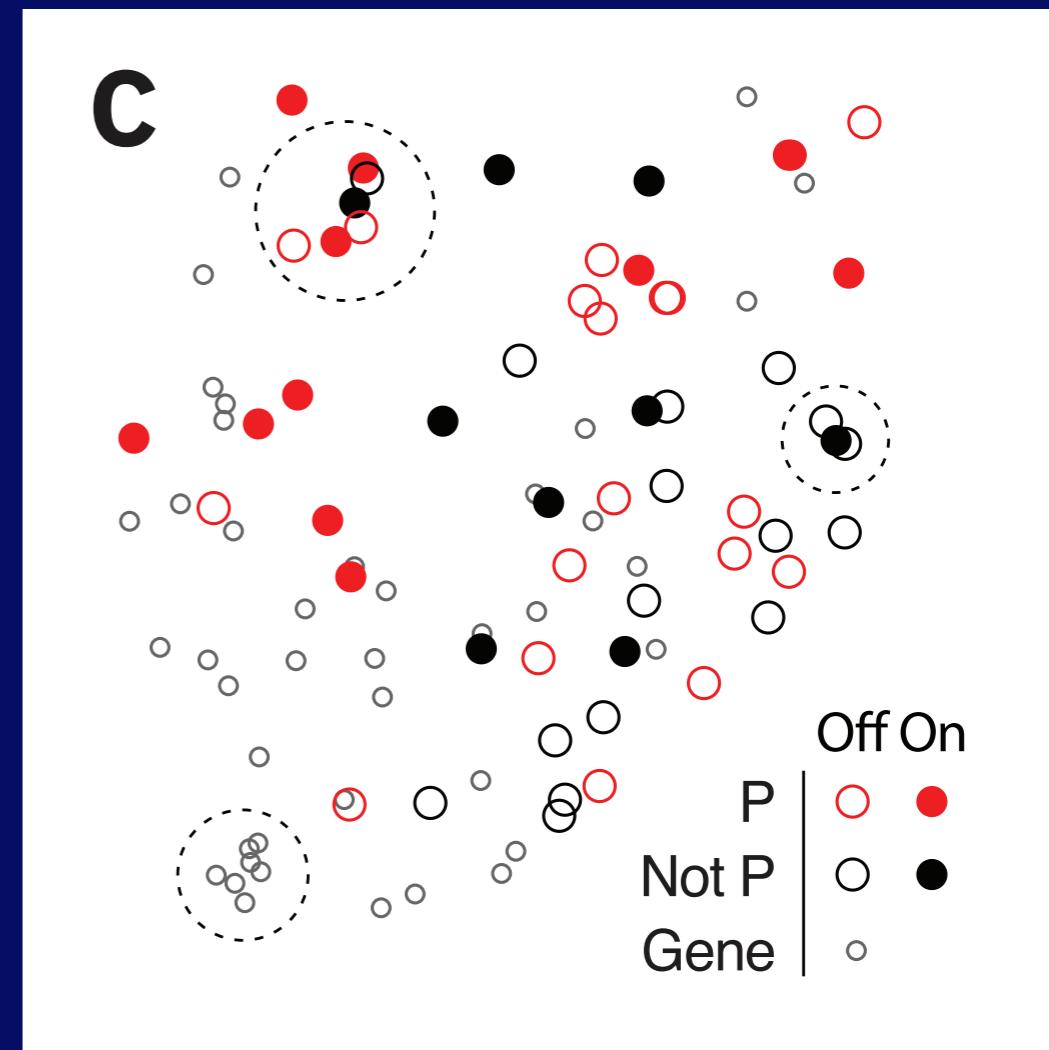
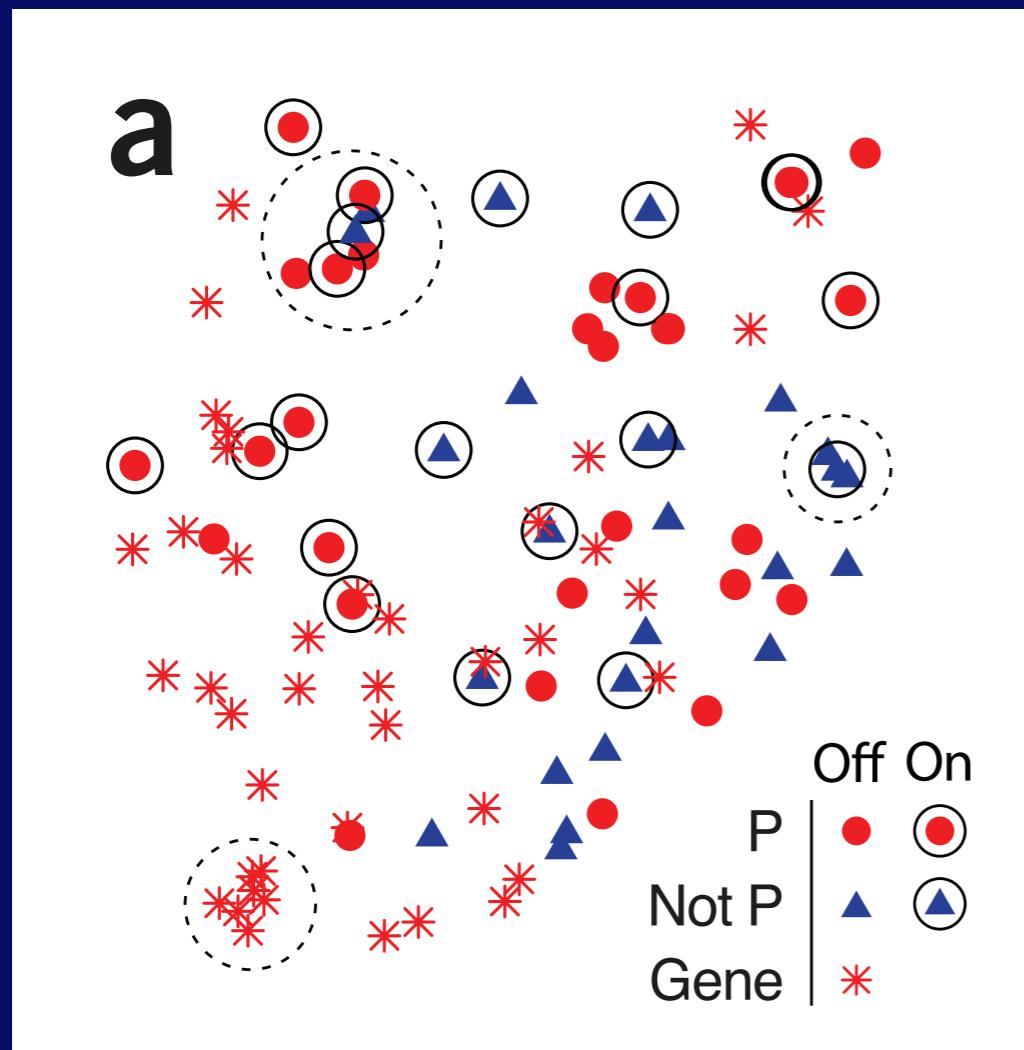
2) Use colour judiciously



Krzywinski & Wong, Nature Methods, 2013

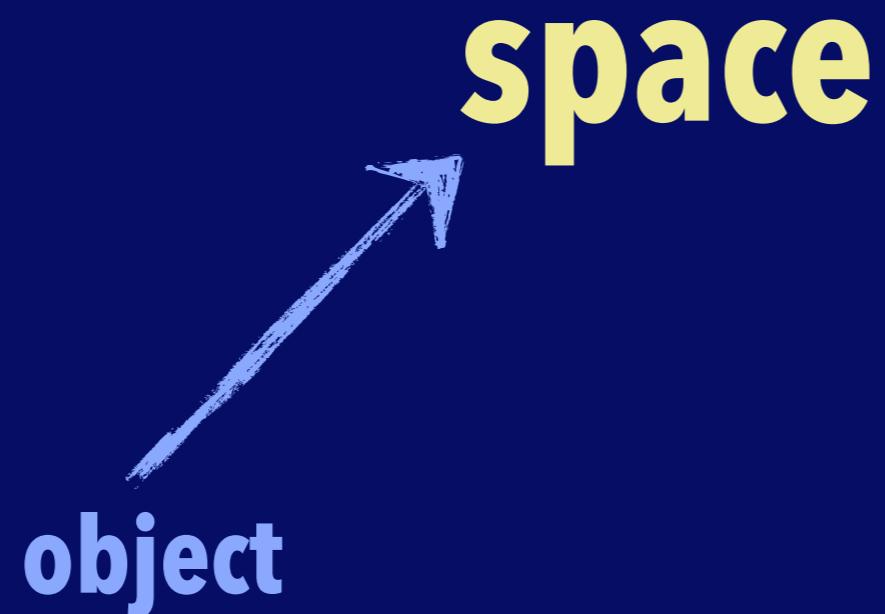
<http://colorbrewer2.org/>

3) Represent data hierarchies



Krzywinski & Wong, Nature Methods, 2013

space

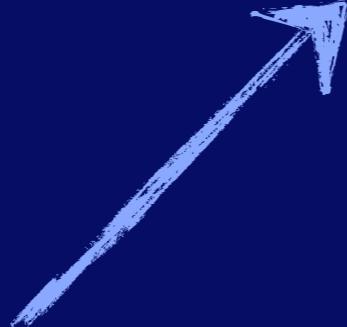


space

object

negative space

space



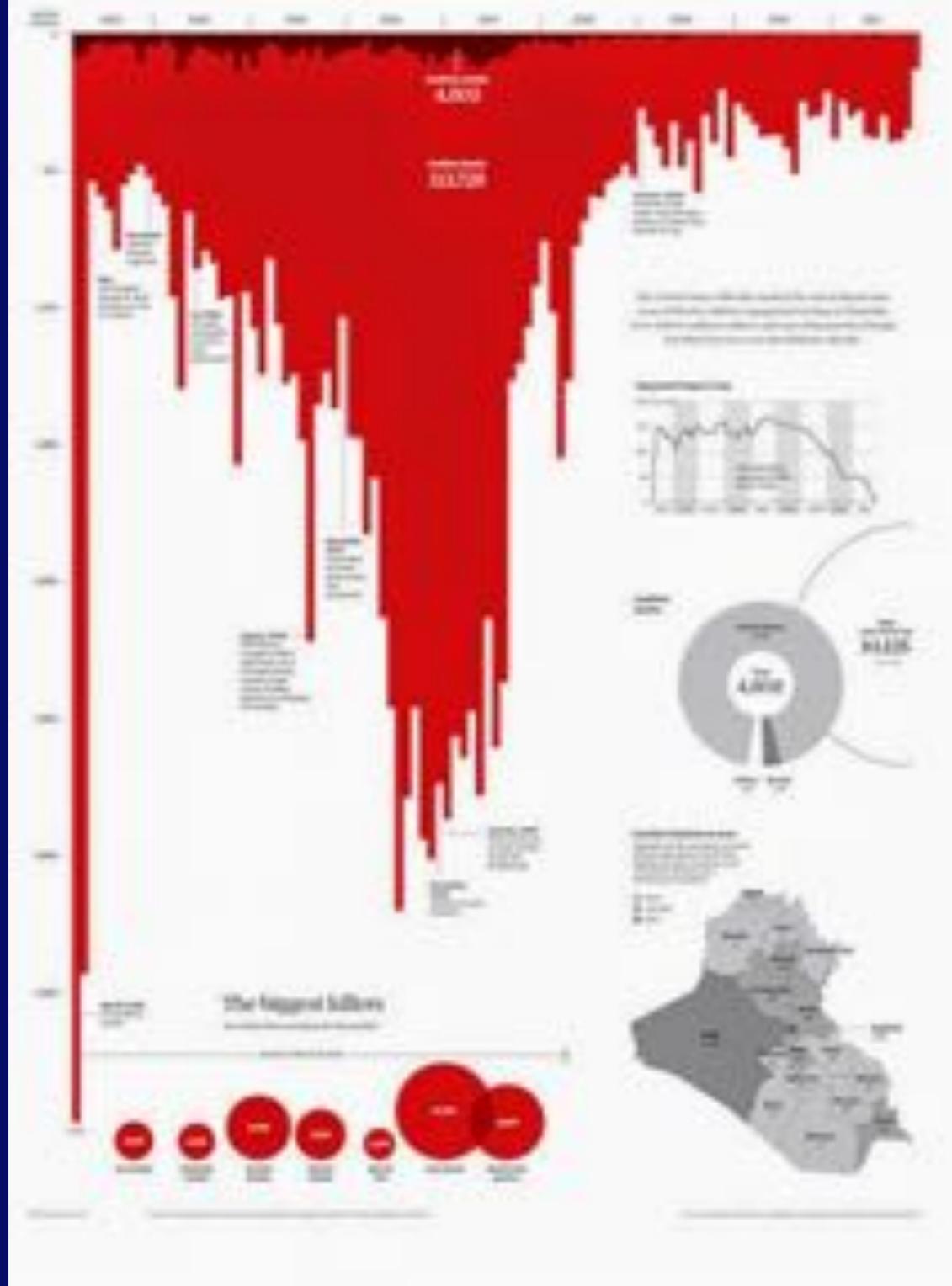
object

figure- ground organization

Credit: Volkswagen/Adam & Eve/DDB London



Iraq's bloody toll

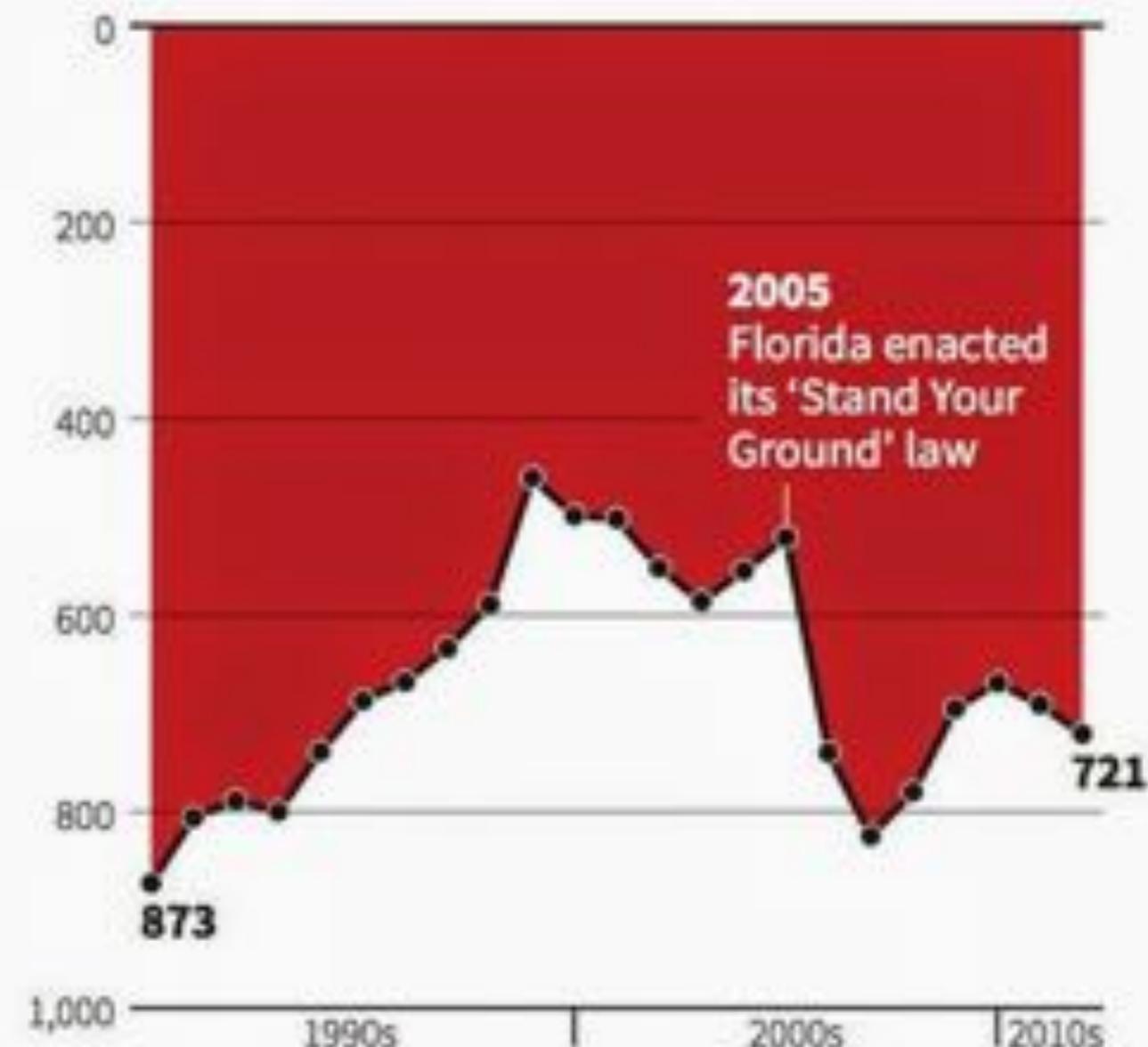


Iraq's bloody toll



Gun deaths in Florida

Number of murders committed using firearms



Source: Florida Department of Law Enforcement

C. Chan 16/02/2014

REUTER

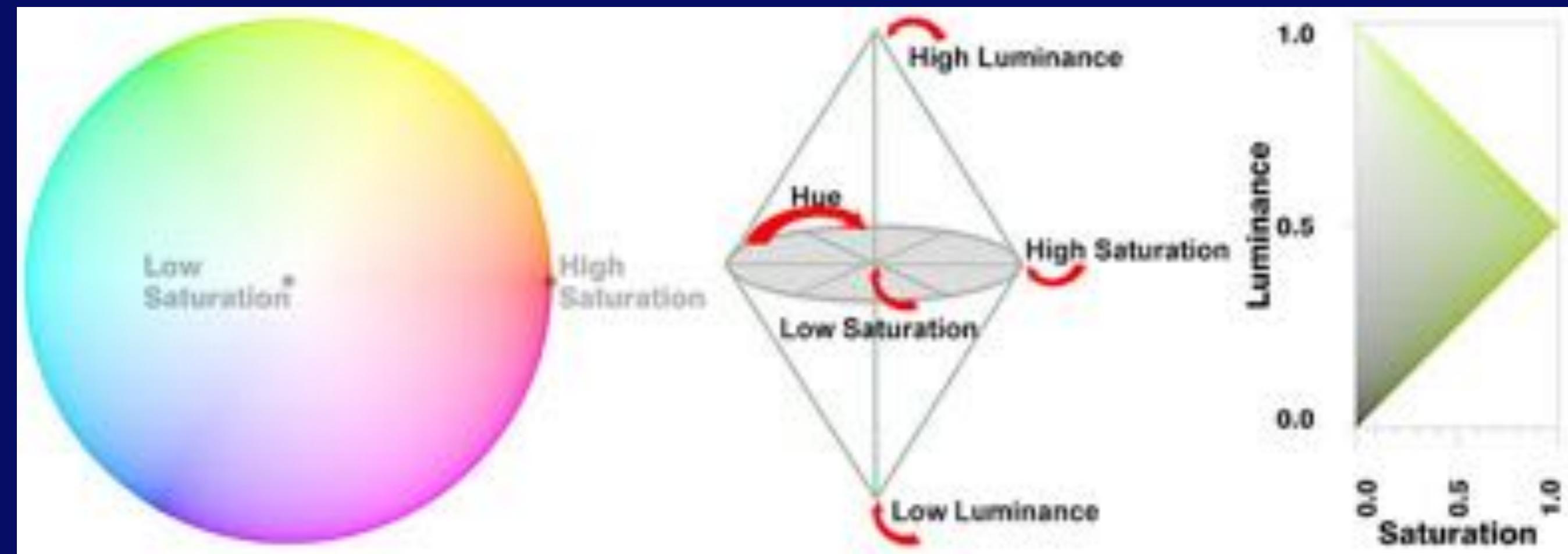
Colour

3 Major Considerations:

- how does it look in colour?
- how does it look for colour blind viewers?
- how does it look in greyscale?

How does it look in colour?

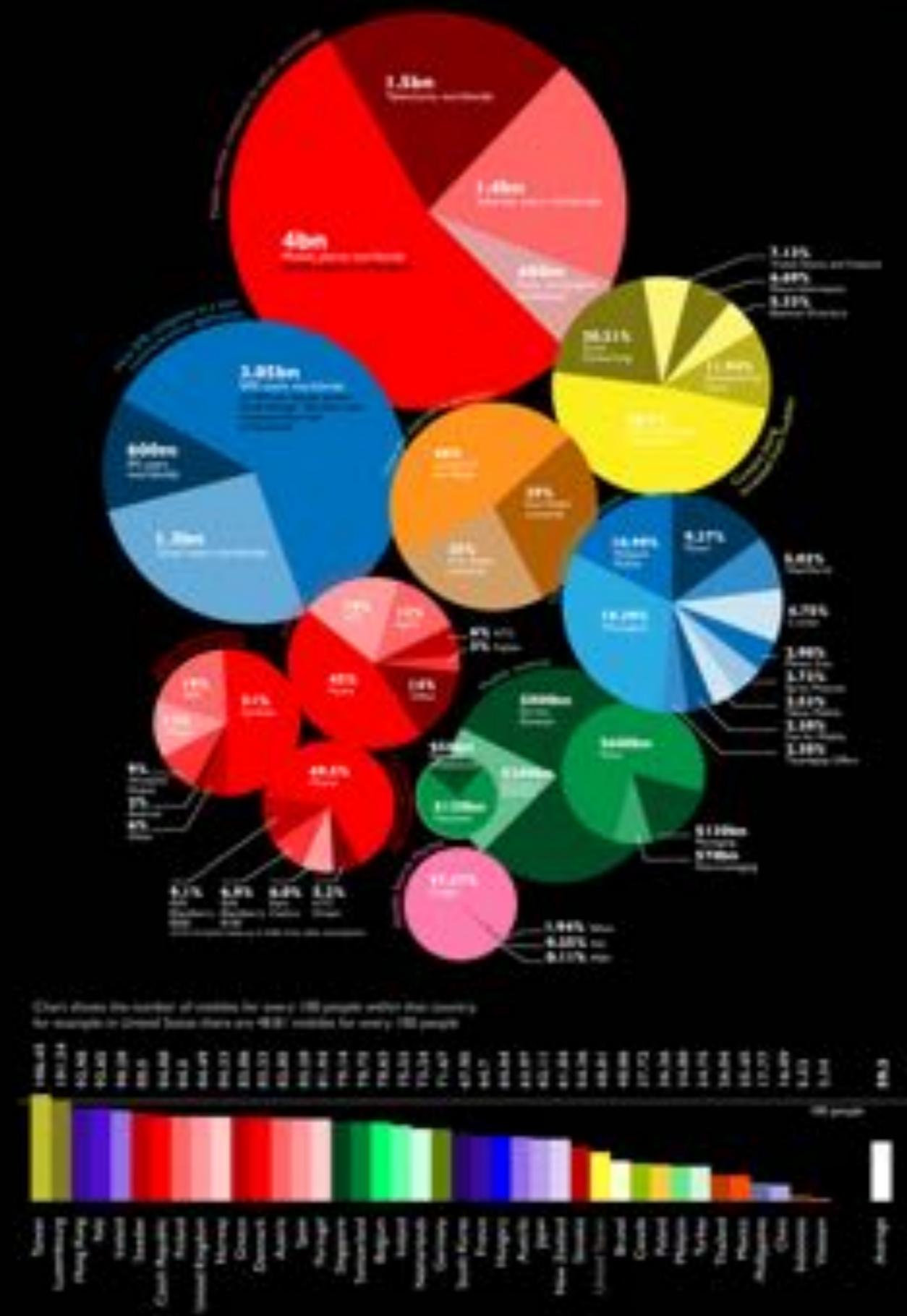
- hue
- luminance
- saturation



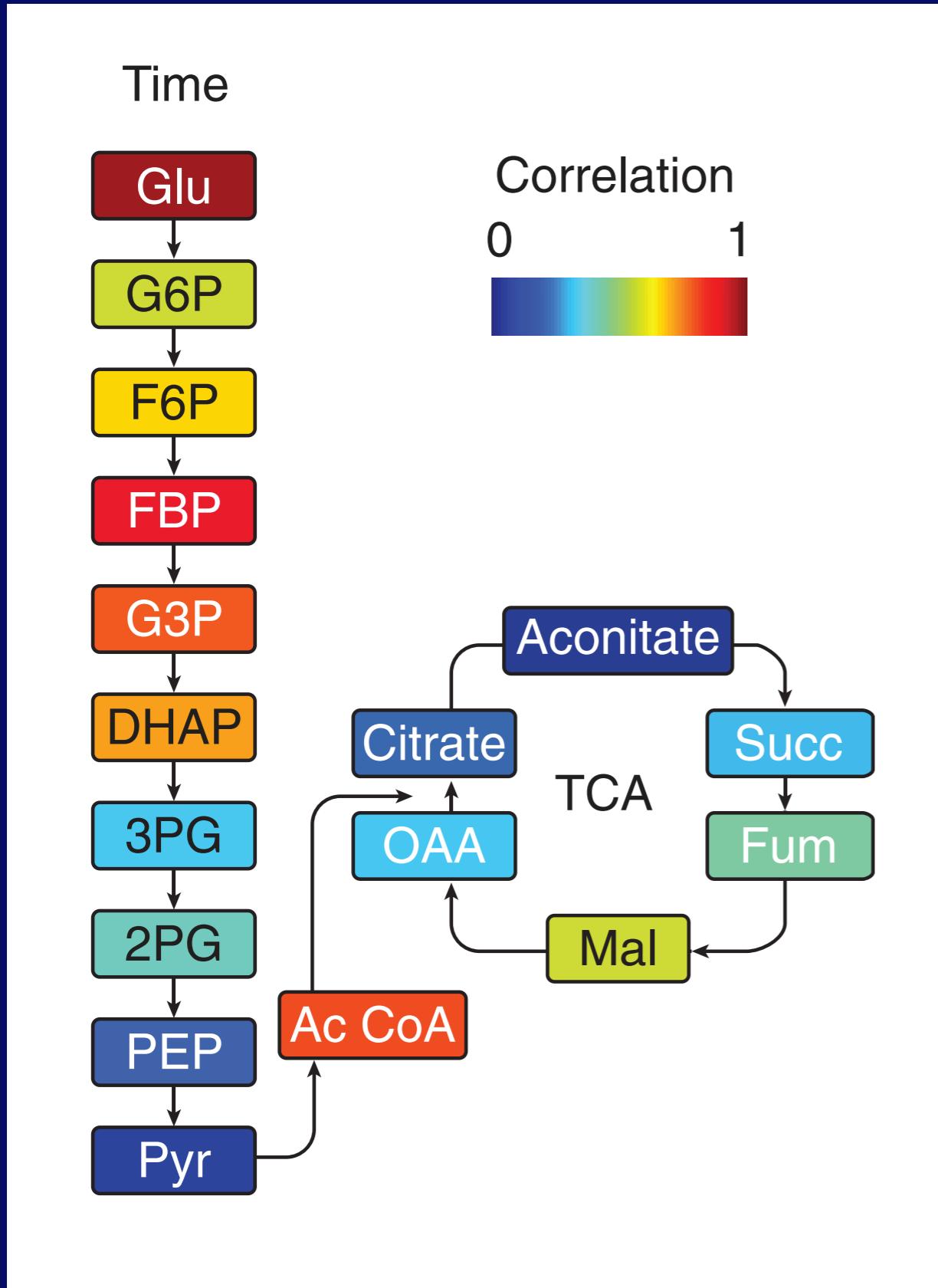
<http://www.research.ibm.com/people/l/lloyd/color/color.HTM>

How does it look in colour?

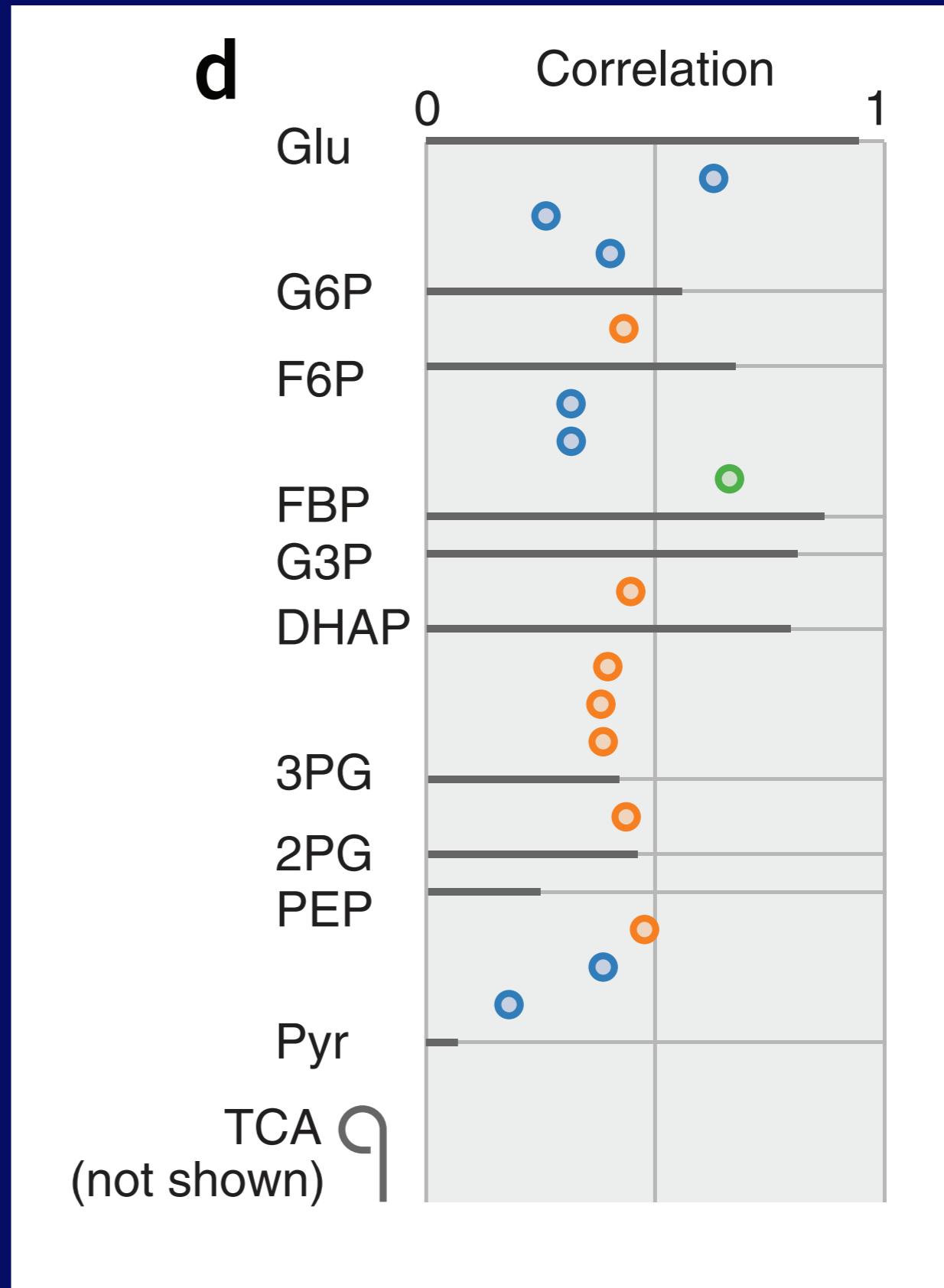
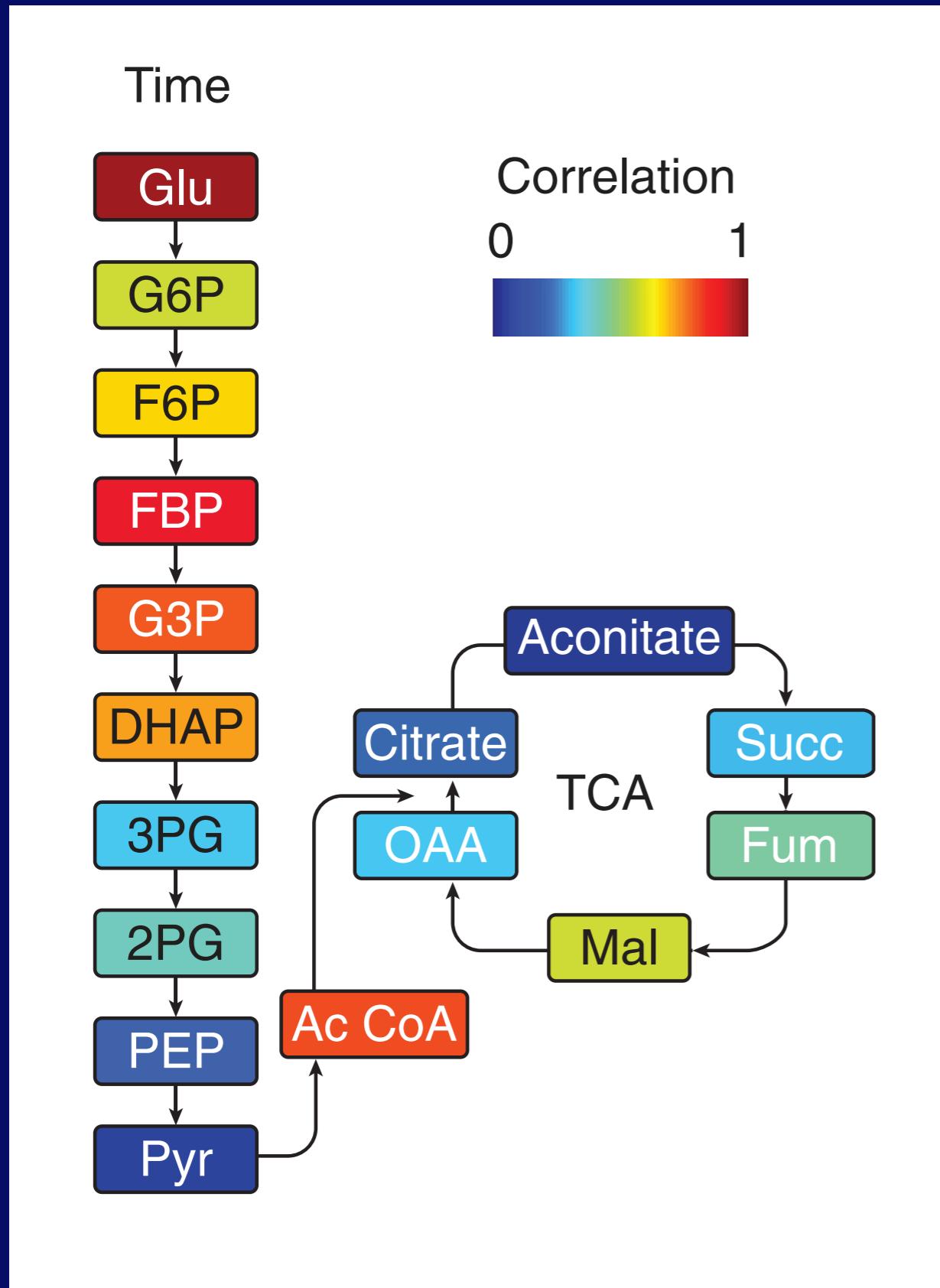




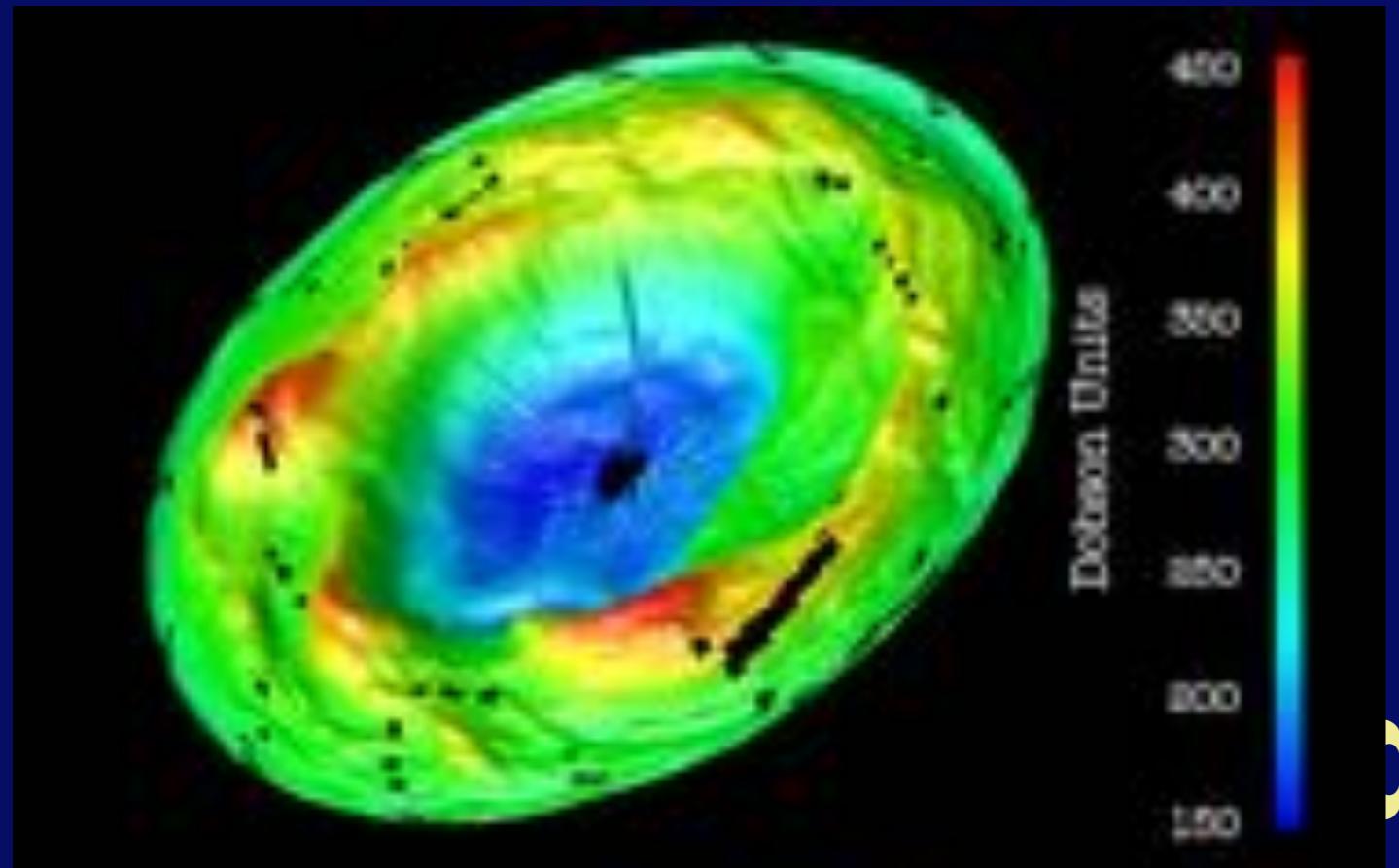
How does it look in colour?



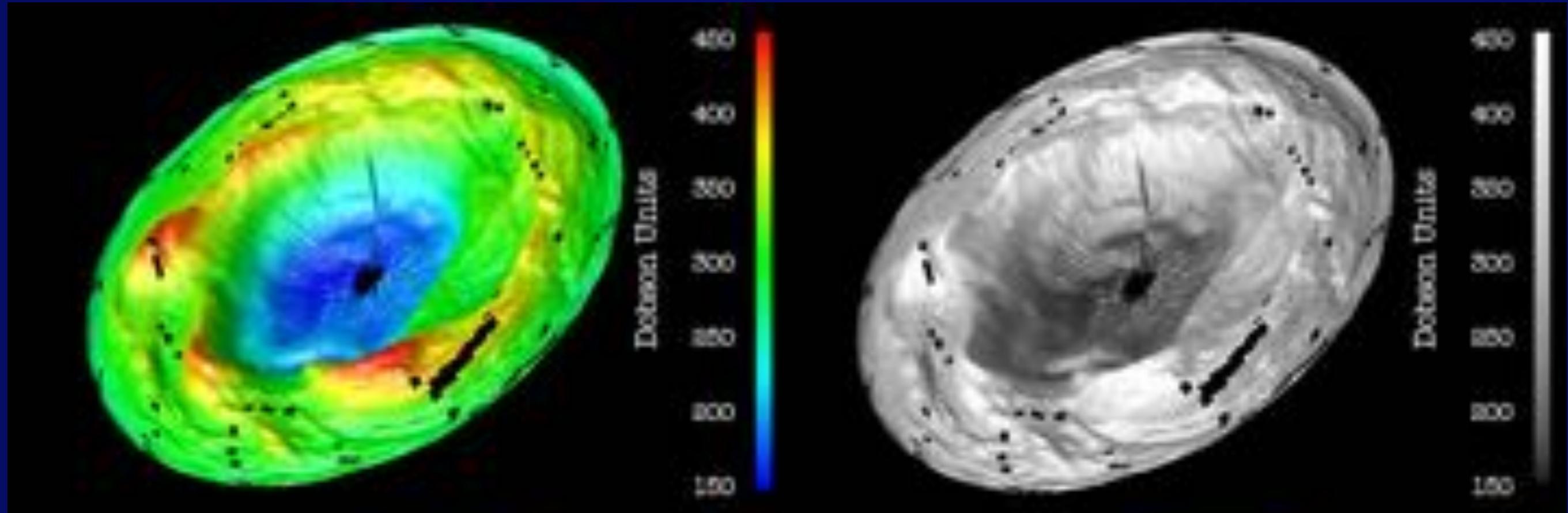
How does it look in colour?



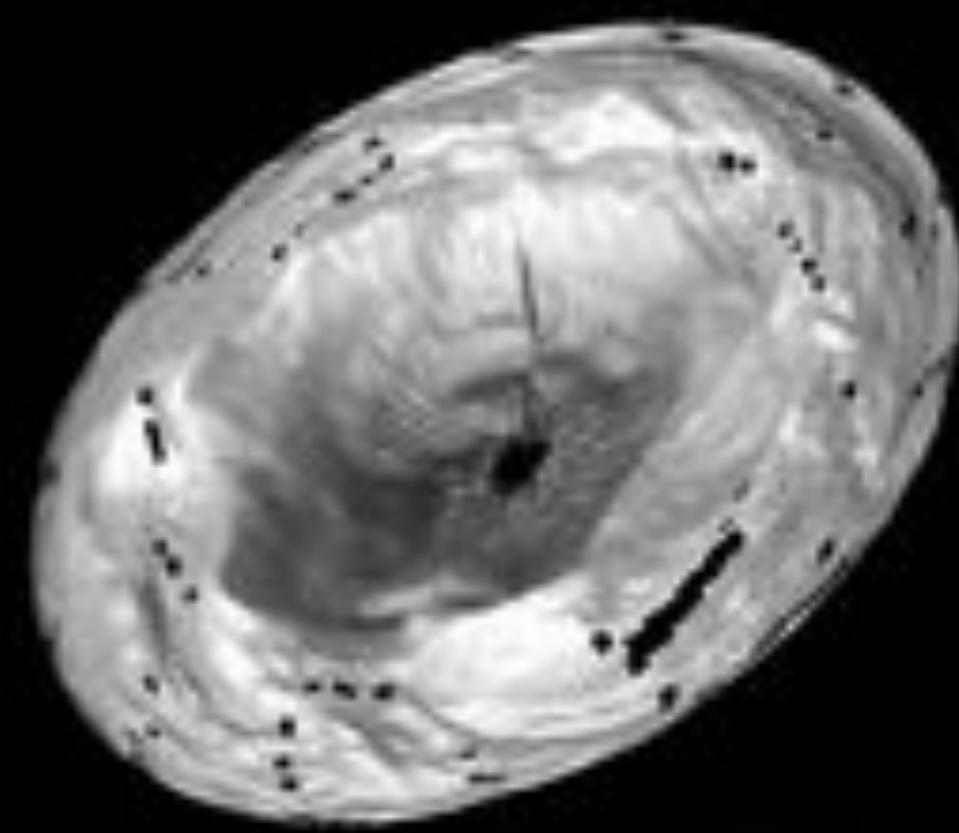
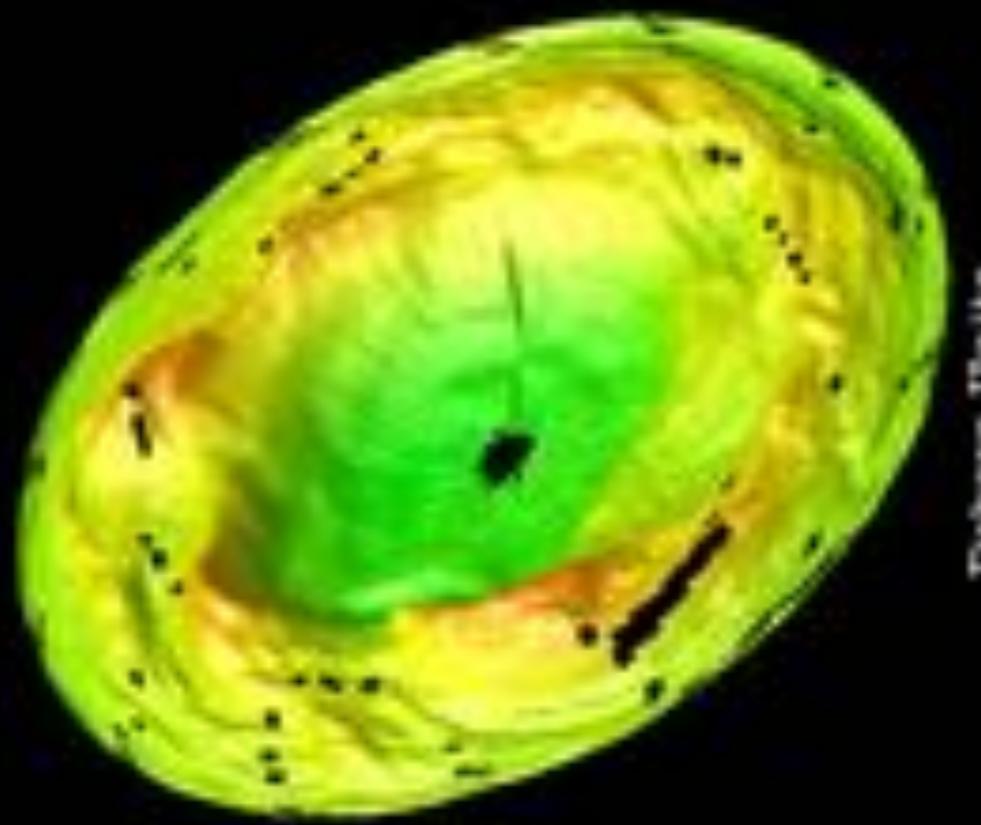
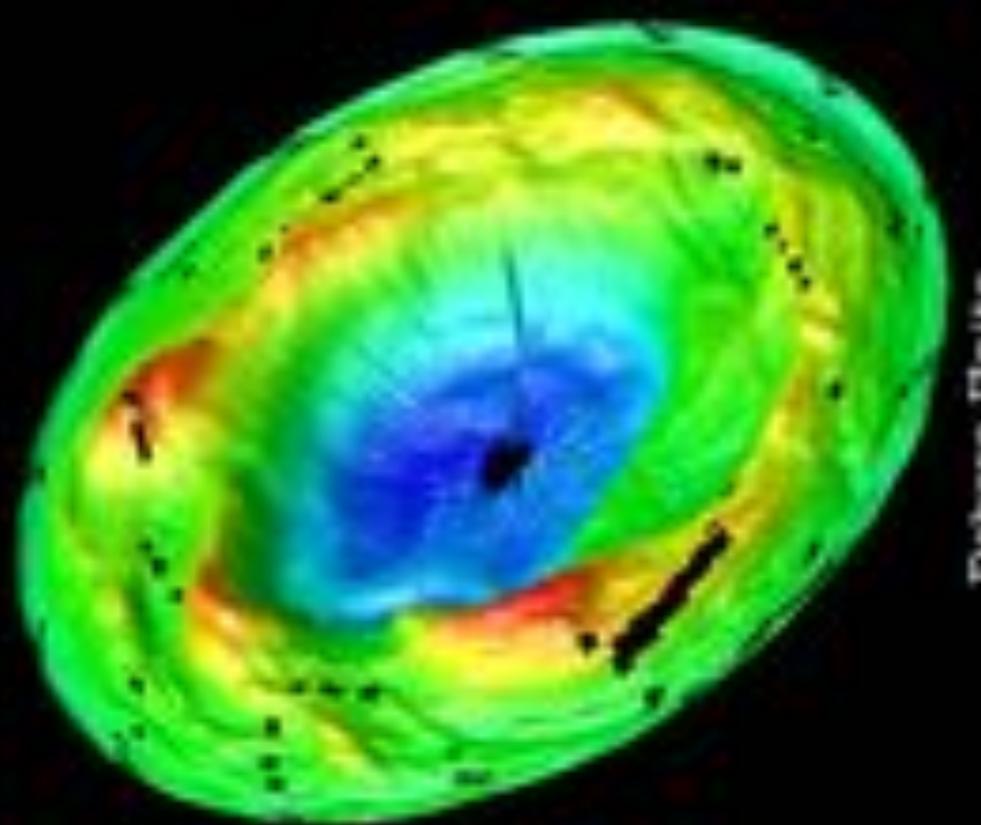
**Hue is not a good dimension for
encoding magnitude data!**



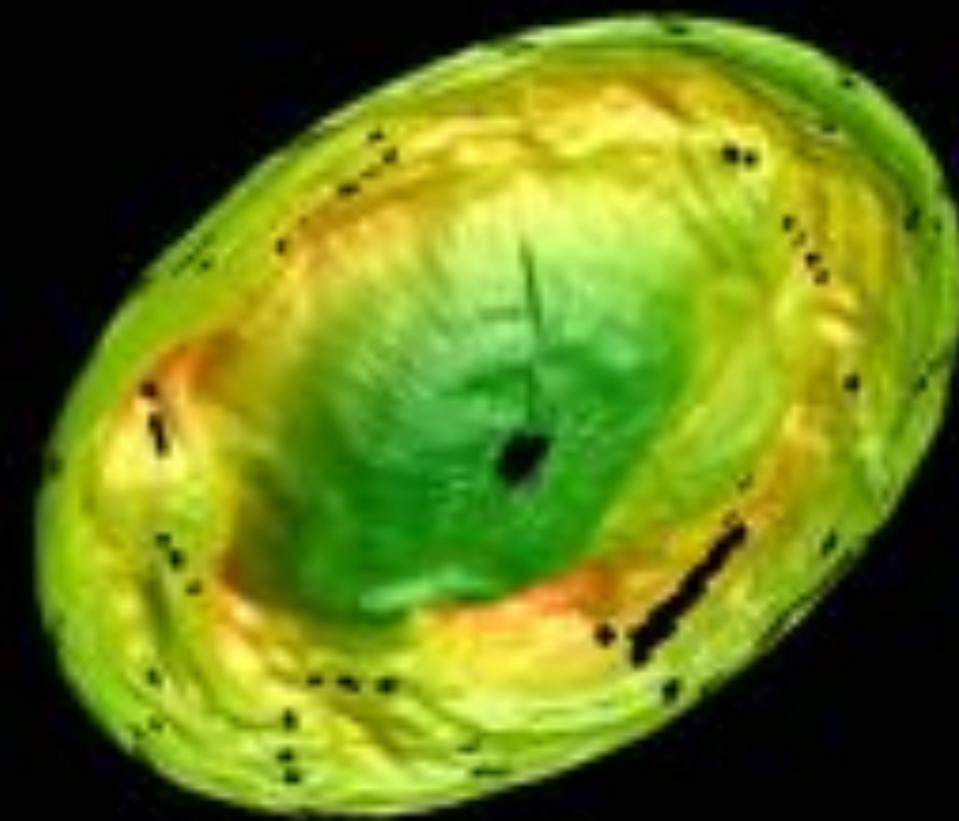
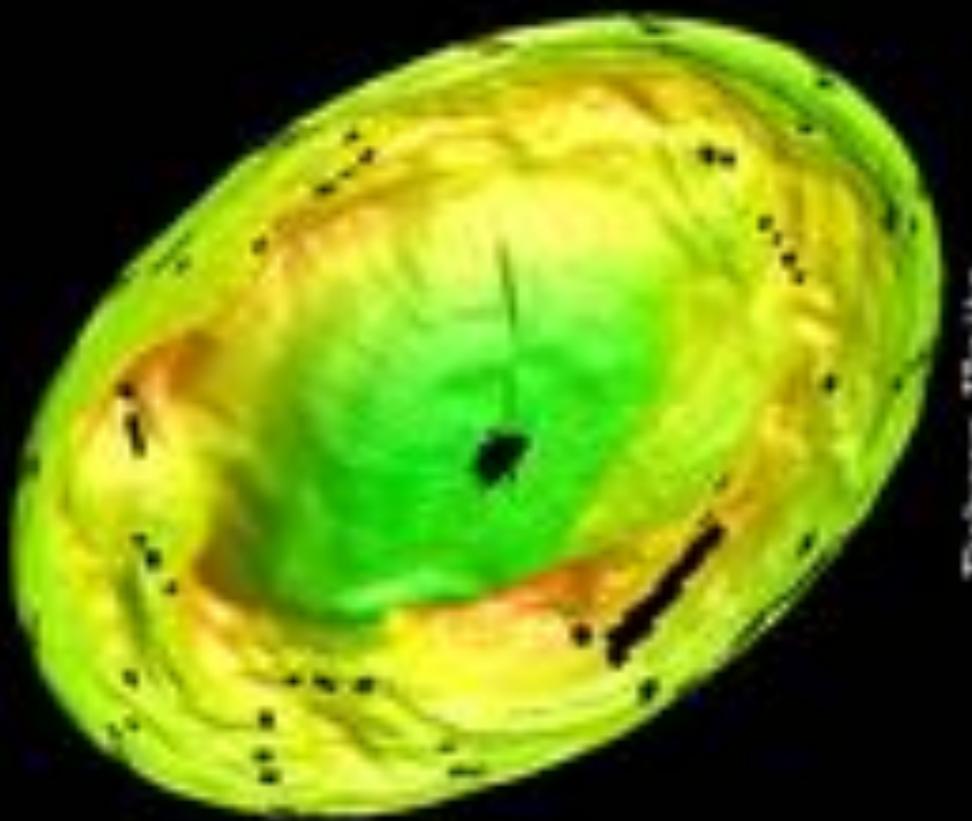
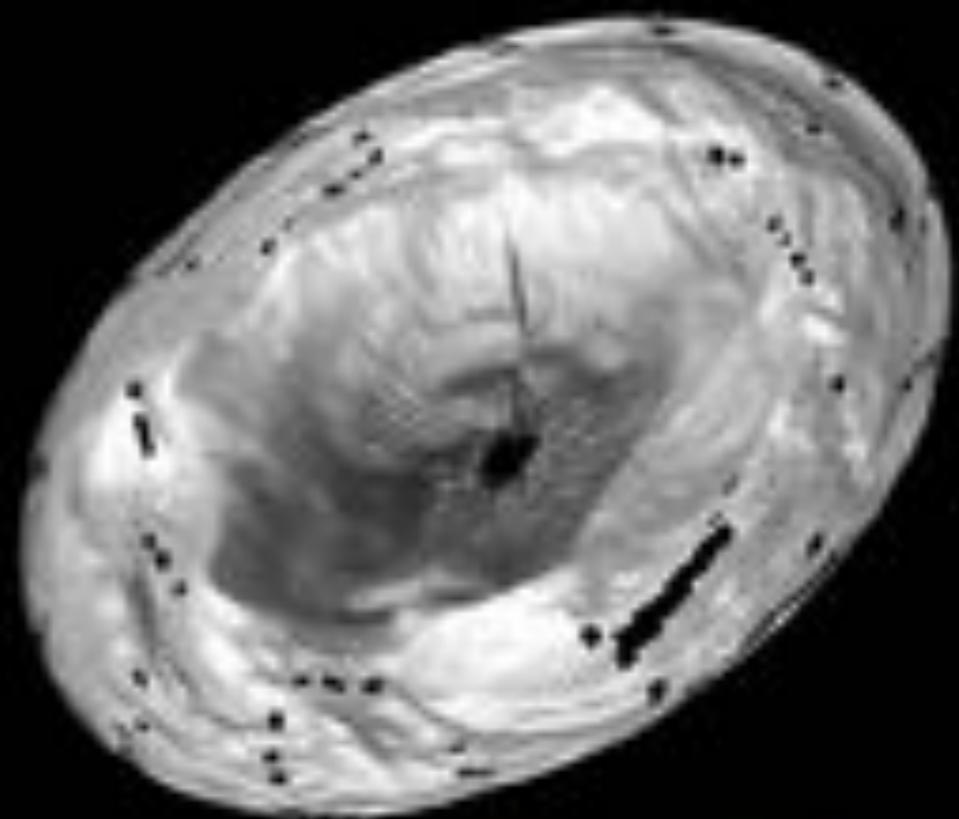
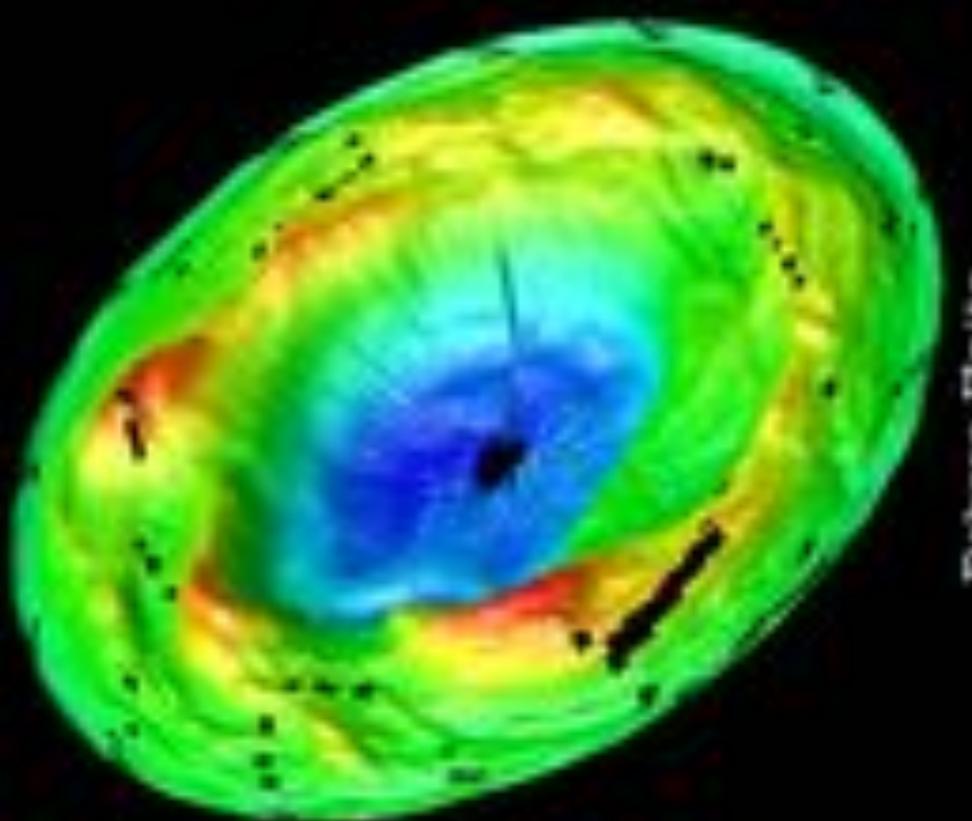
3d dimension for
encoding magnitude data!

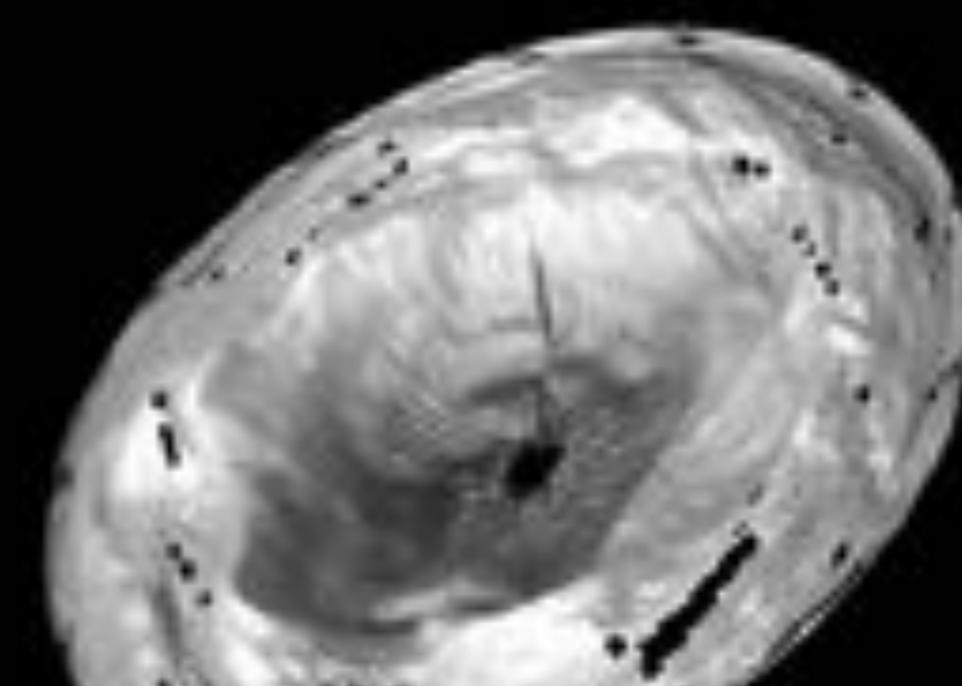
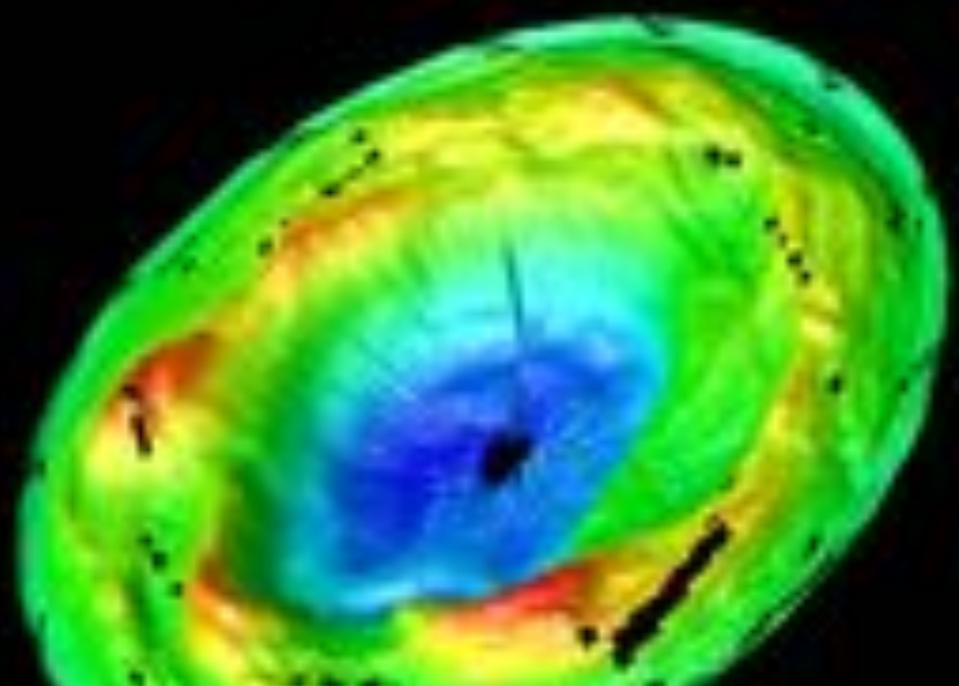


encoding magnitude data!

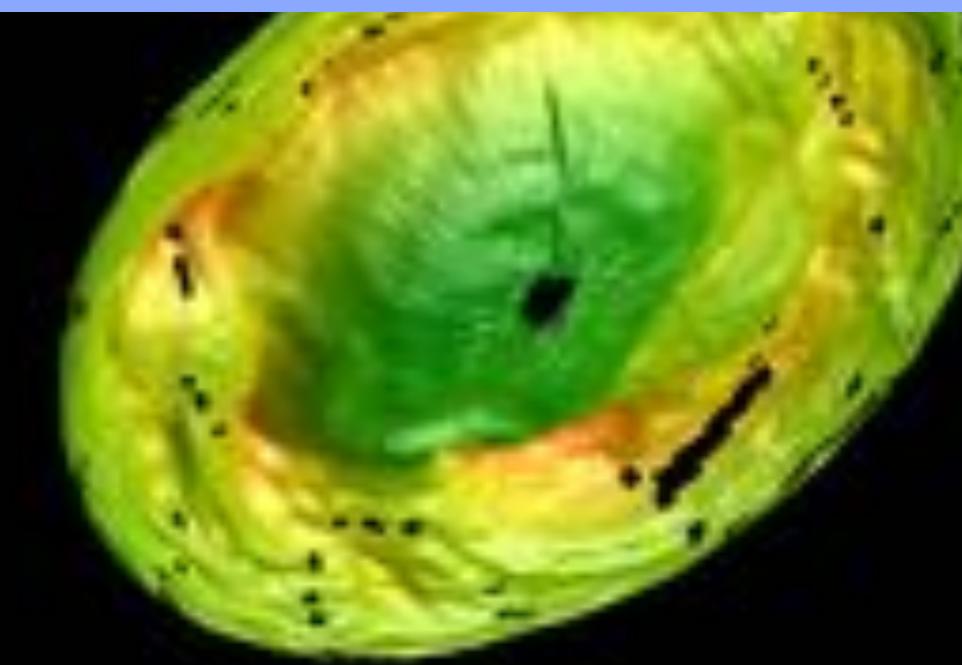
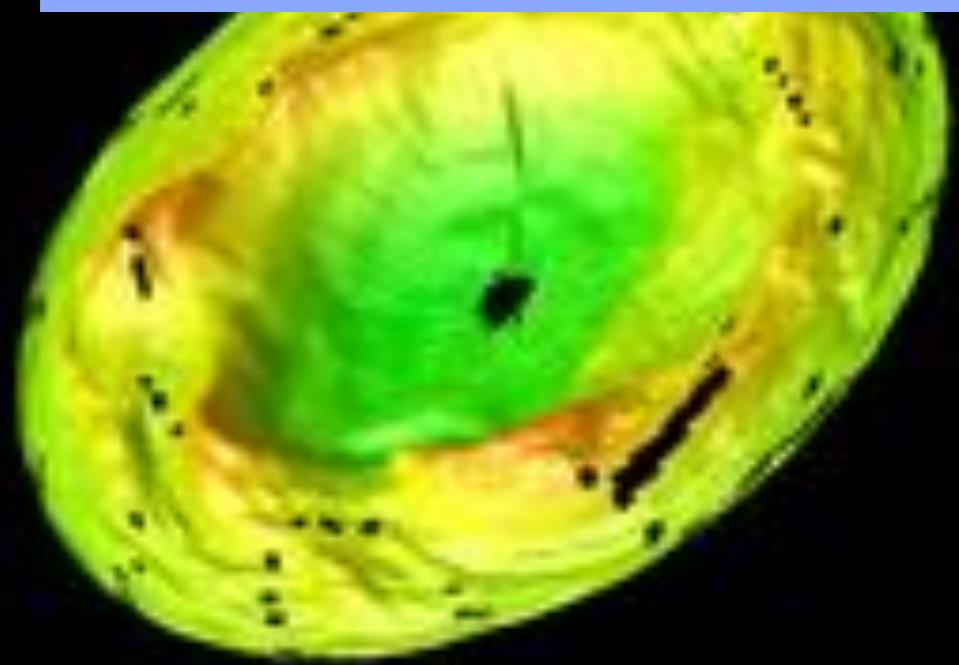


Latitude data!

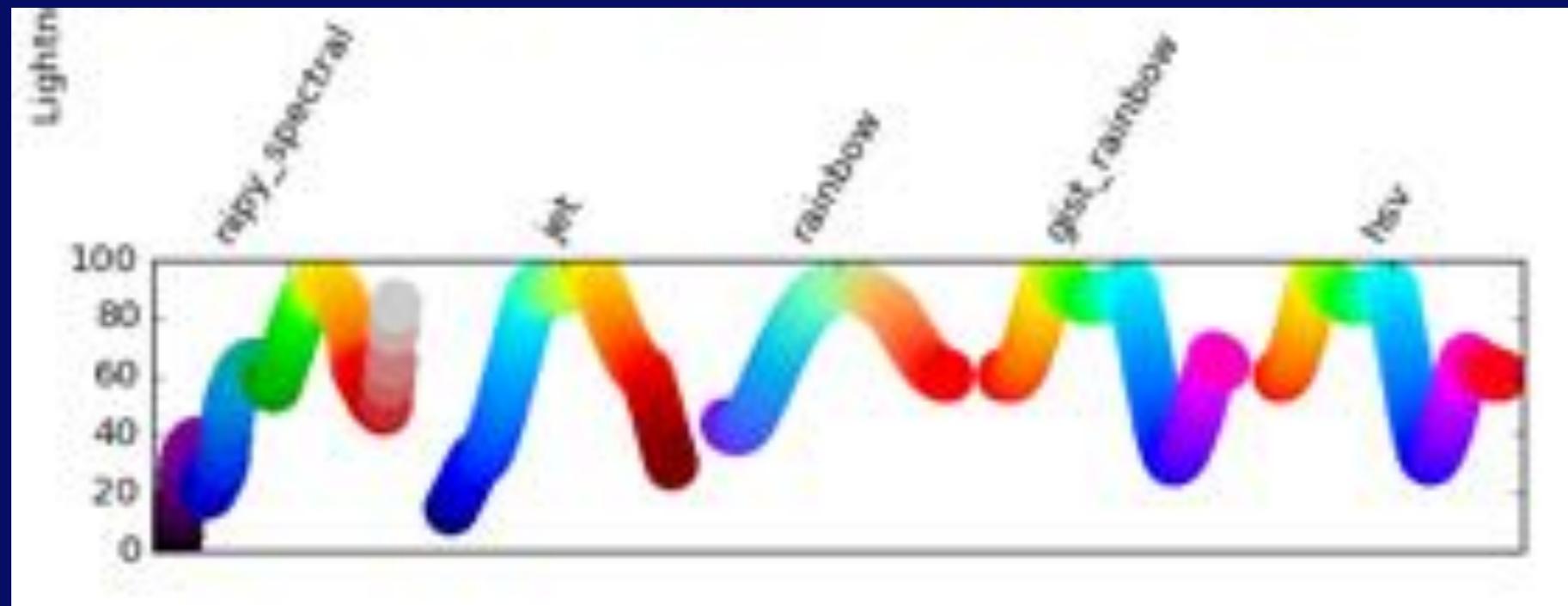
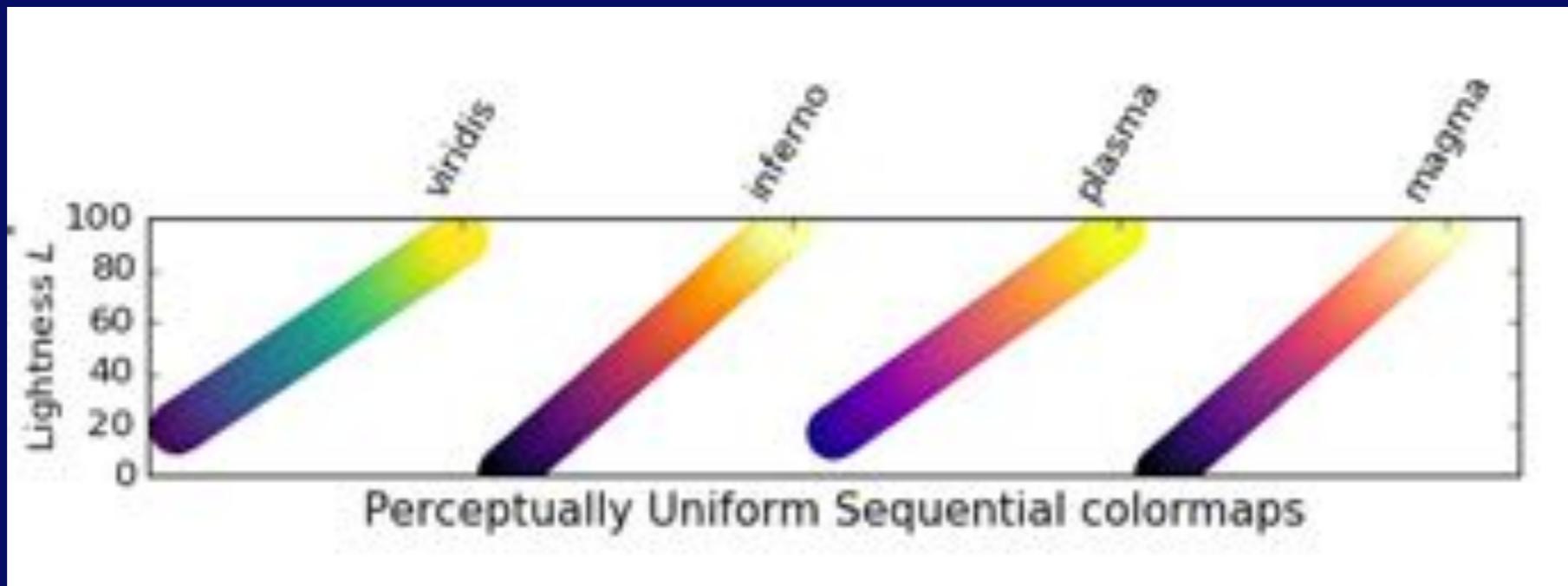




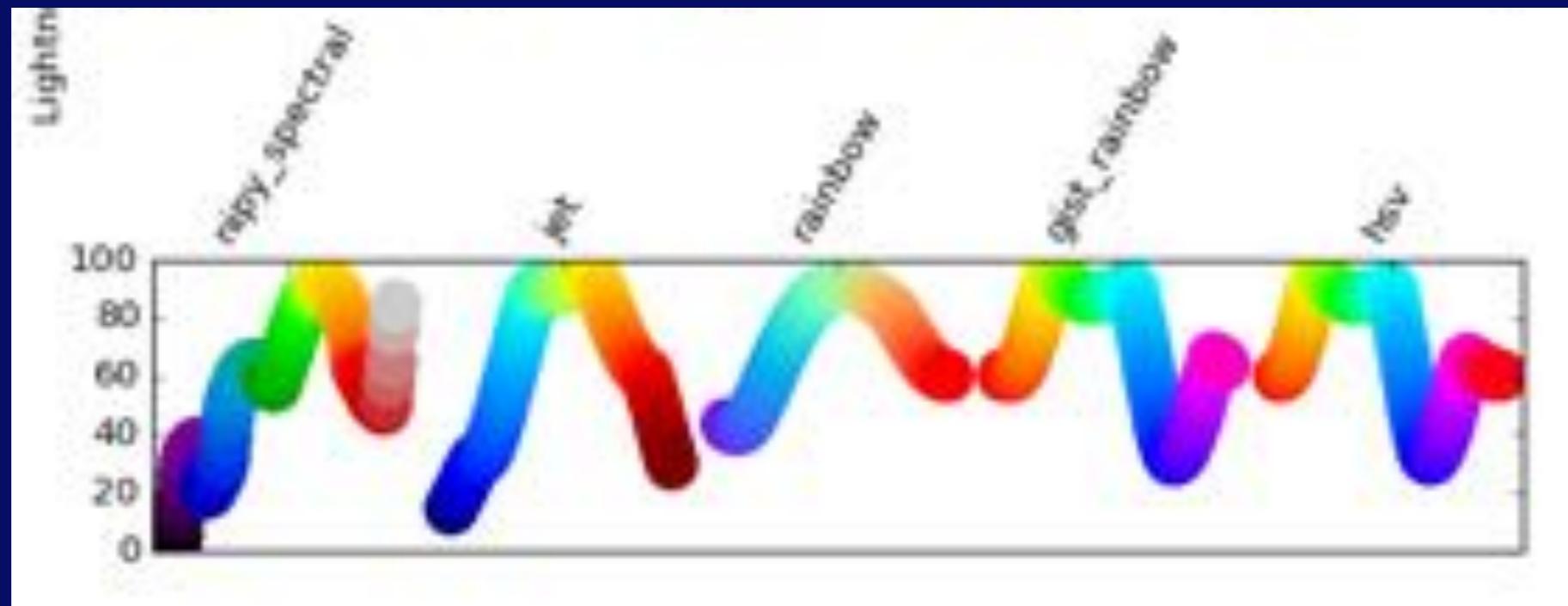
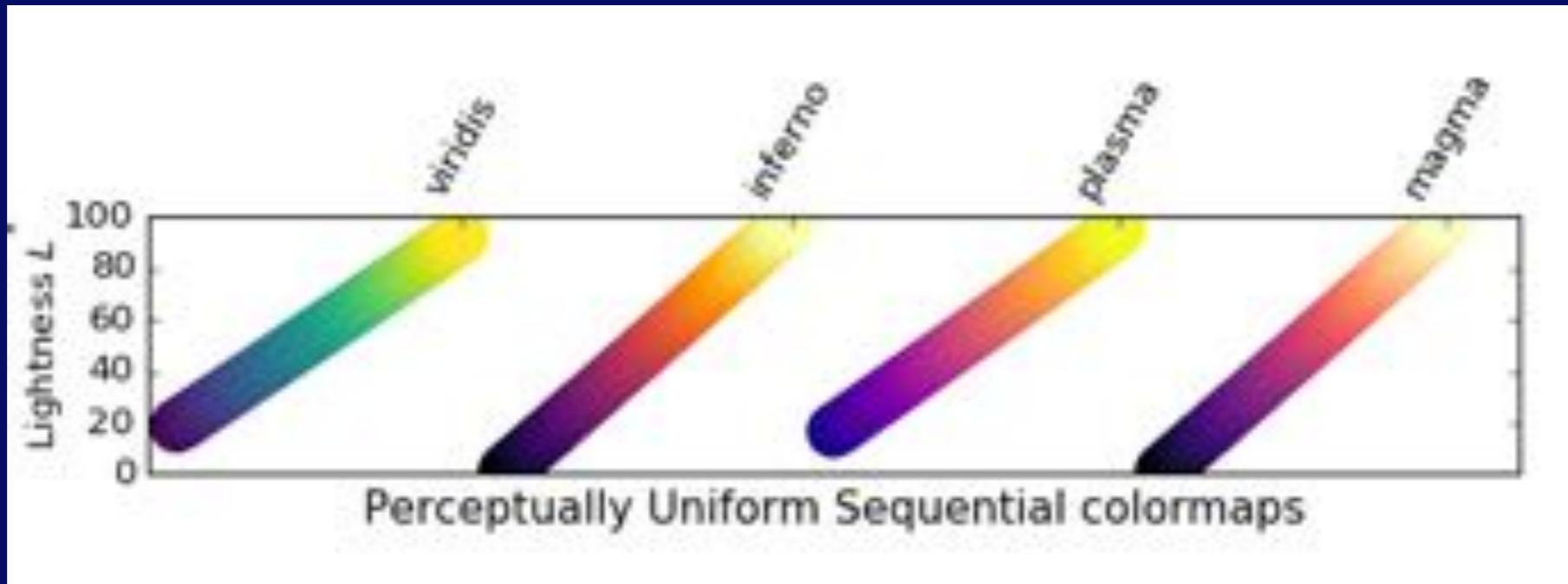
**luminance → high spatial frequency data
saturation → low spatial frequency data**



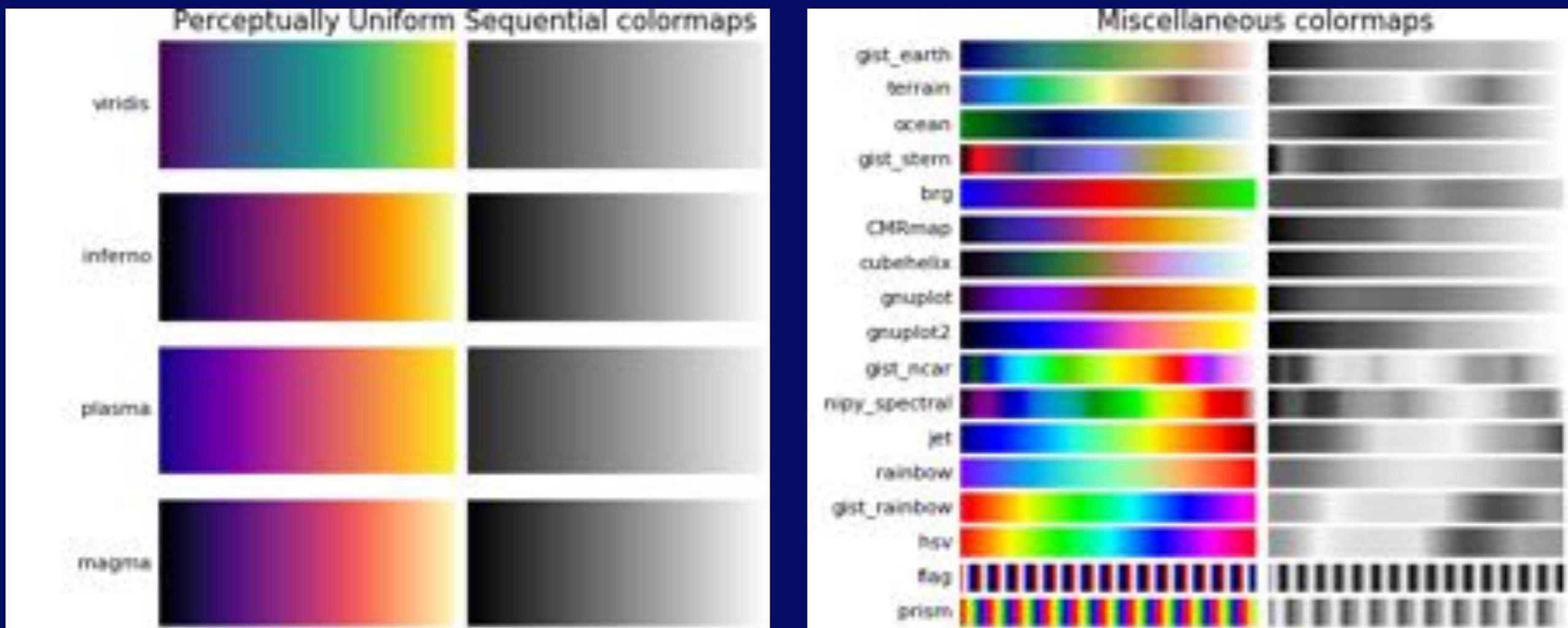
How does it look in grayscale?



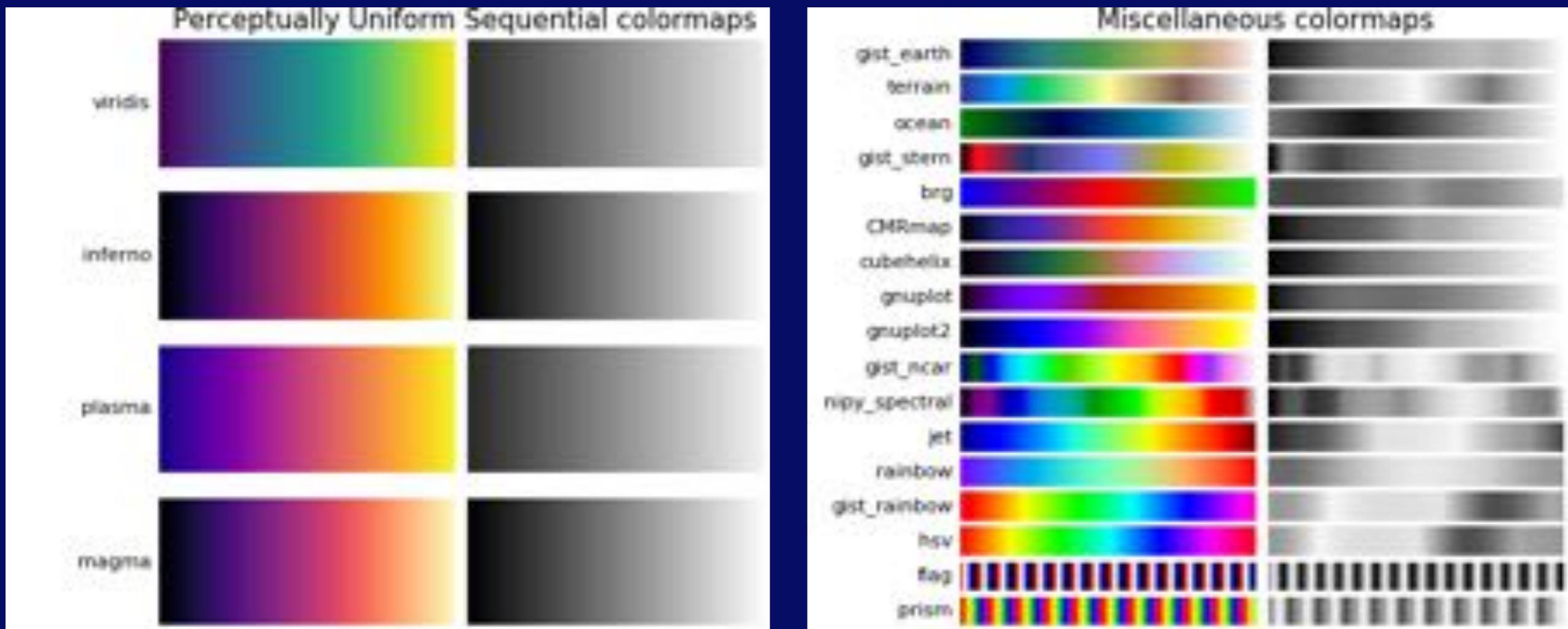
How does it look in grayscale?



How does it look in grayscale?

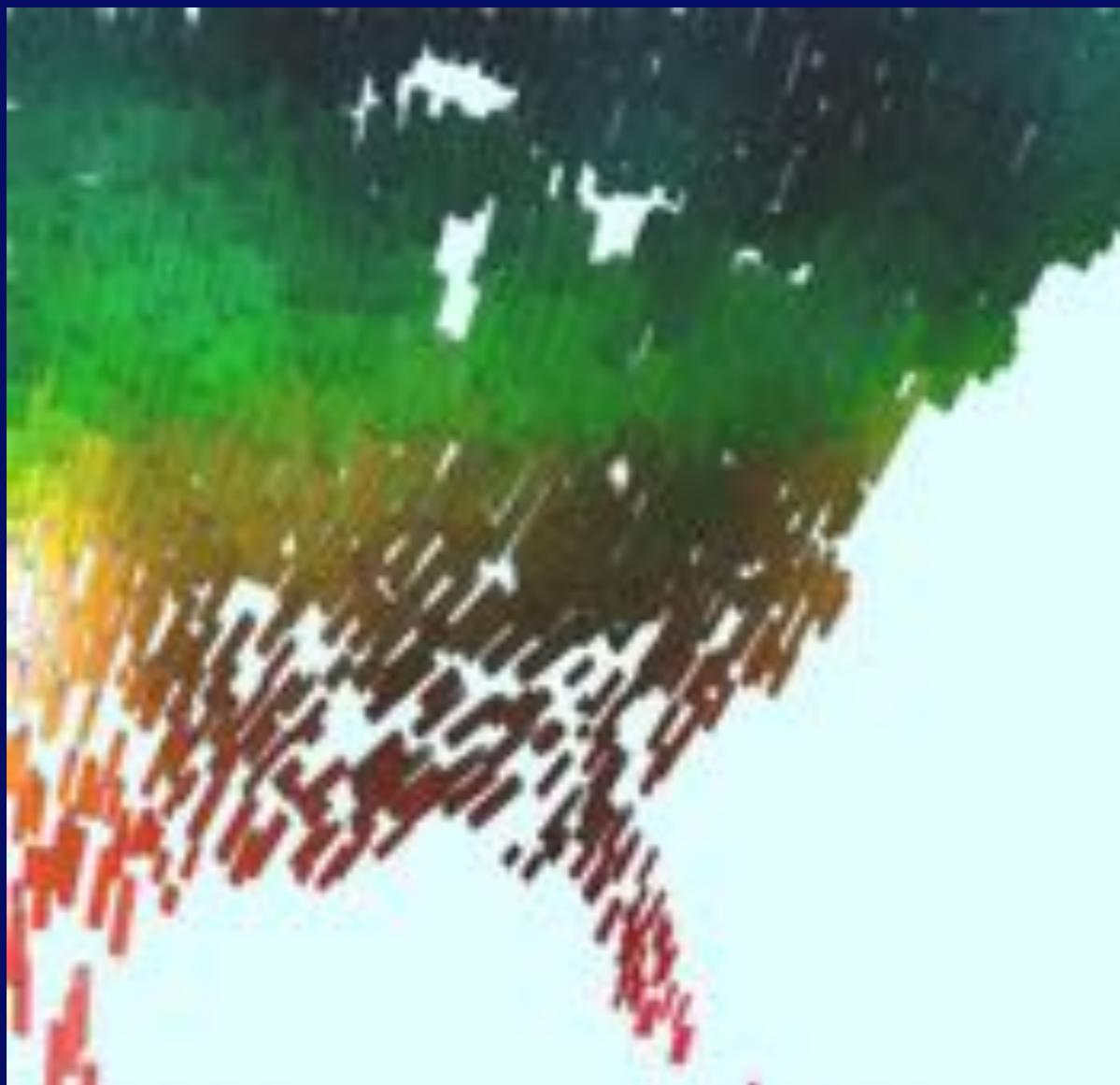


How does it look in grayscale?

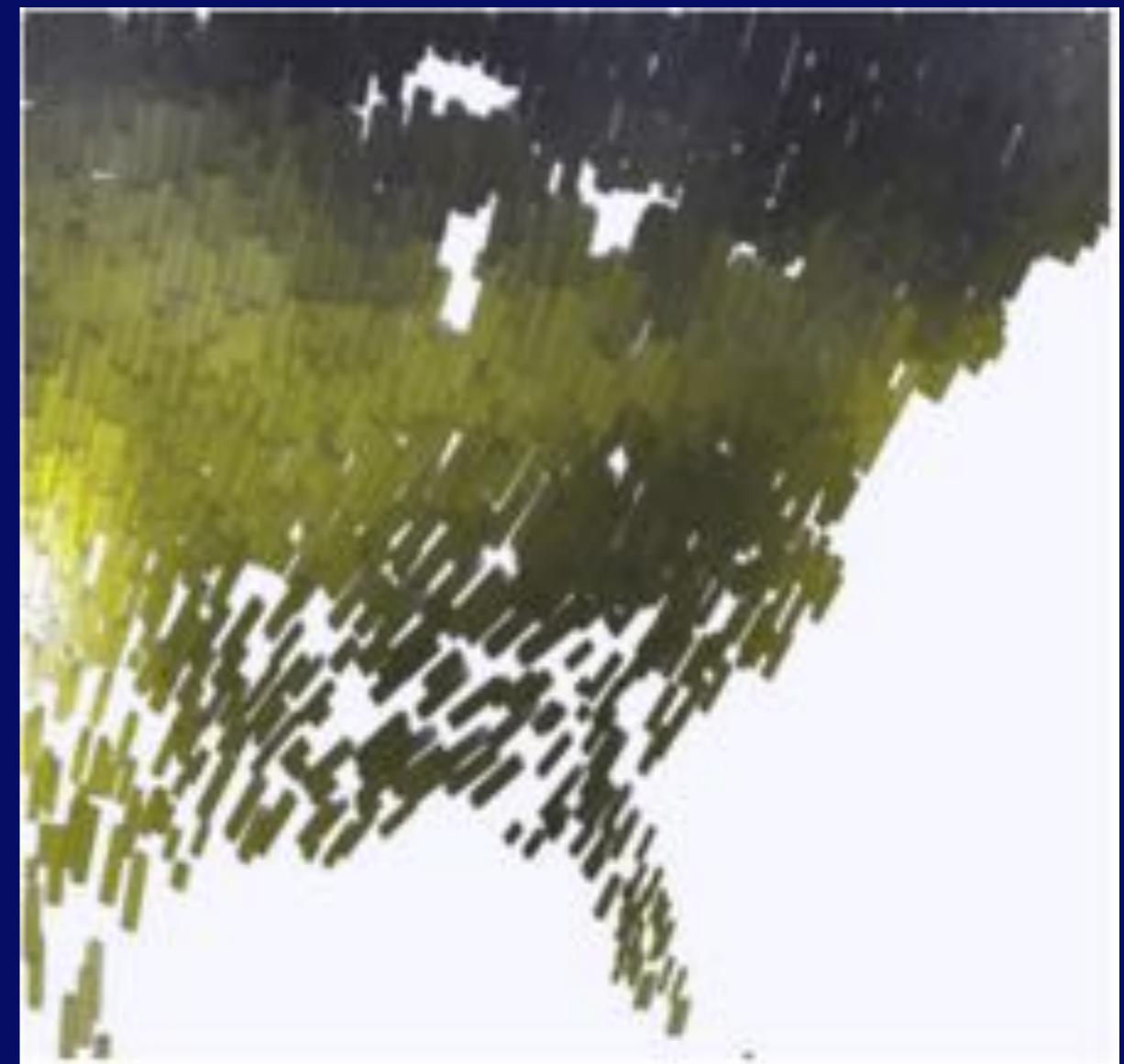
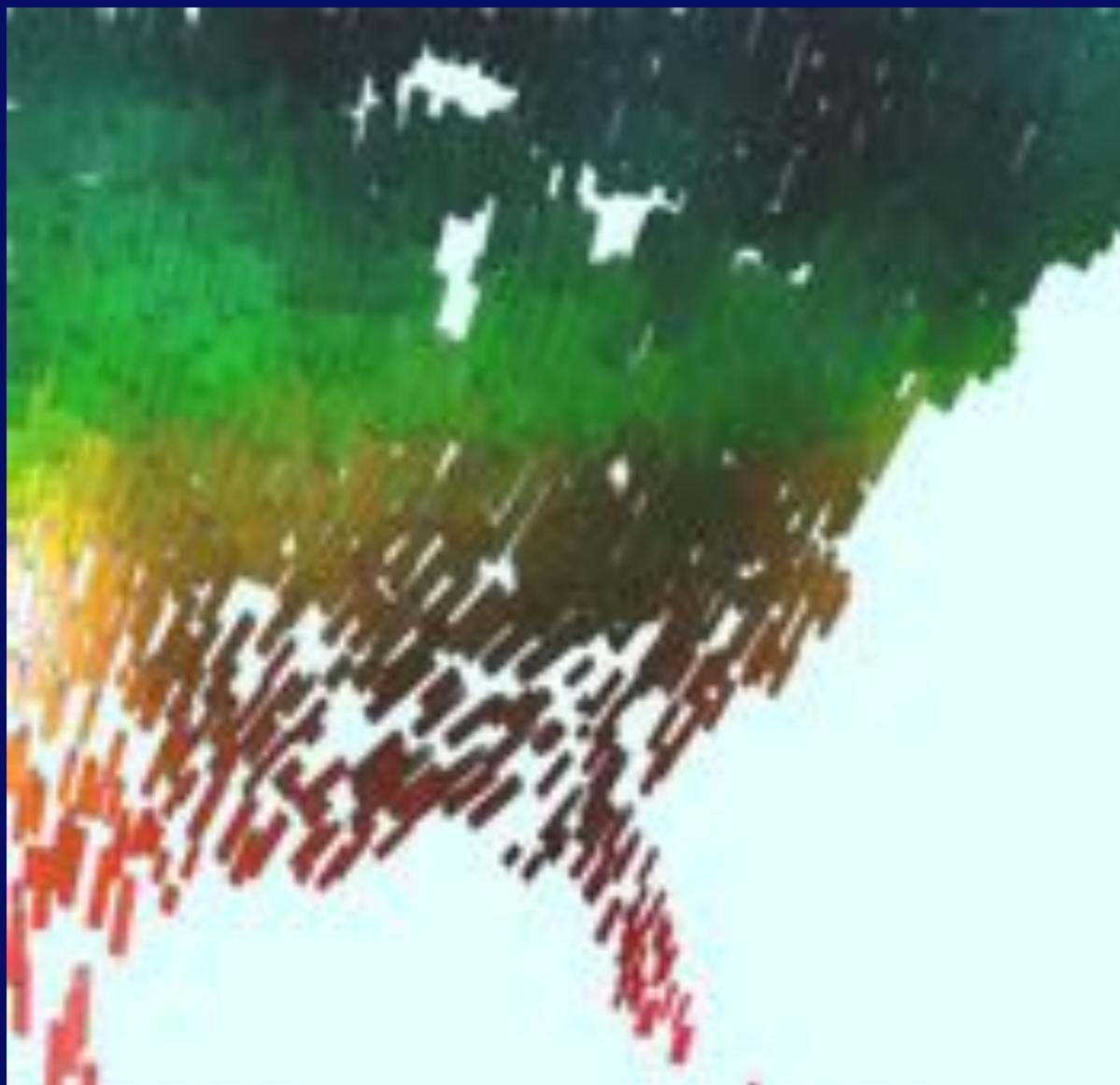


<http://matplotlib.org/users/colormaps.html>

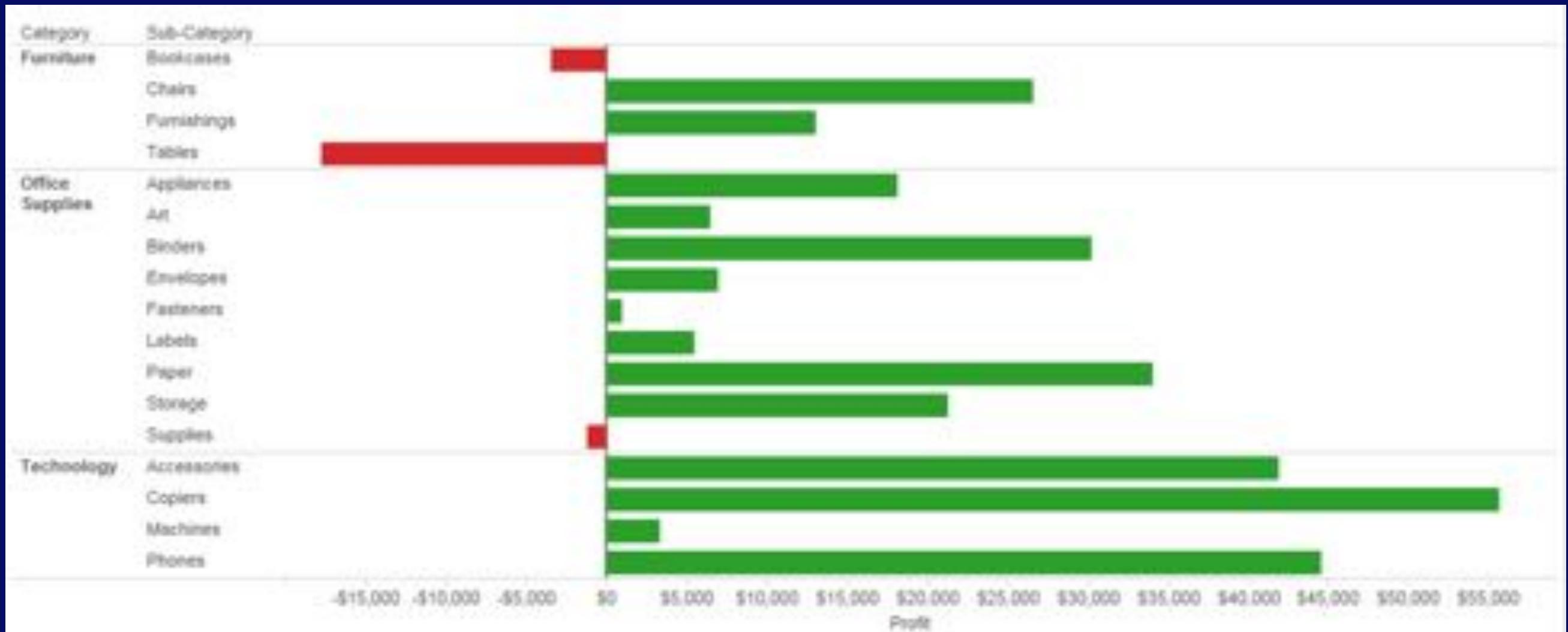
How does it look for colour blind viewers?



How does it look for colour blind viewers?



How does it look for colour blind viewers?



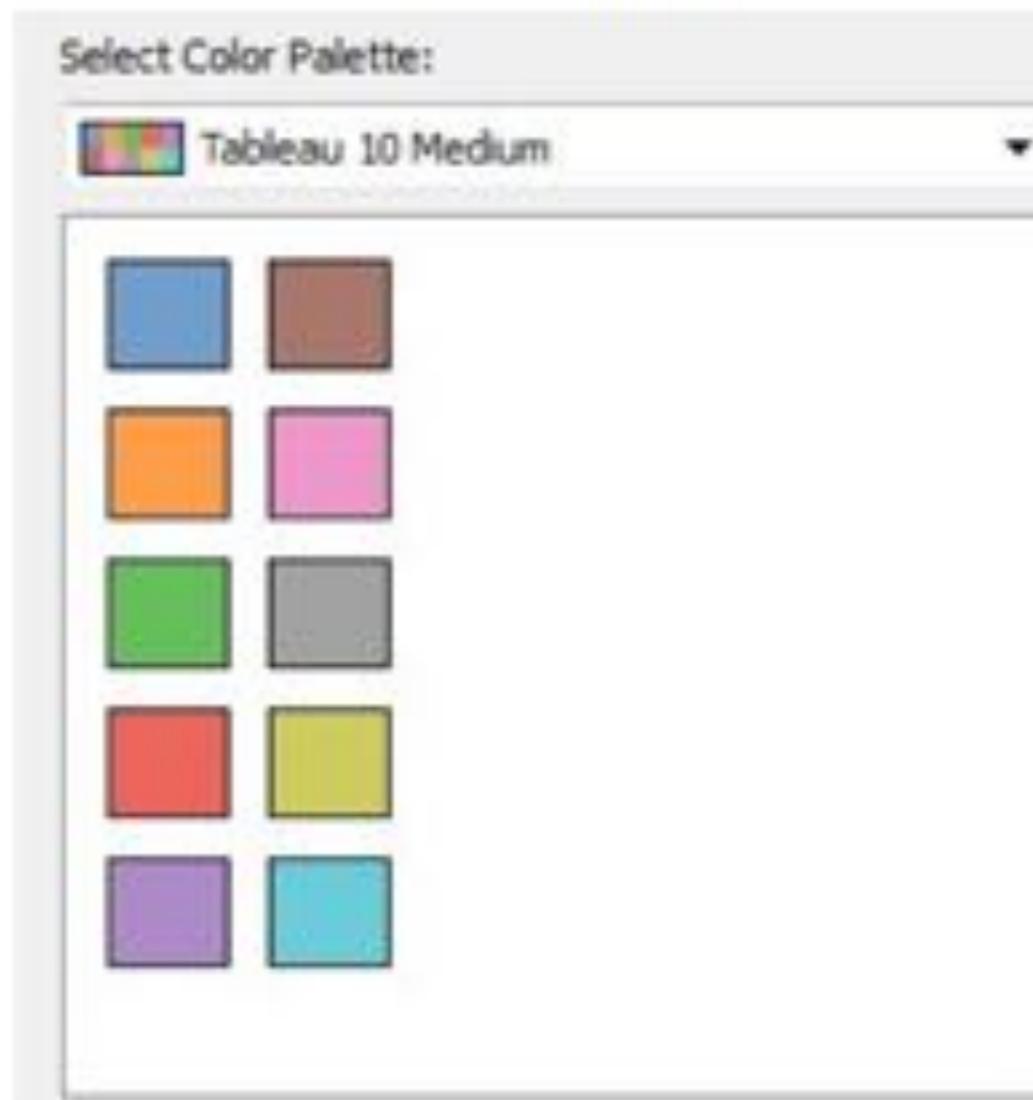
<https://www.tableau.com/about/blog/2016/4/examining-data-viz-rules-dont-use-red-green-together-53463>

**Beware: it's not just red and
green!**

<https://www.tableau.com/about/blog/2016/4/examining-data-viz-rules-dont-use-red-green-together-53463>

Your Results:

Original Image



Deutanope Simulation



How to colour-blind-proof your figure:

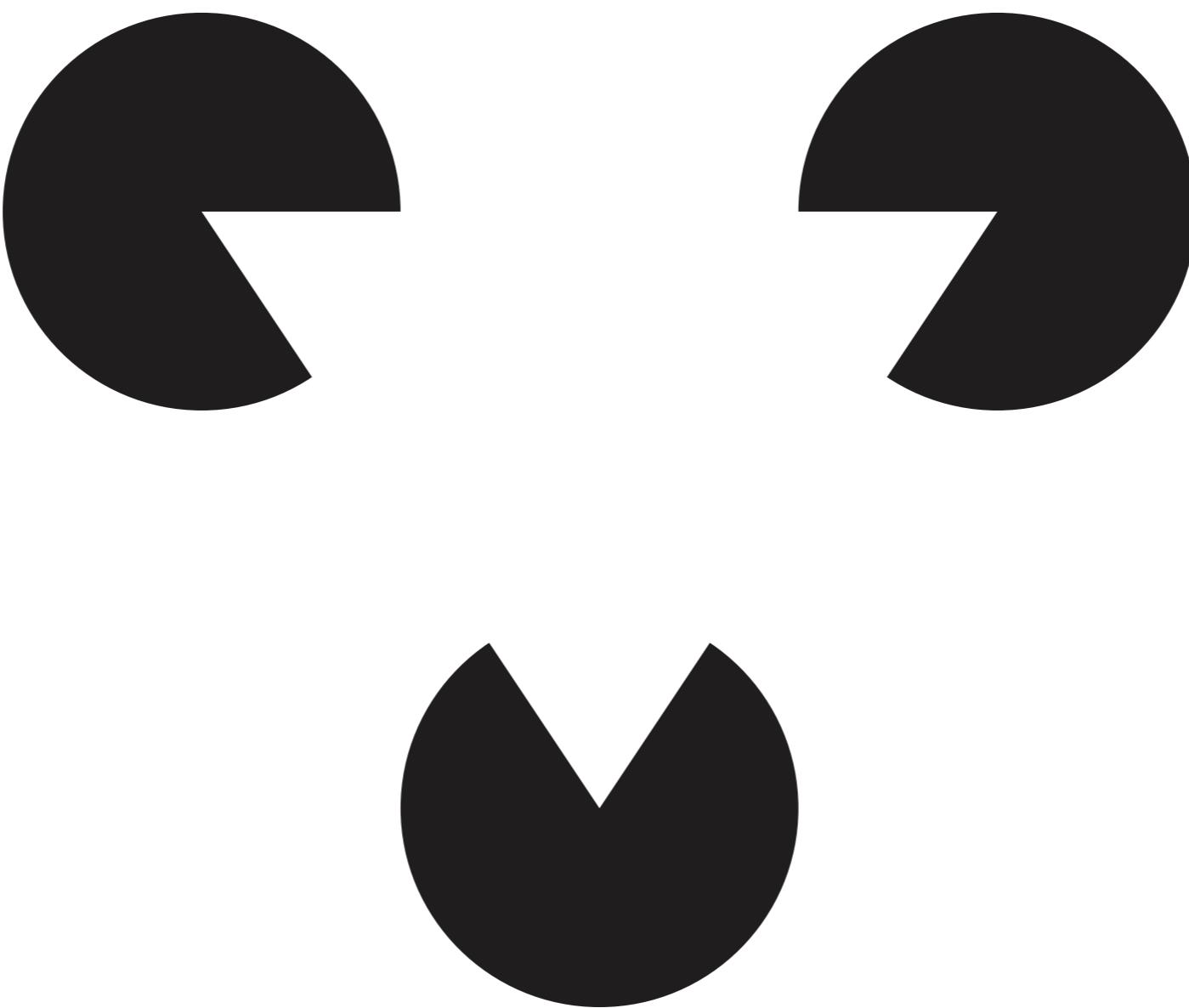
- **matplotlib: e.g. viridis**
- **seaborn: “colorblind”**
- **use intensity to distinguish**
- **use shape to distinguish**
- **check using simulators, plug-ins etc.**

Colour Resources:

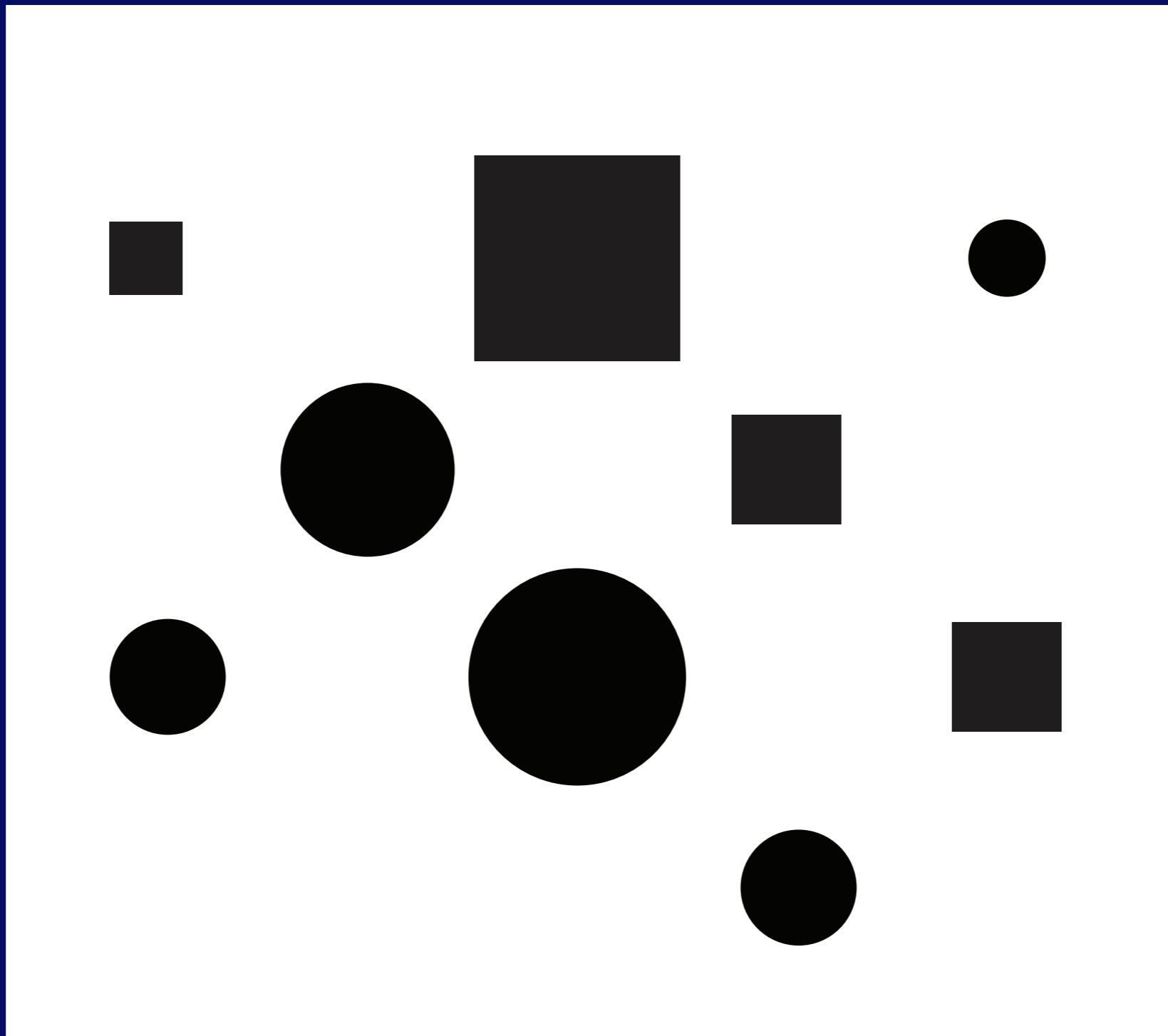
- <http://www.research.ibm.com/people/l/lloydt/color/color.HTM>
- <https://www.tableau.com/about/blog/2016/4/examining-data-viz-rules-dont-use-red-green-together-53463>
- <http://matplotlib.org/users/colormaps.html>
- <http://www.color-blindness.com/coblis-color-blindness-simulator/>
- <http://www.vischeck.com>
- <http://colororacle.org>
- <http://colorbrewer2.org>
- <http://www.palettable.io>

visual hierarchy

Gestalt Principles

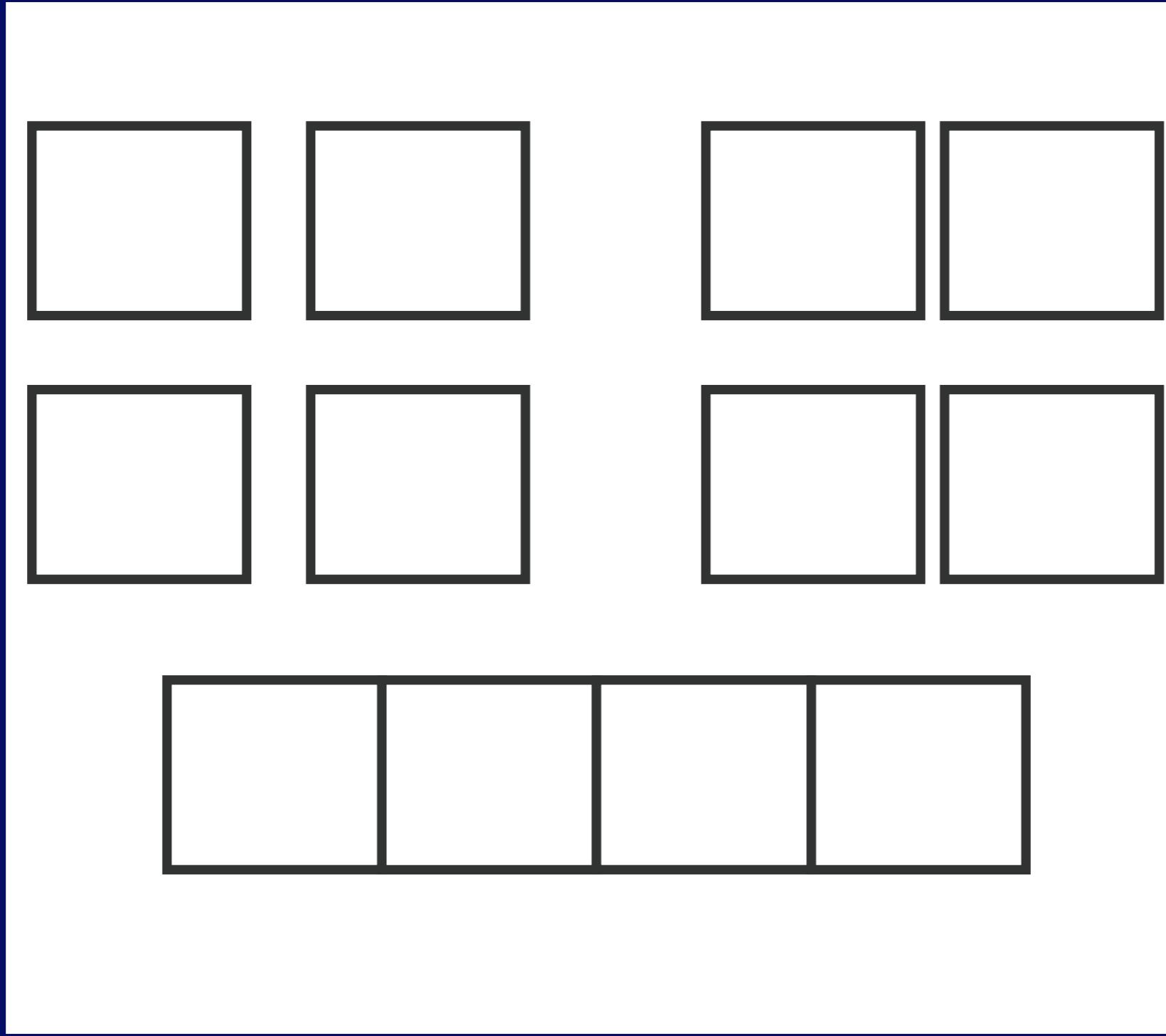


Similarity

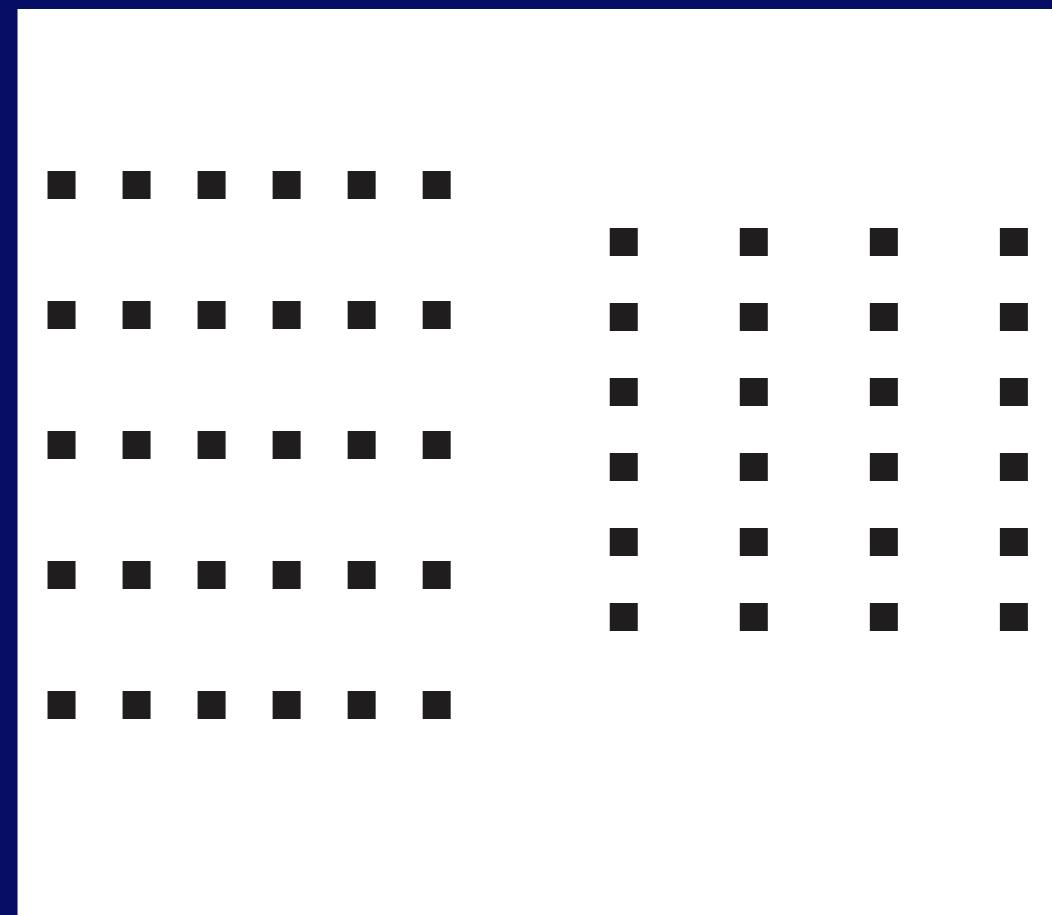
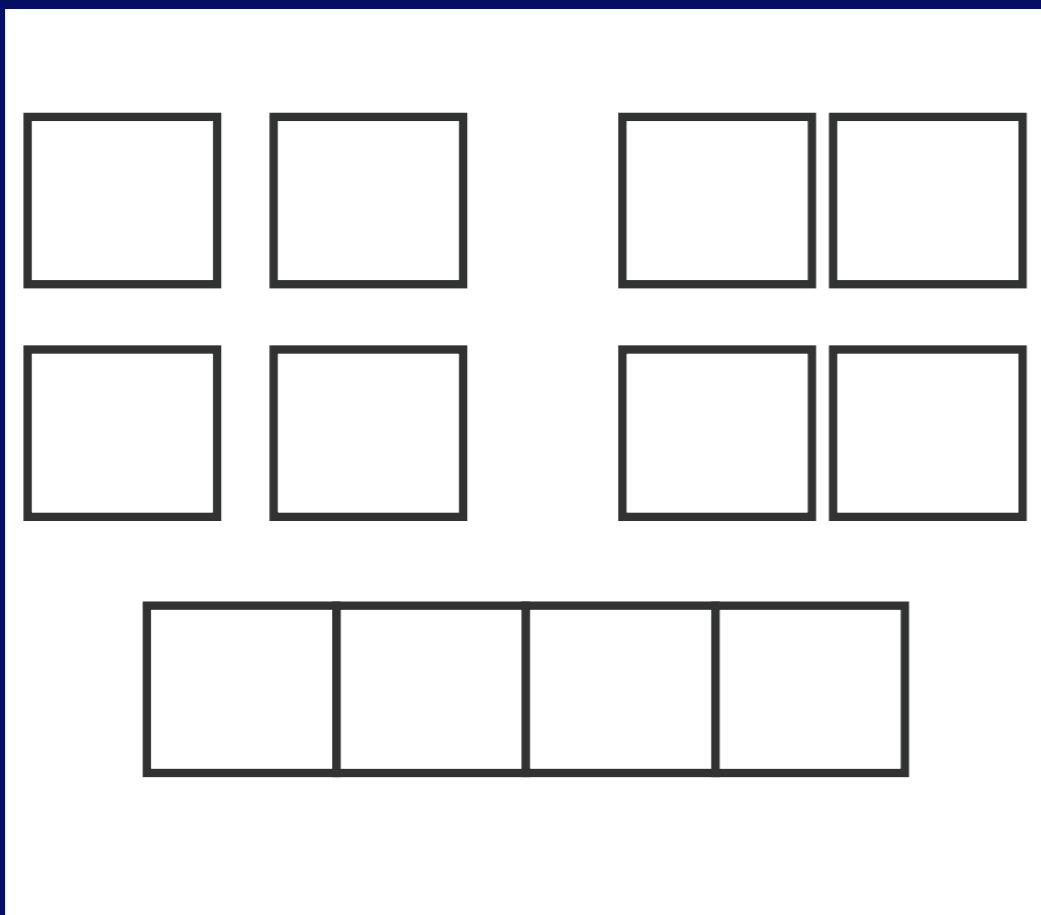


Wong, Nature Methods, 2010

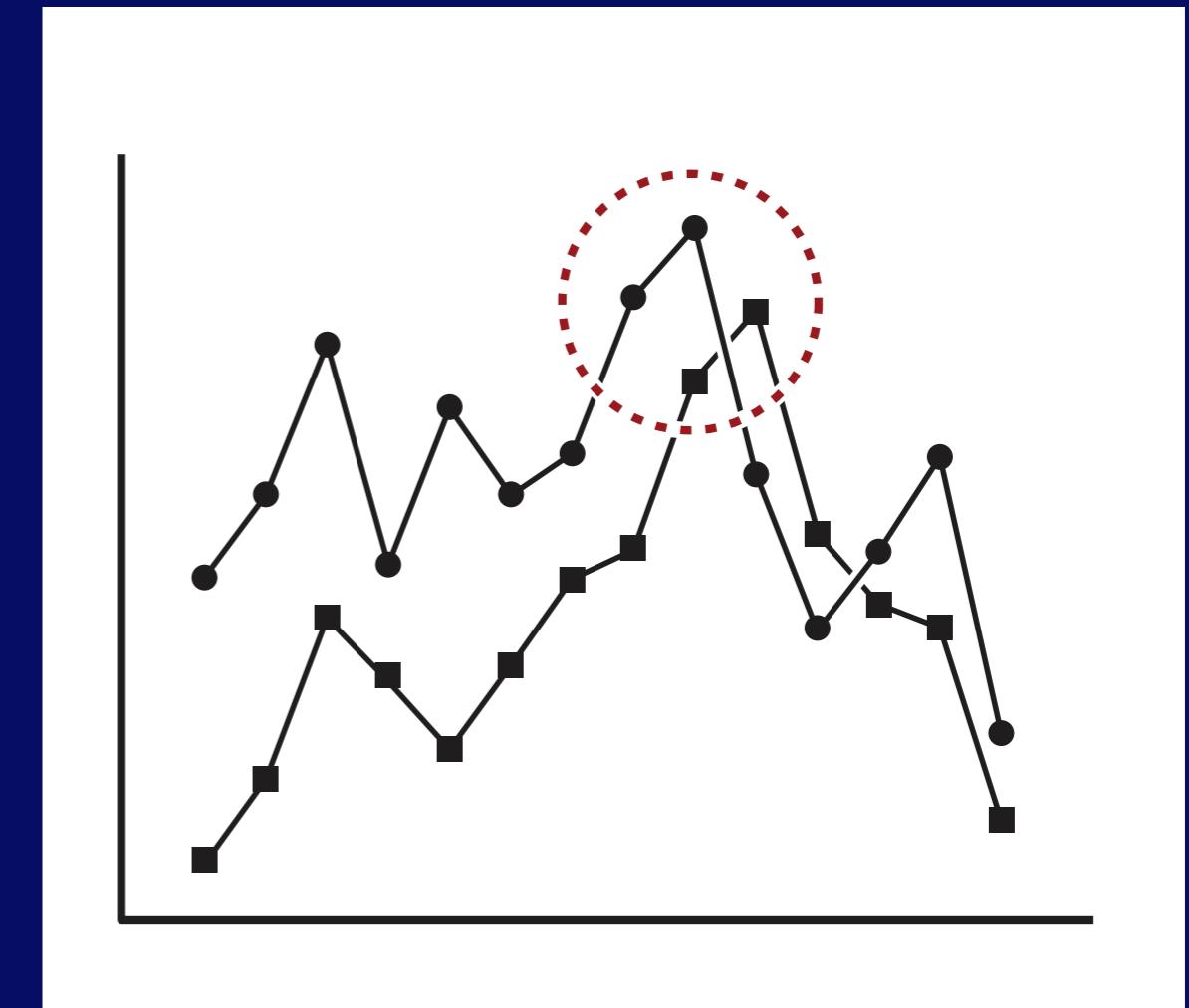
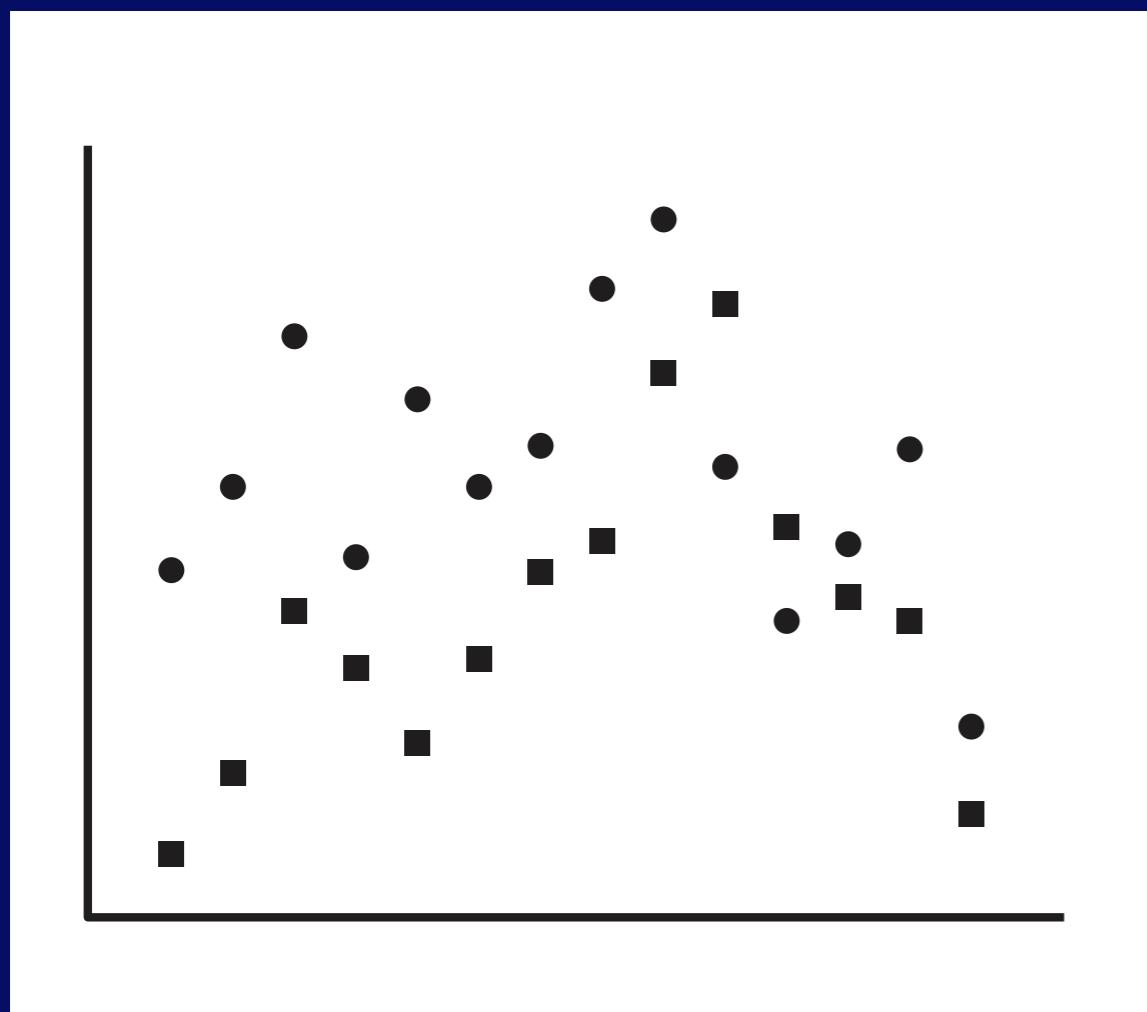
Proximity



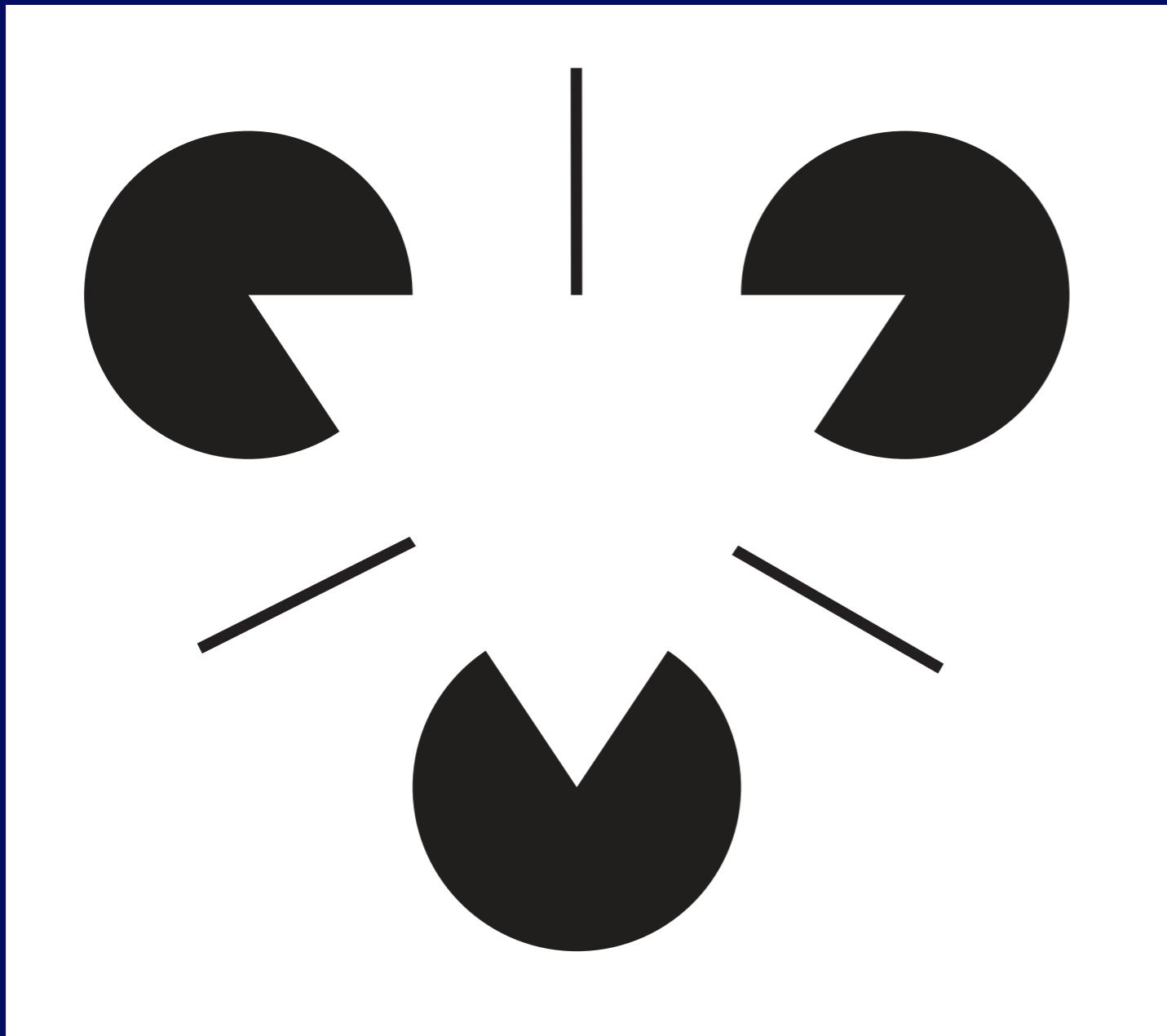
Proximity



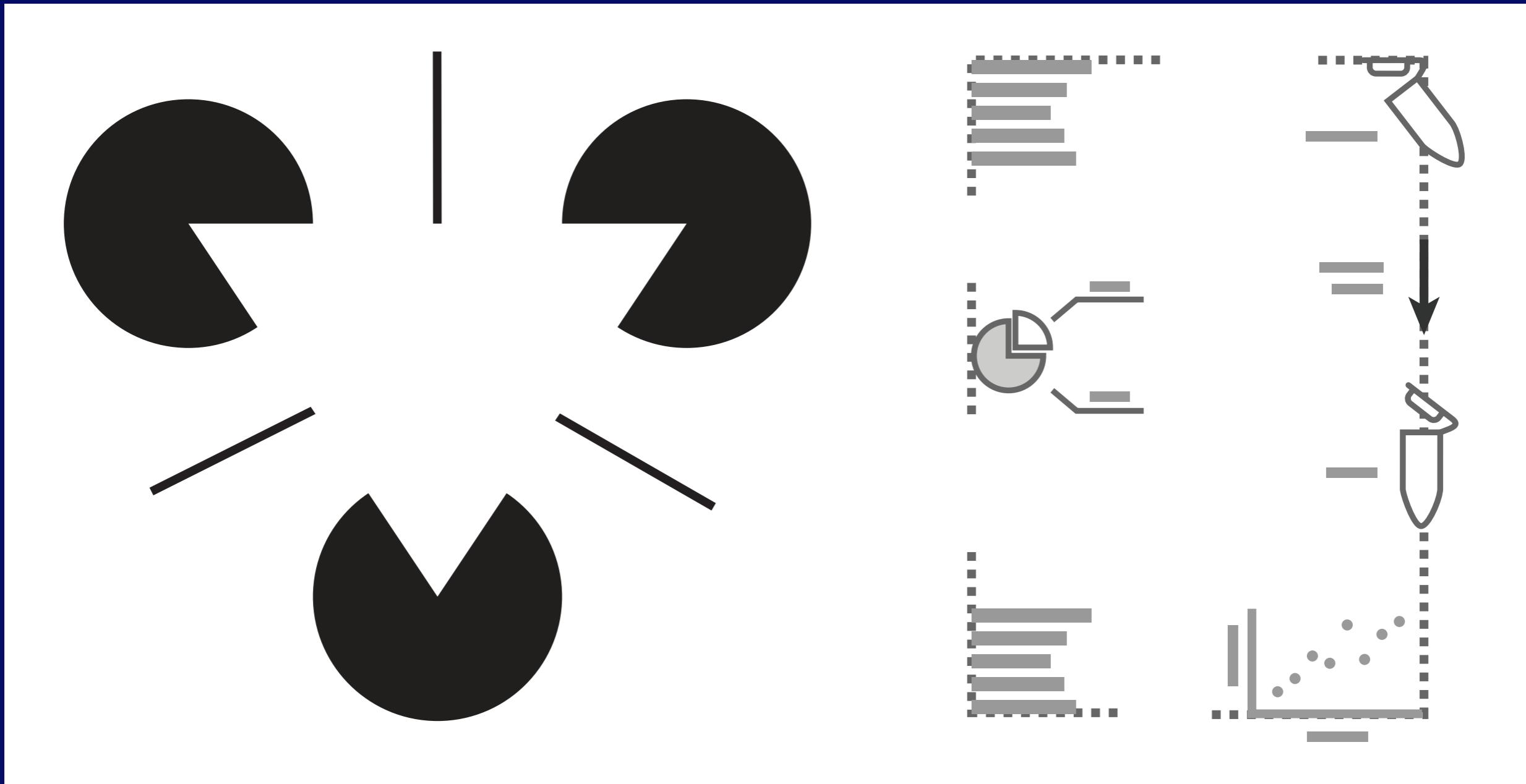
Connection + Enclosure



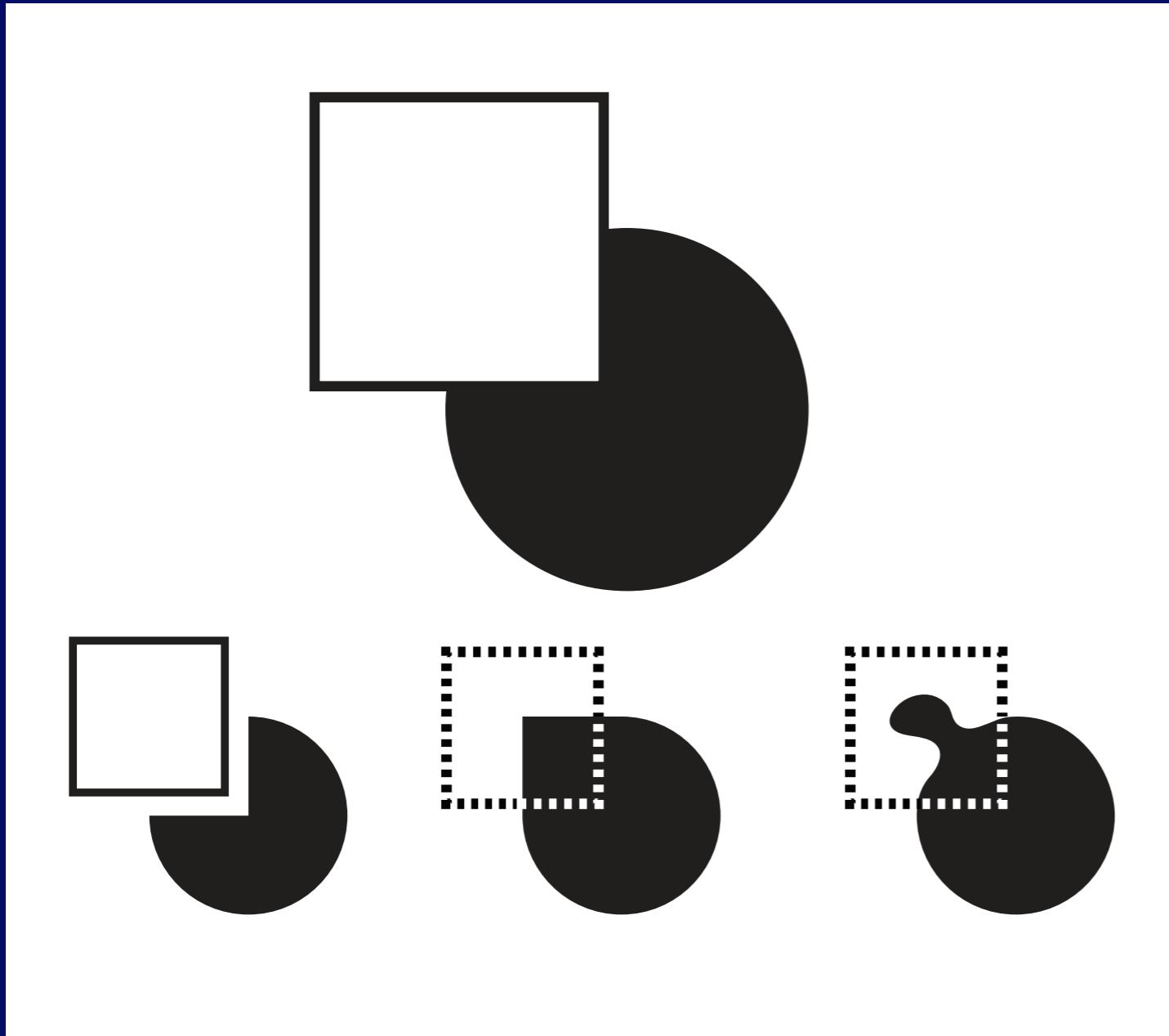
Visual Interpolation



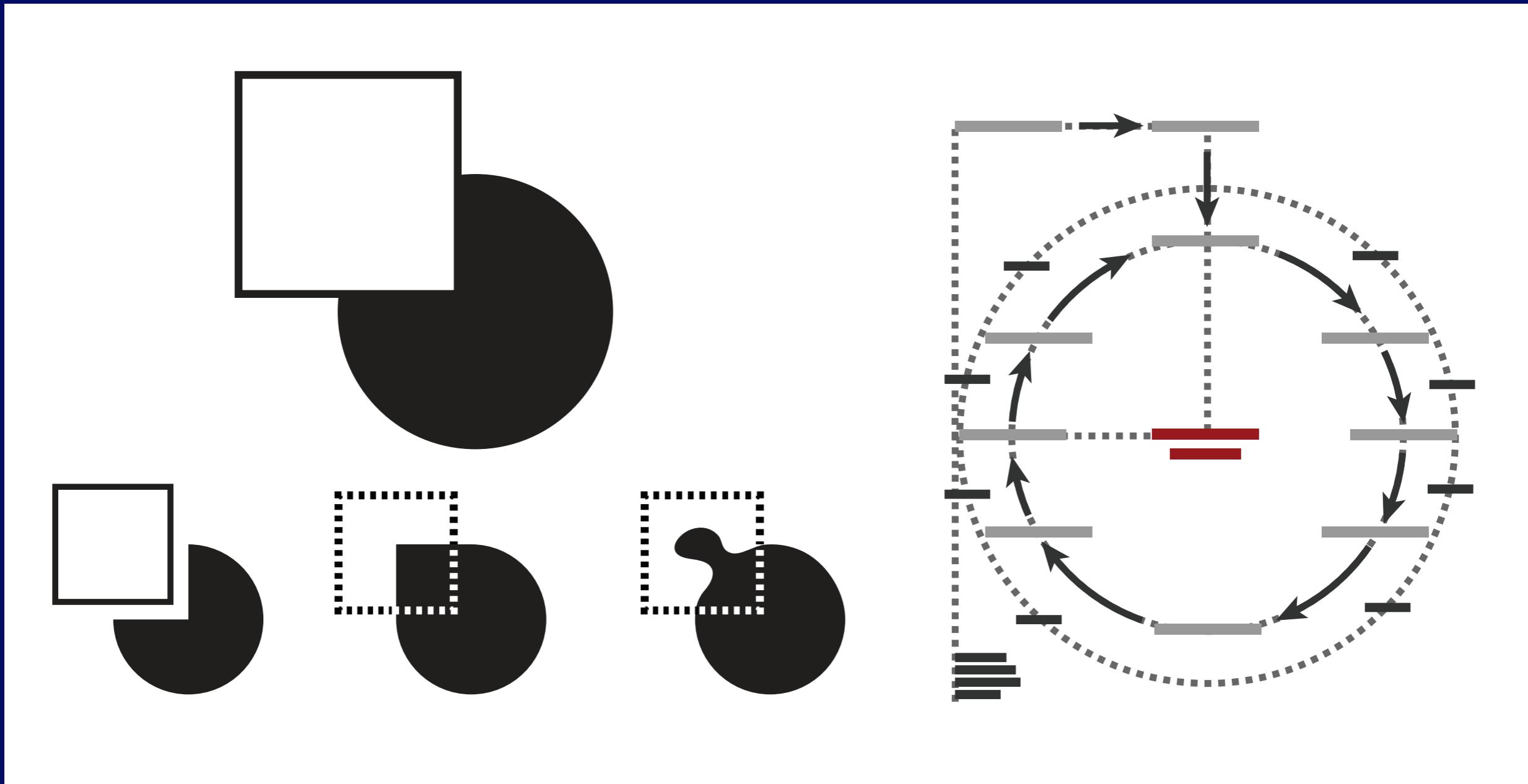
Visual Interpolation



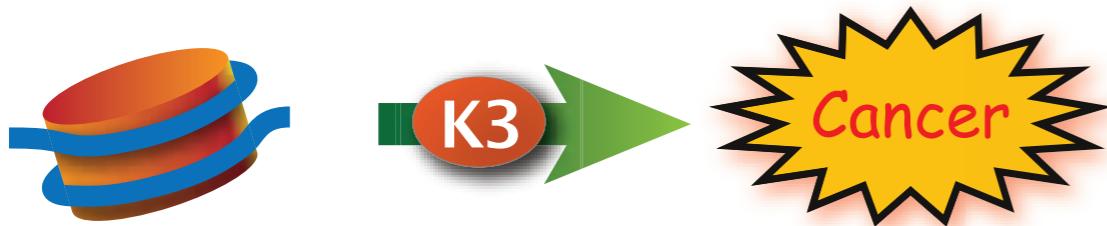
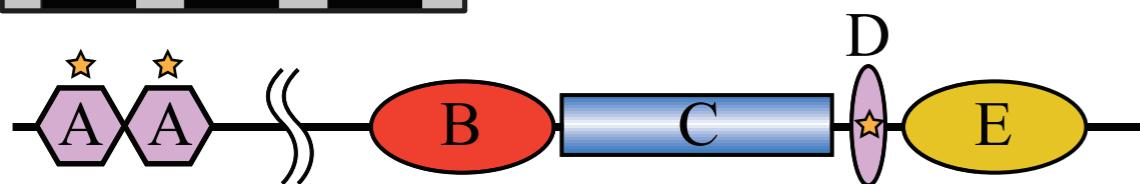
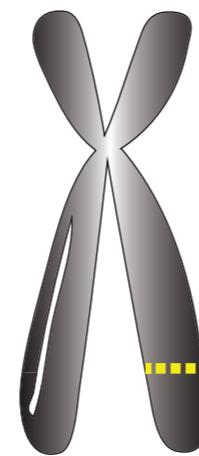
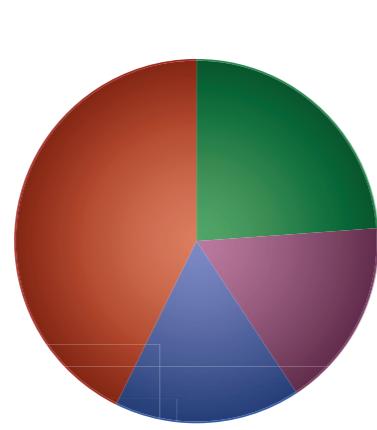
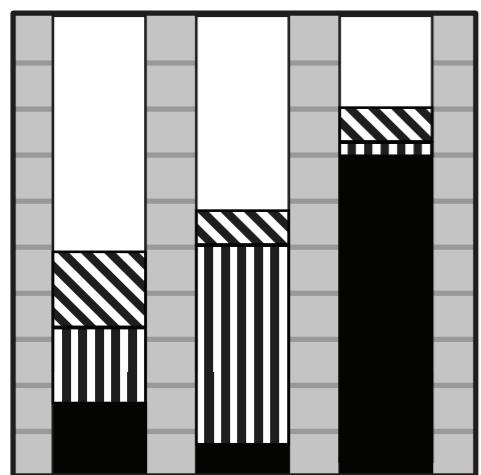
Visual Completion



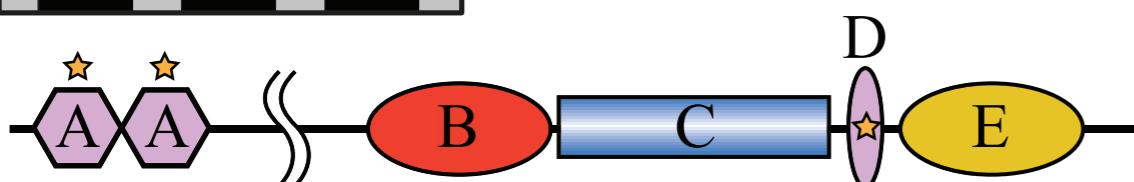
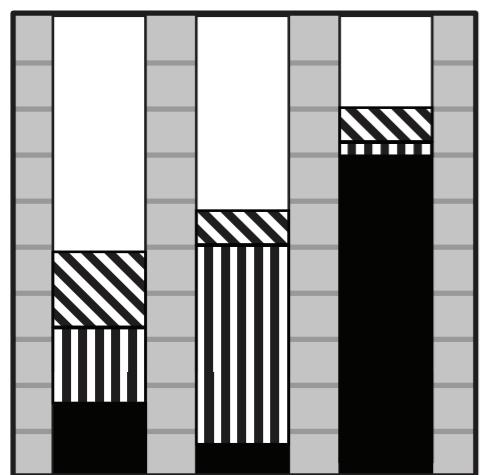
Visual Completion



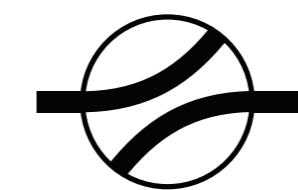
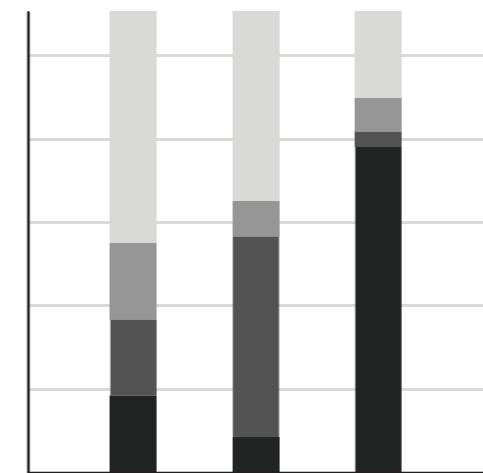
a



a



b

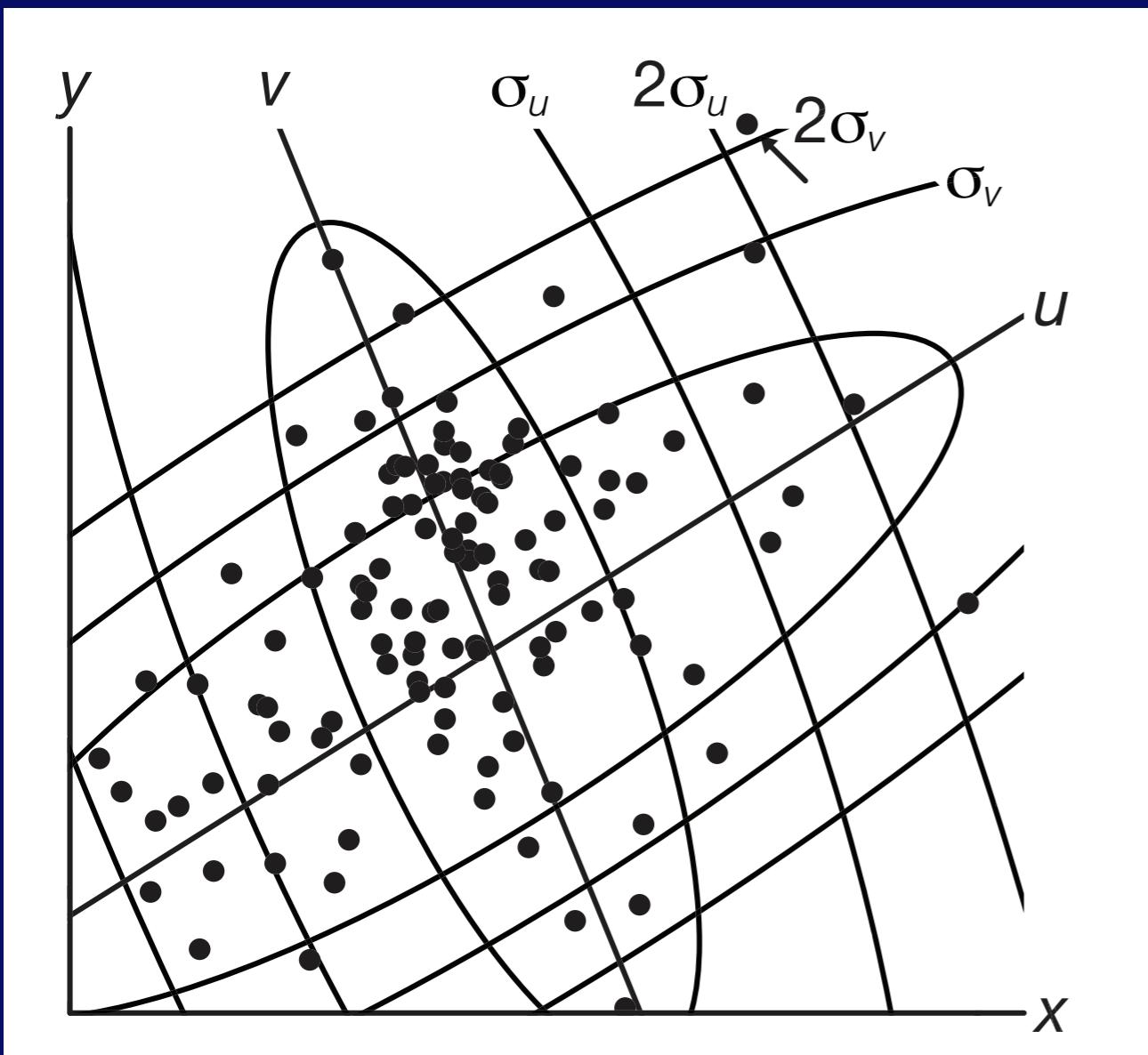


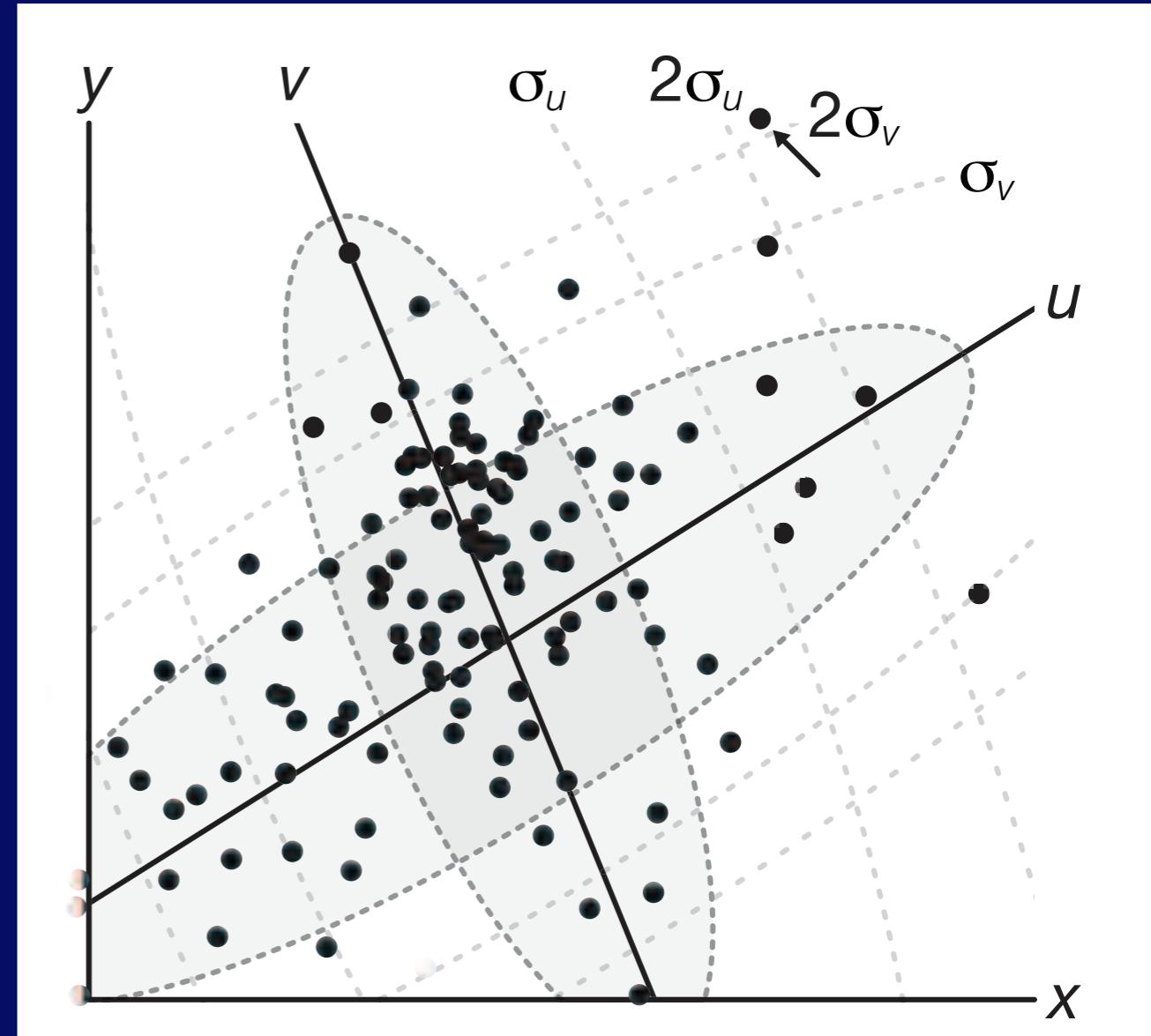
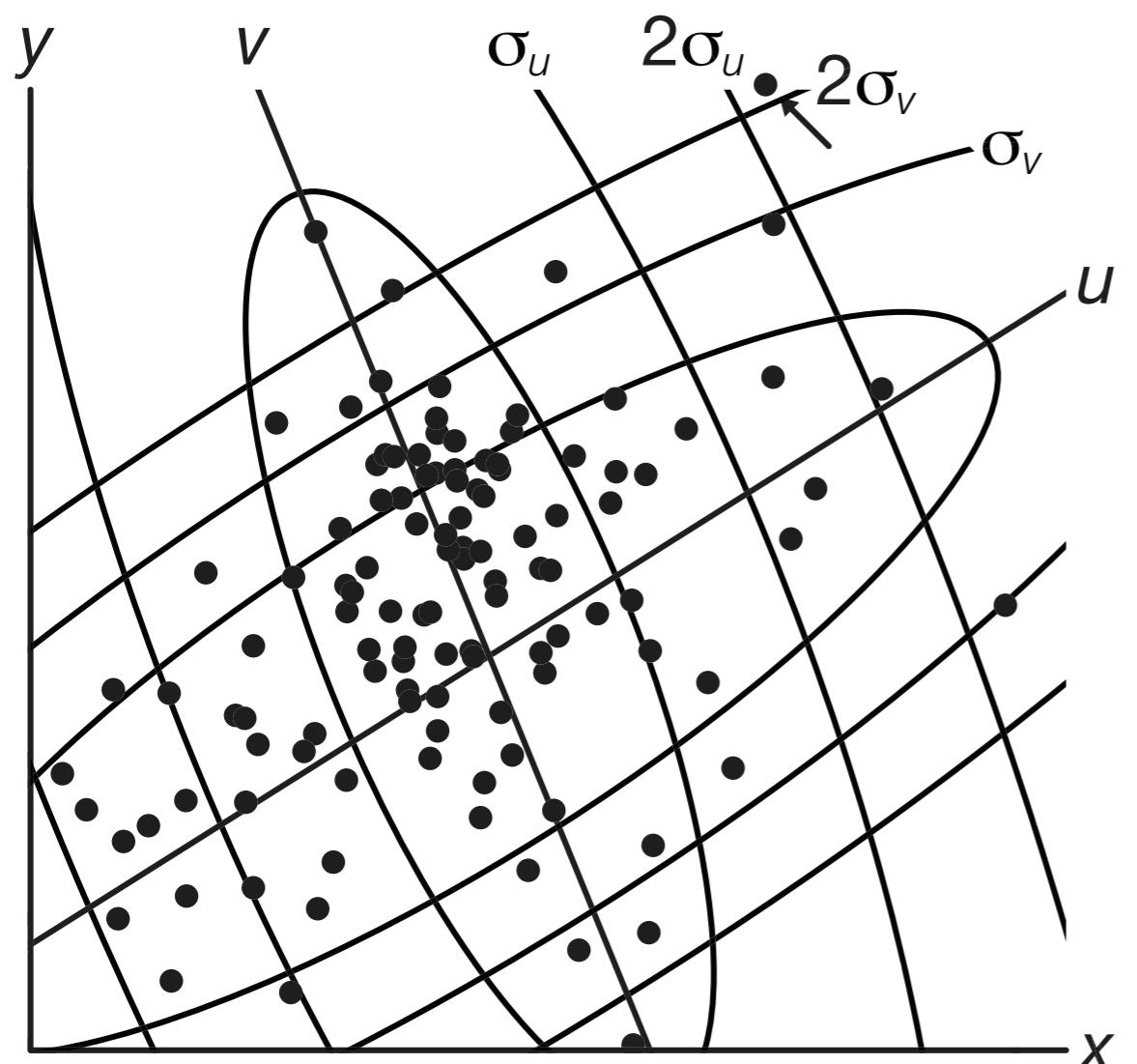
in practice ...

*World
government*



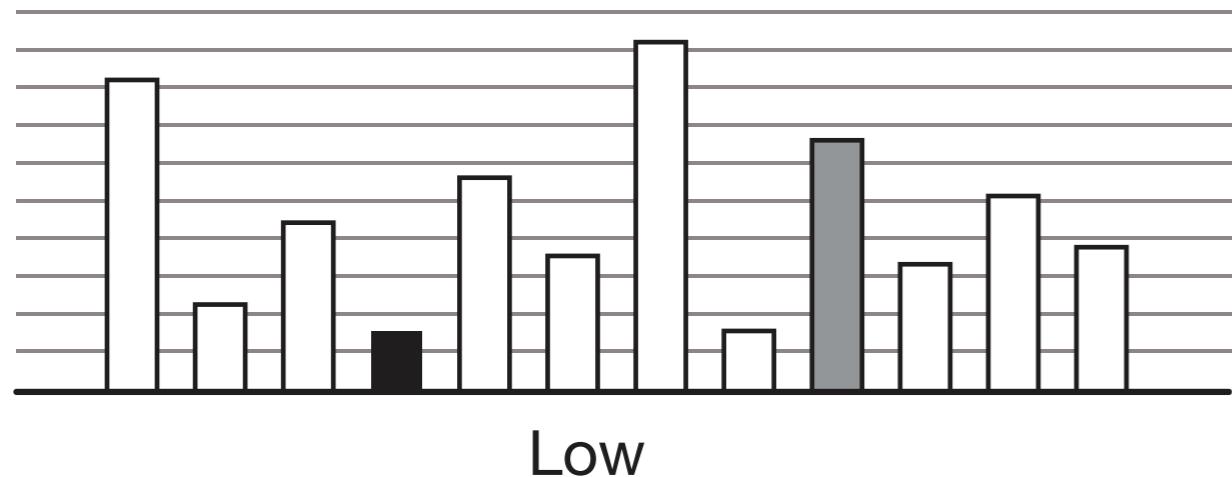
Bureau d'Etudes





Grids

10 grids

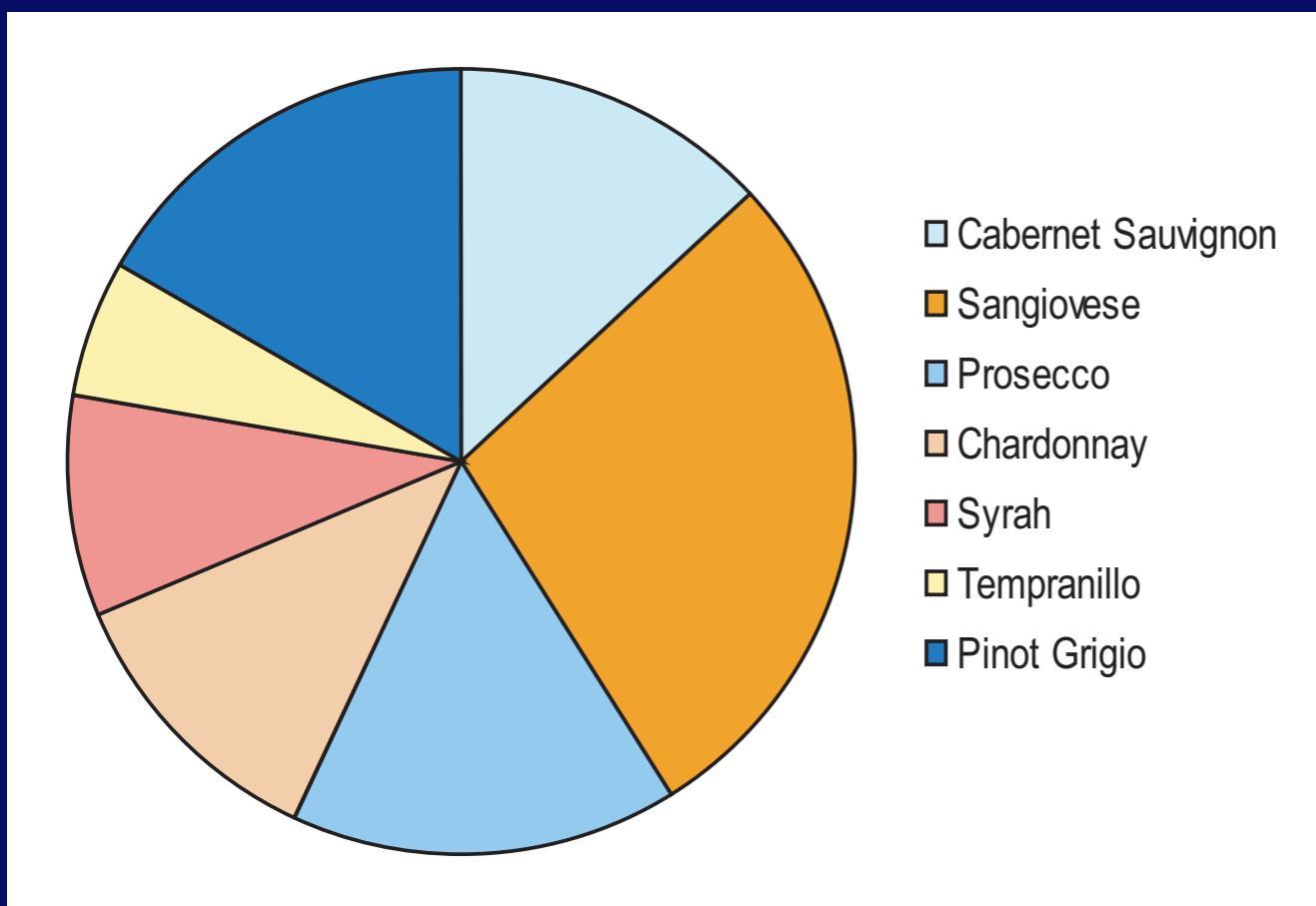




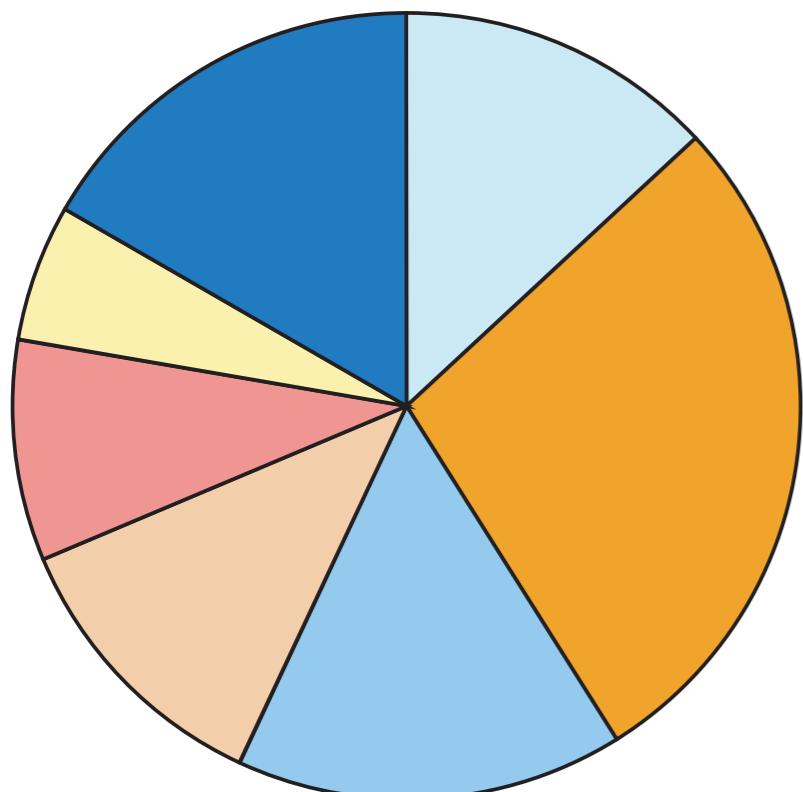
Pie charts



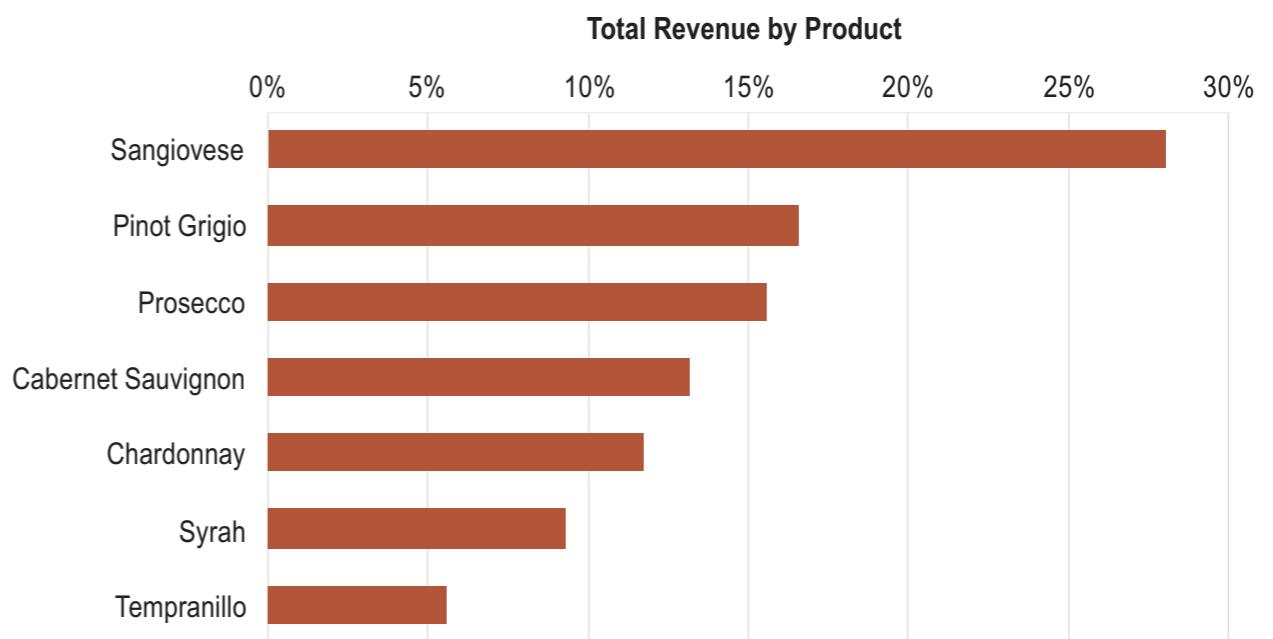
Pie charts



Pie charts



- Cabernet Sauvignon
- Sangiovese
- Prosecco
- Chardonnay
- Syrah
- Tempranillo
- Pinot Grigio



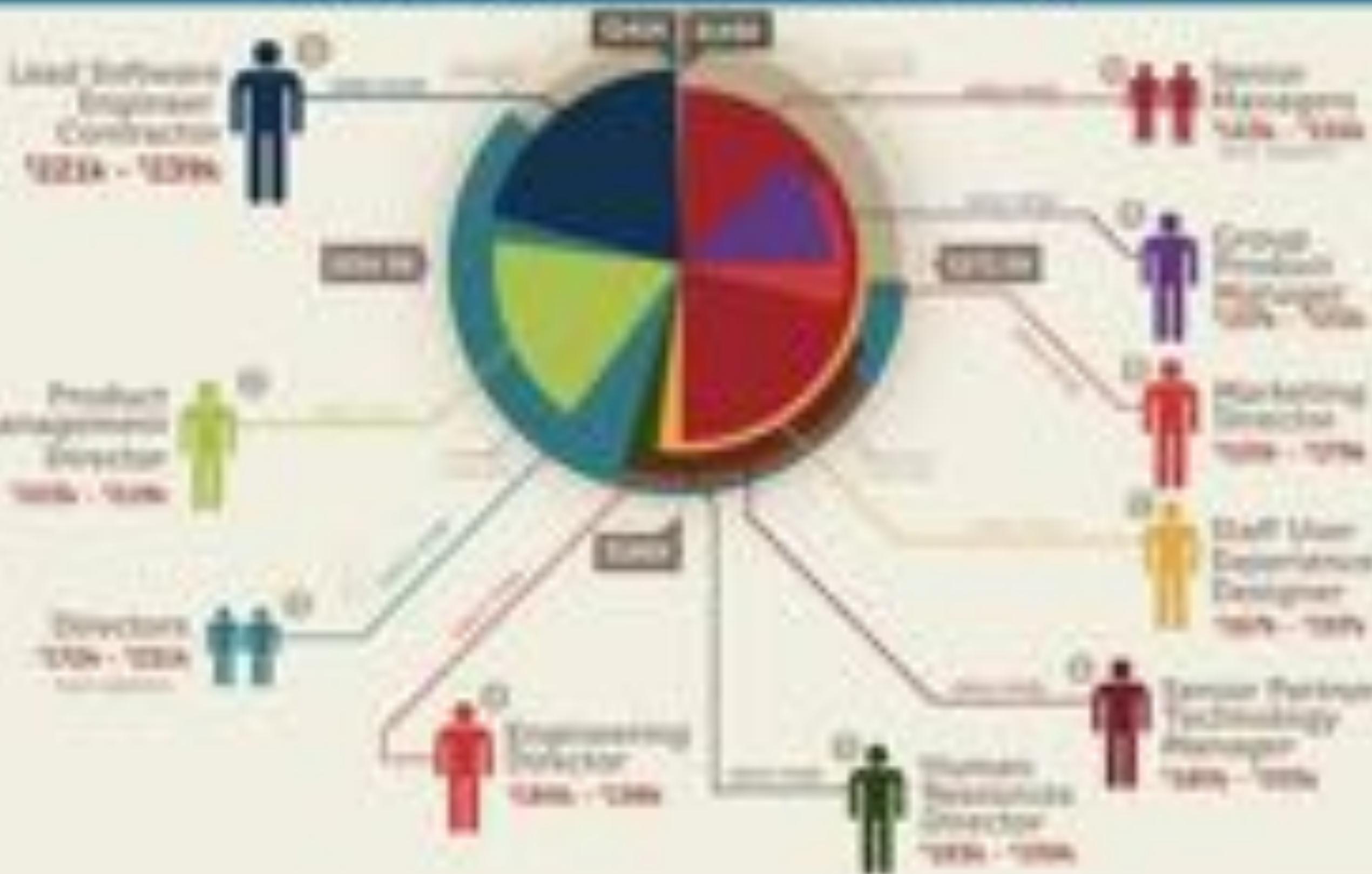
+ obvious part-to-whole
relationship

**- terrible for comparing
information**

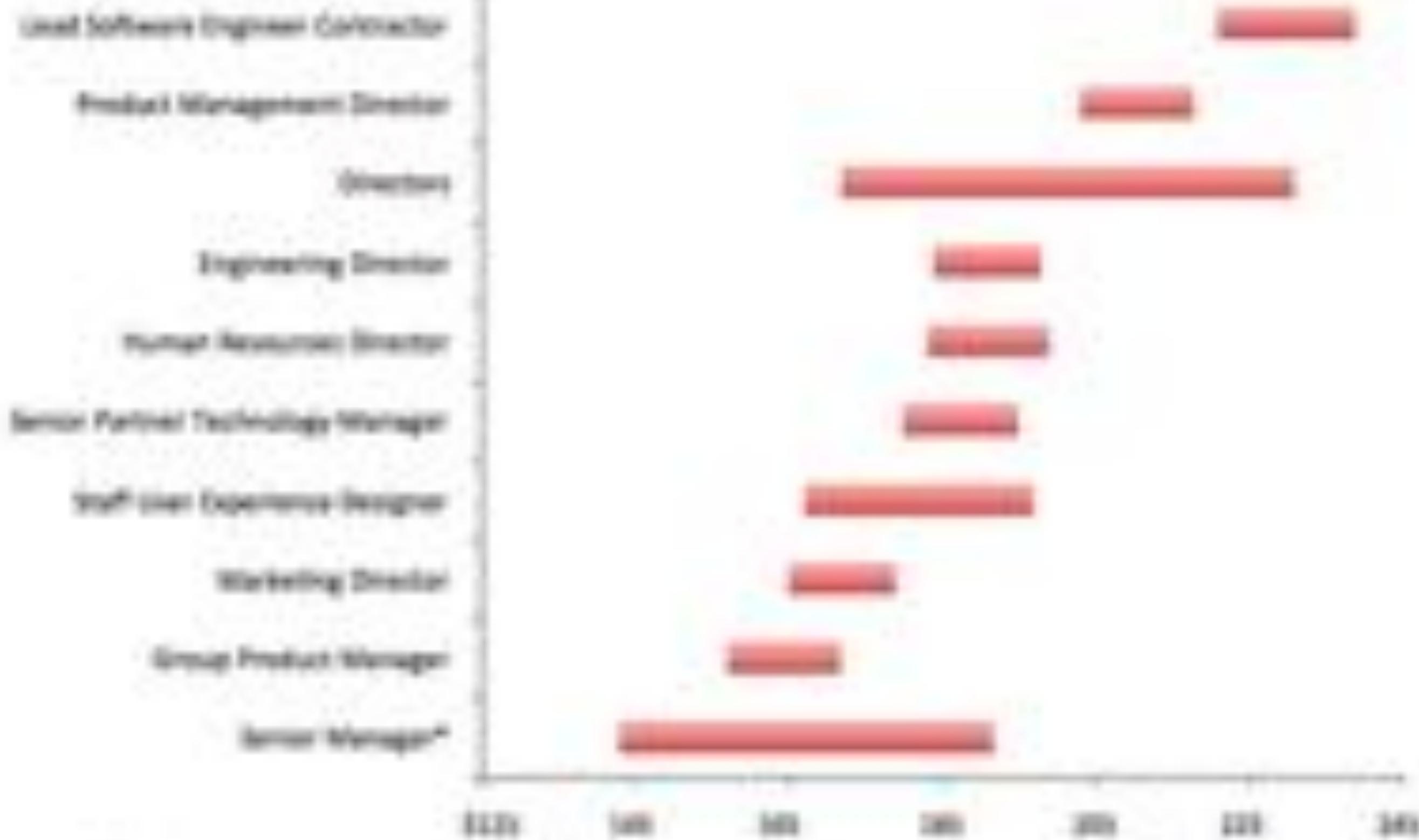
**- we are bad at judging
area and angles**

top 10 salaries at Google

RANGE FROM \$143,000 TO \$541,000 PER YEAR



Top 20-Senior Positions by Job Category
According to users of GlassDoor



*From 17 respondents from the 2016
of Senior Managers

ANNUAL SALARY IN THOUSANDS OF DOLLARS
(Self-reported by respondents)

More Resources

- <http://blogs.nature.com/methagora/2013/07/data-visualization-points-of-view.html>
- <http://www.jstor.org/stable/pdf/2683253.pdf>
- <http://mason.gmu.edu/~dcarr/lib/v6n3.pdf>
- <http://www.stat.columbia.edu/~gelman/research/published/dodhia.pdf>
- <https://flowingdata.com/category/visualization/ugly-visualization/>
- <http://www.datavis.ca>
- <https://curriculum.code.org/csp/unit2/10/>
- http://www.perceptualedge.com/articles/visual_business_intelligence/save_the_pies_for_dessert.pdf
- <http://www.datavizcatalogue.com>
- **Edward Tufte: The Visual Display of Quantitative Information**
- <https://www.csc2.ncsu.edu/faculty/healey/PP>
- <http://www-users.cs.umn.edu/%7einterran/texture/index.html>
- [https://en.wikipedia.org/wiki/Figure-ground_\(perception\)](https://en.wikipedia.org/wiki/Figure-ground_(perception))
- http://www.improving-visualisation.org/case-studies/id=7#jump_3