

MassMutual DSDP 2019: PERCEPTION & COLOR

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Flashback: mental models



The “gestalt effect”

ge·stalt

/gə'Štält,-'Štôlt/

noun PSYCHOLOGY

an organized whole that is perceived as more than the sum of its parts.



Translations, word origin, and more definitions

Our brain's ability to generate whole forms, instead of just collections of unrelated elements

1. Reification



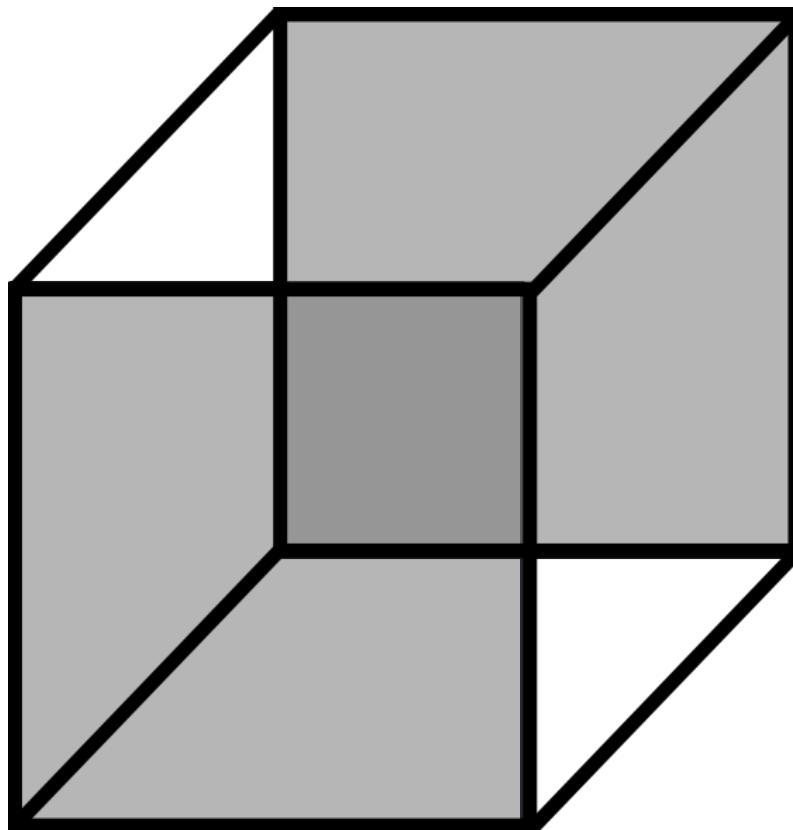
Demonstration of reification in perception from Lehar S. (2003)
The World In Your Head, Lawrence Erlbaum, Mahwah, NJ. p. 52, Fig. 3.3

2. Emergence

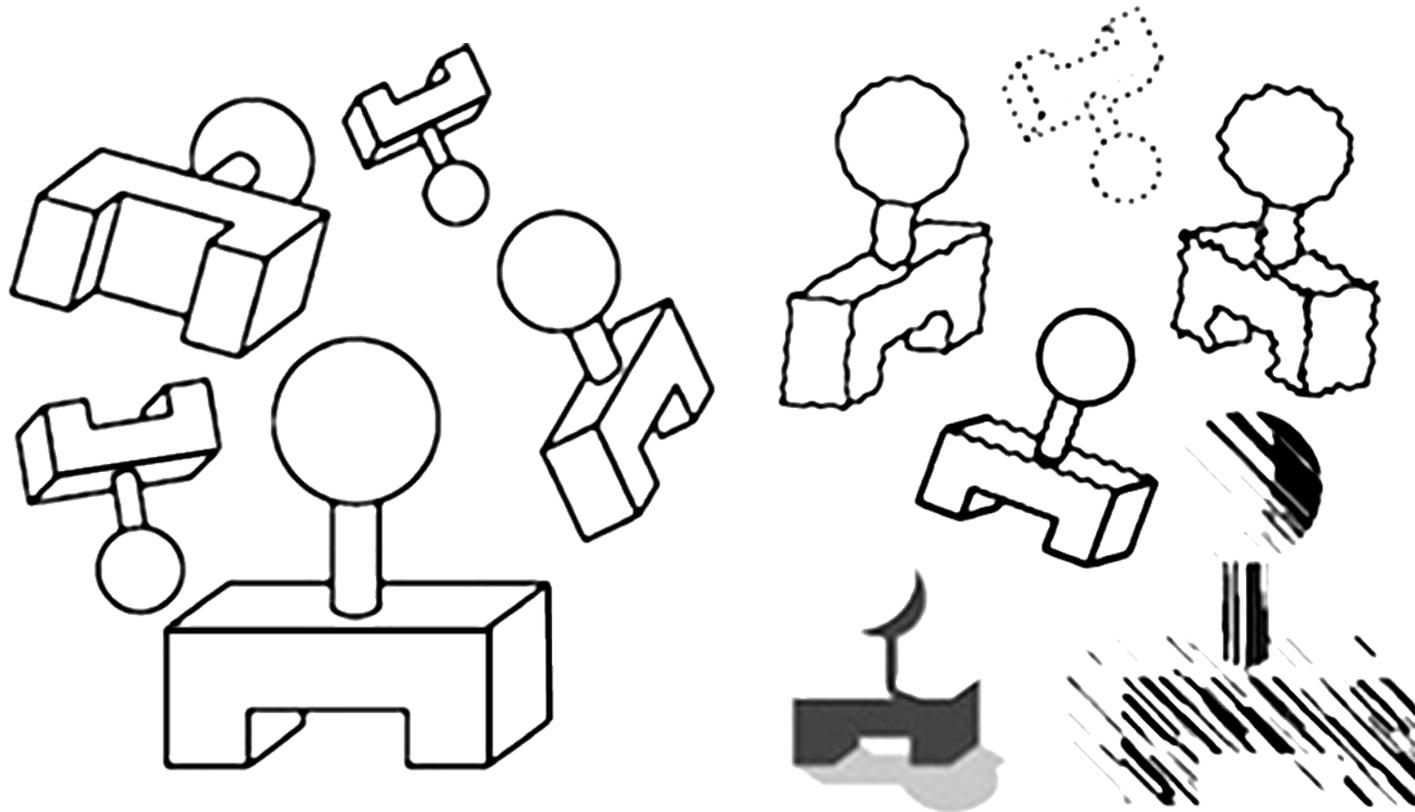


Life Magazine: 58;7 1965-02-19, p 120. Photographer: Ronald C James

3. Multistability



4. Invariance



Demonstration of invariance in perception from Lehar S. (2003)
The World In Your Head, Lawrence Erlbaum, Mahwah, NJ. p. 53, Fig. 3.5

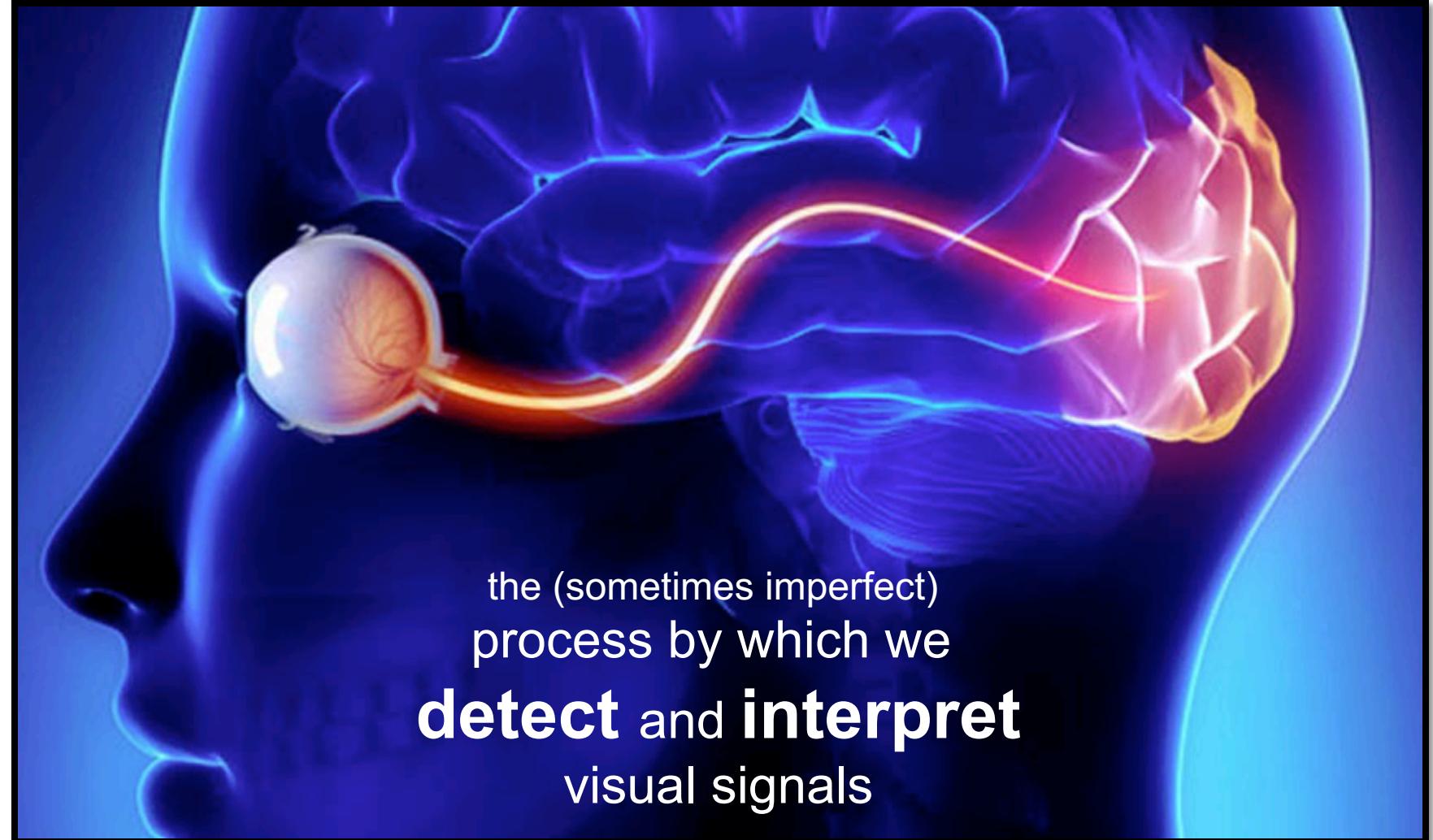
Hacking the brain

Question: what makes all this mental model stuff useful to us (designers and readers of data)?

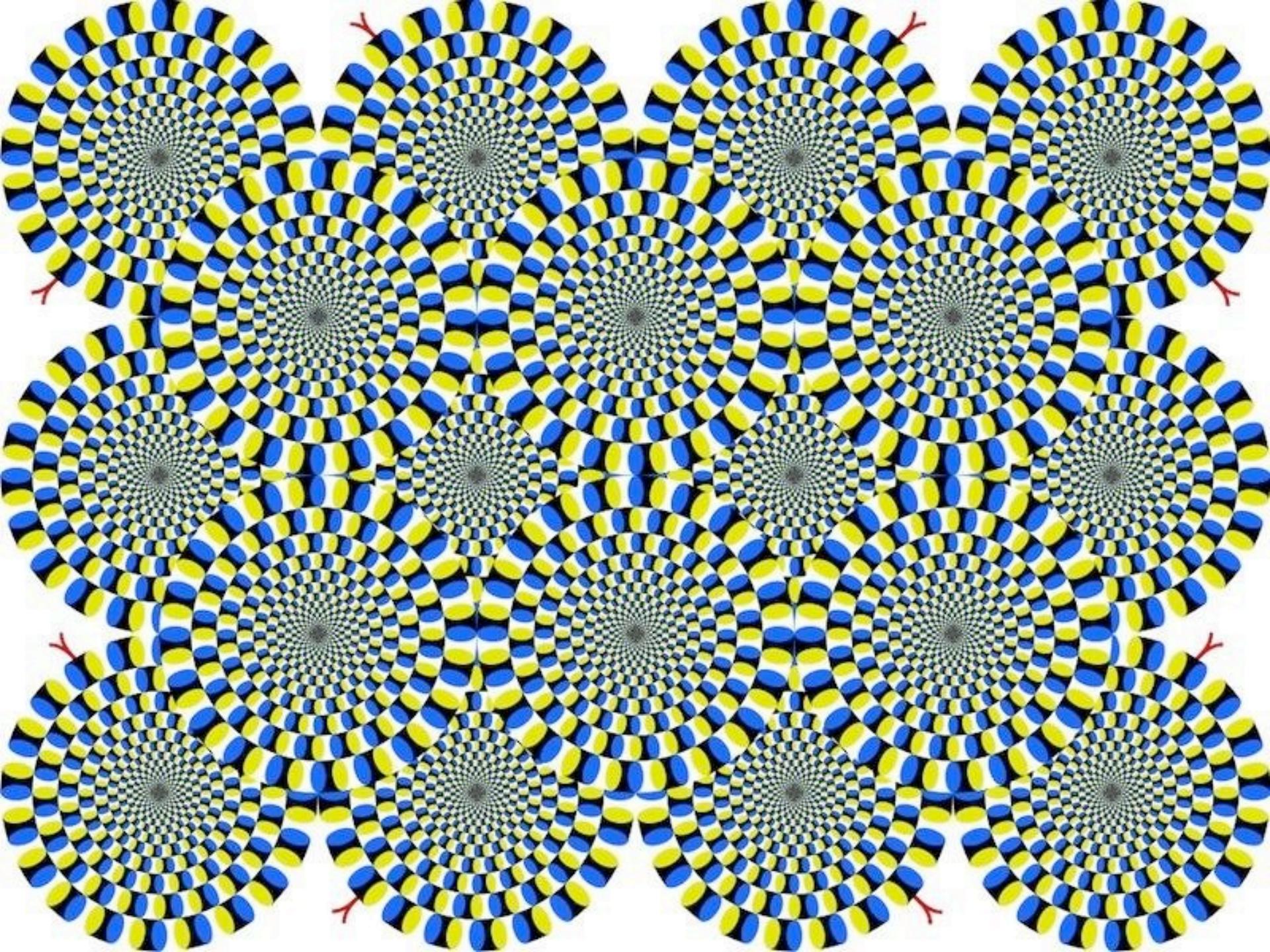
Answer: in order to understand how people interpret and make sense of data, we need to know what **cues** they're picking up on – and how to situate those cues within a larger framework

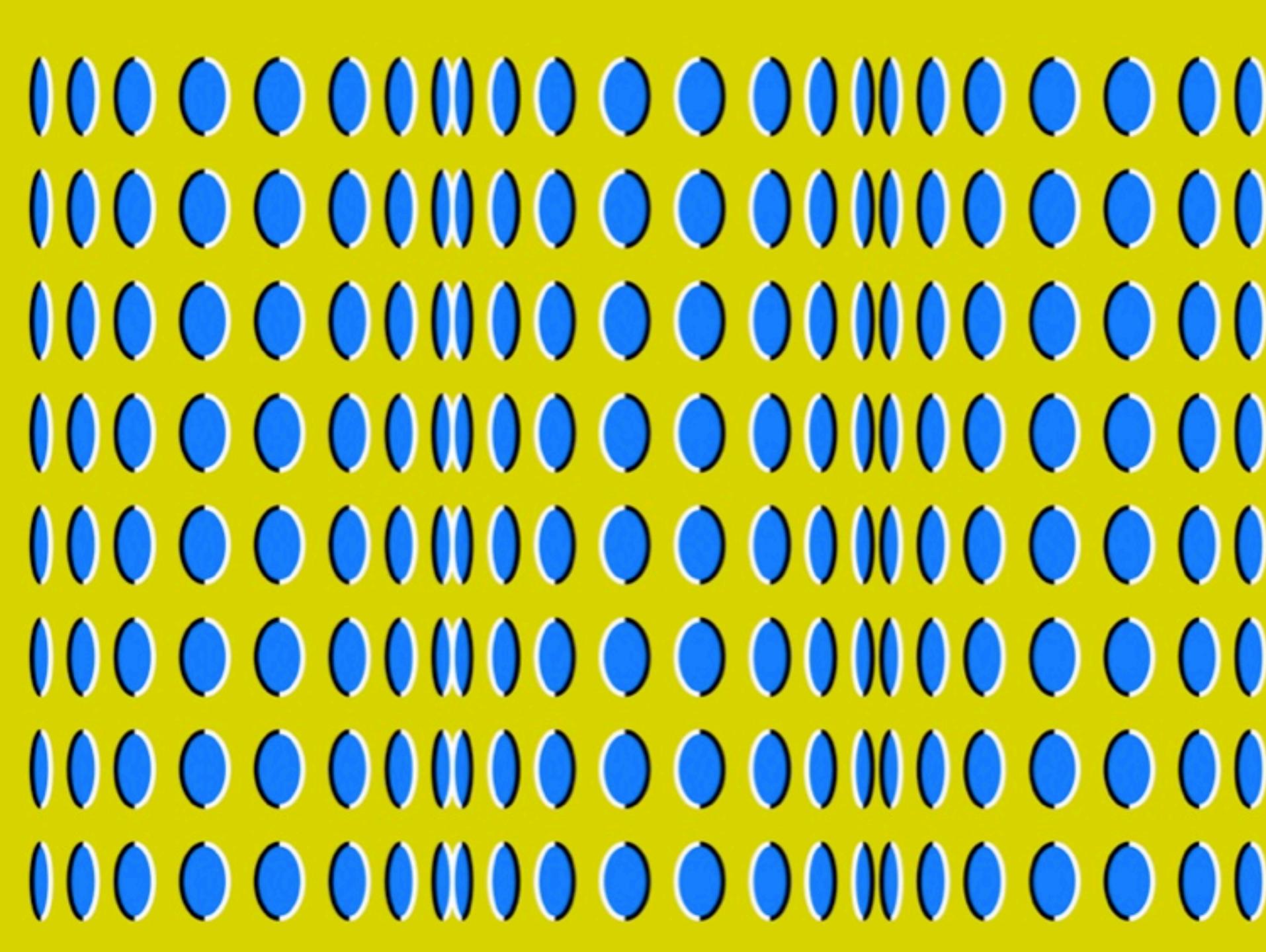


Visual perception (def.)

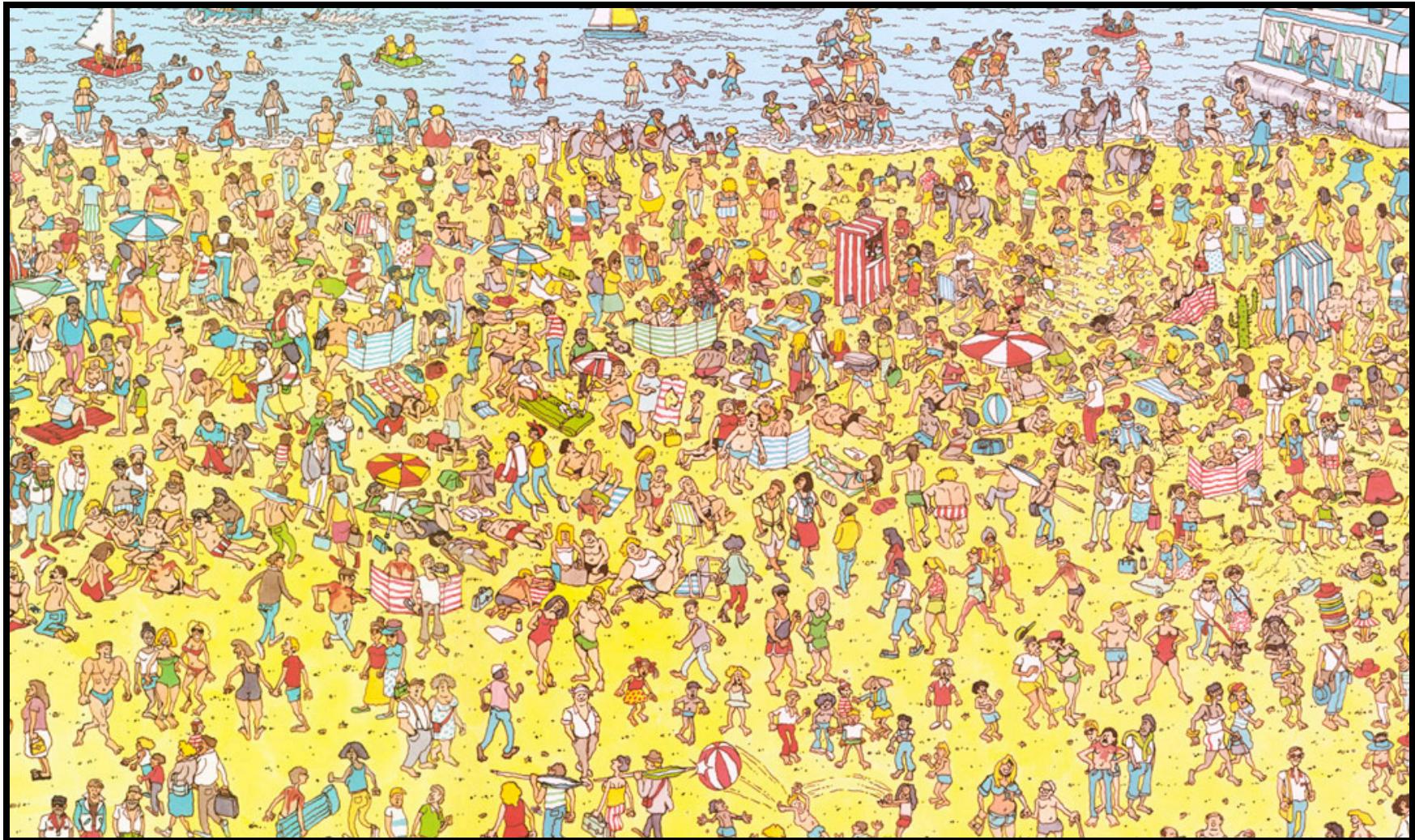


the (sometimes imperfect)
process by which we
detect and **interpret**
visual signals

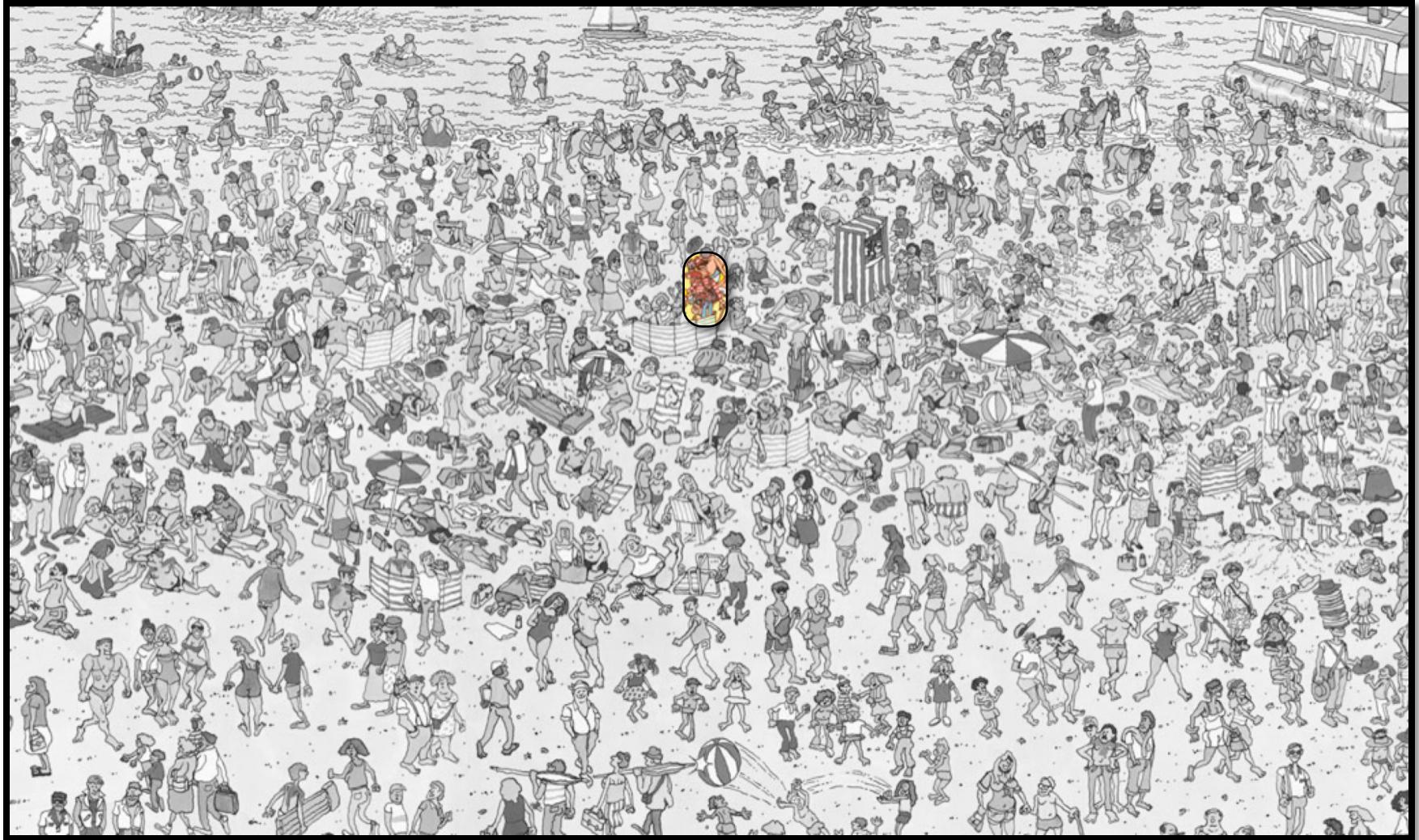




Some things are processed slowly

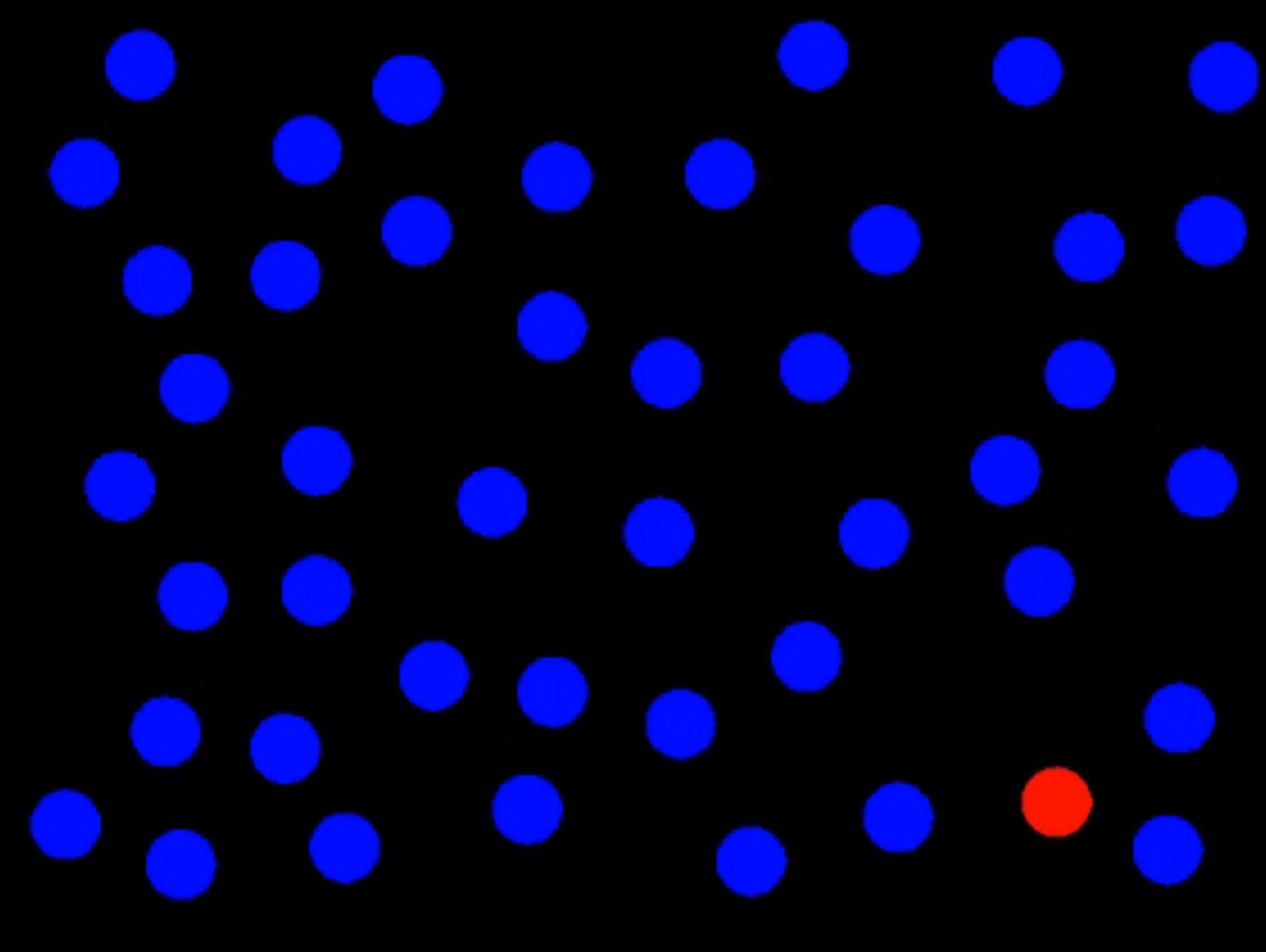


Others are incredibly fast



Fast = “pre-attentive processing”

- Things that happen in <200ms of visual stimulation
- Performed in parallel across the entire visual field
- Example:



What did you see?



Pre-attentive processing facilitates:

- Target detection (presence or absence)
- Boundary detection / grouping
- Region tracking
- Counting and estimation

Attentive counting

1281768756138976546984506985604982826762
9809858458224509856458945098450980943585
9091030209905959595772564675050678904567
8845789809821677654876364908560912949686

How many threes are there?

Pre-attentive counting

1281768756138976546984506985604982826762

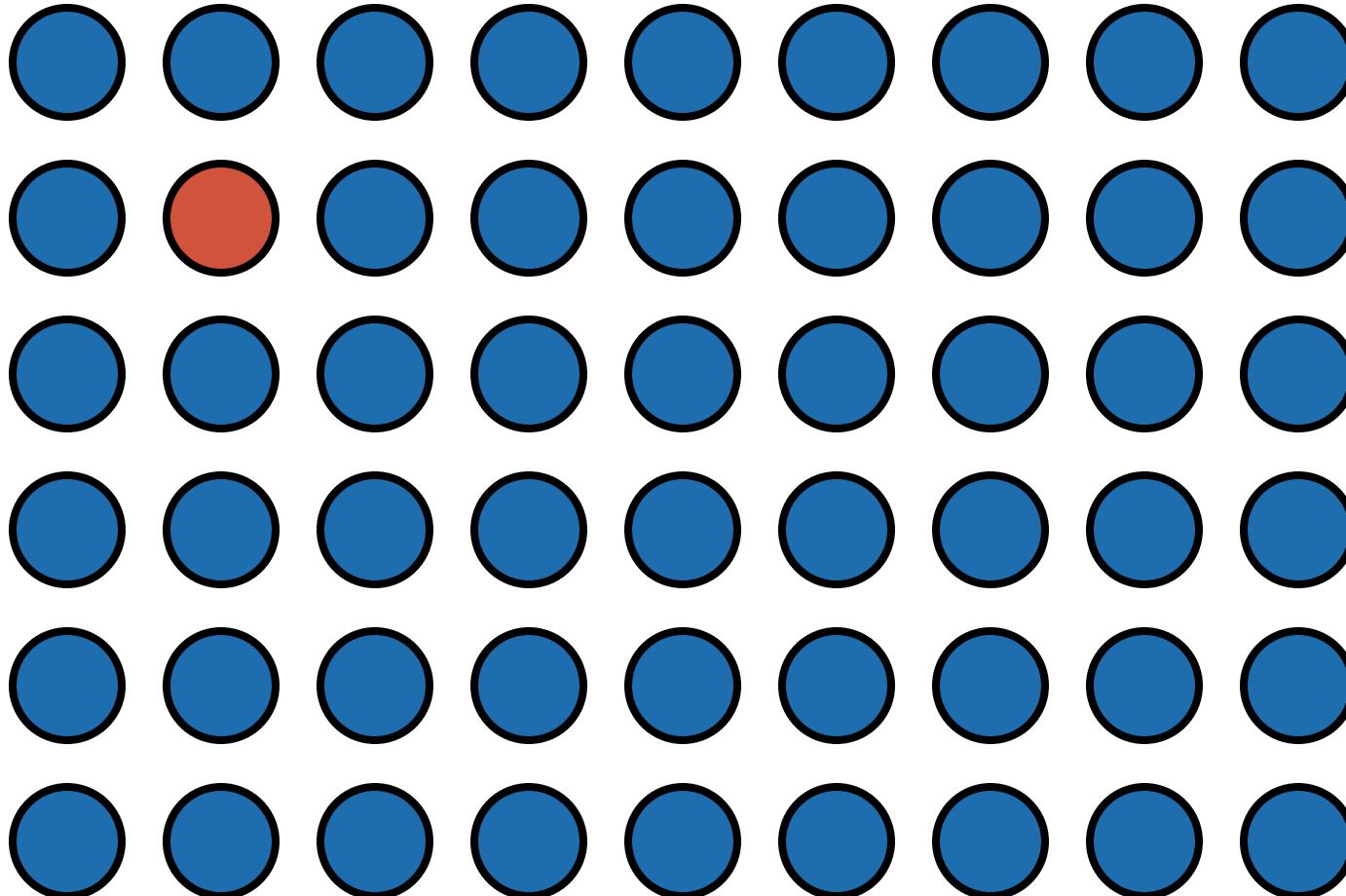
9809858458224509856458945098450980943585

9091030209905959595772564675050678904567

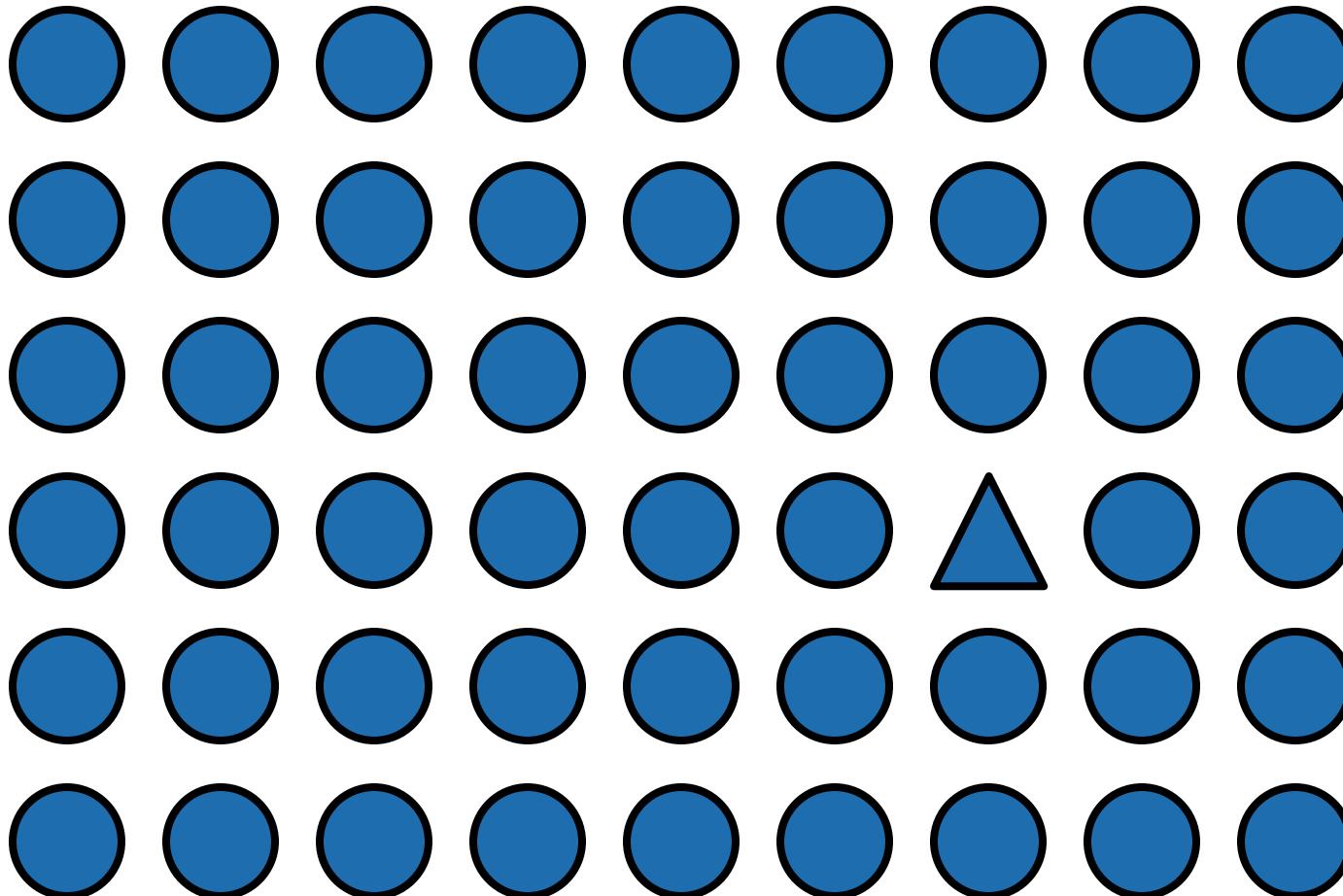
8845789809821677654876364908560912949686

How many threes are there?

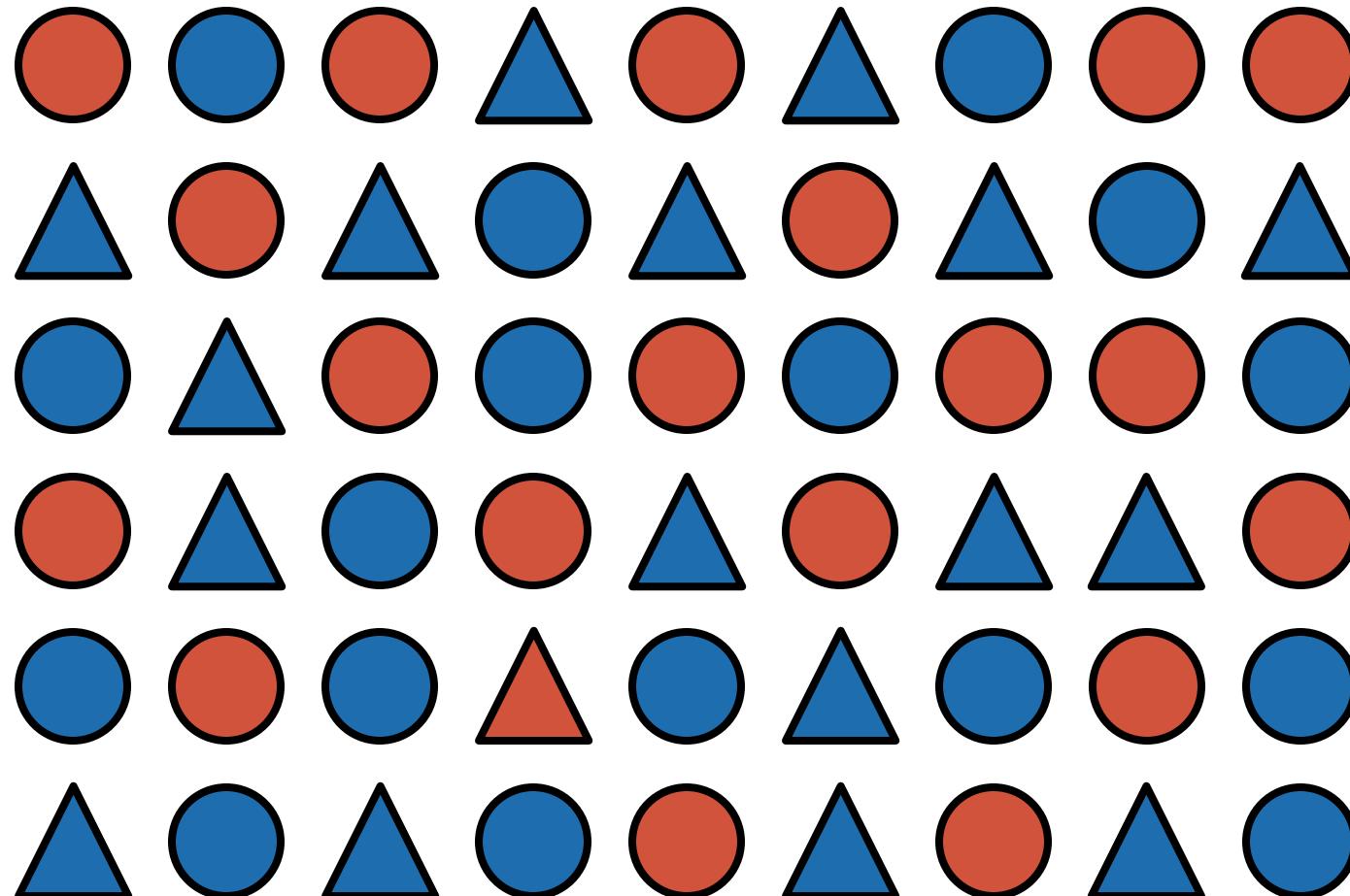
Pre-attentive processing: color (hue)



Pre-attentive processing: shape (curvature)



Pre-attentive processing: shape + color?



Discussion: what's going on here?

- **Answer:** this is called “conjunction”
 - If you search for **red** things, you get a bunch of **red** circles (as well as the **red triangle**).
 - Similarly, if you search for **triangles**, you get a bunch of **blue triangles** (as well as the **red triangle**).
 - Either way, you have to search through them all one by one!



Pre-attentive processing for visualization

- Whatever draws our eyes draws our attention
- This can be useful
- It can also be problematic:

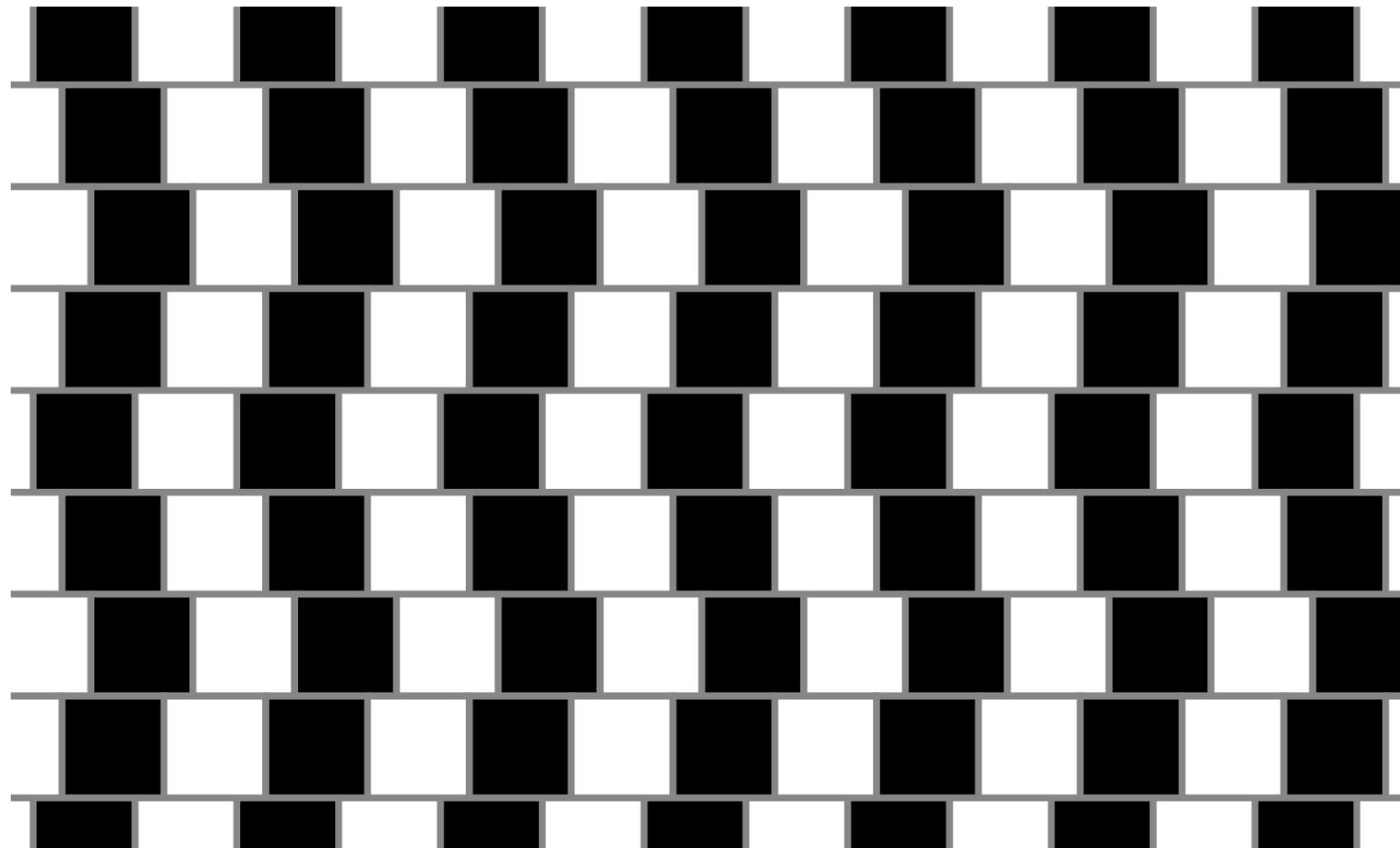
Ex. flicker can cause change blindness



Can you see it now?



Sometimes gestalt & pre-attention compete



Sometimes gestalt & pre-attention compete



Magnitude estimation

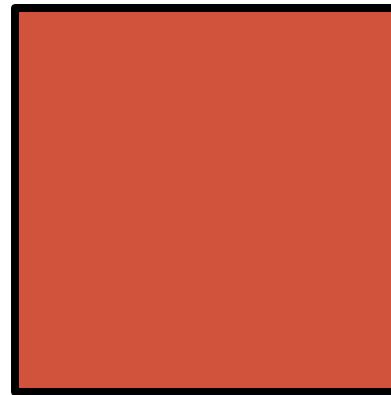
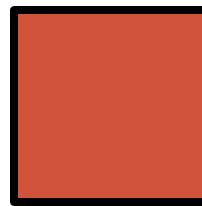
Question: How much **bigger** is the lower bar?



Answer: 2x

Magnitude estimation

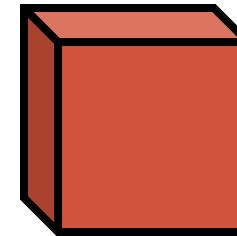
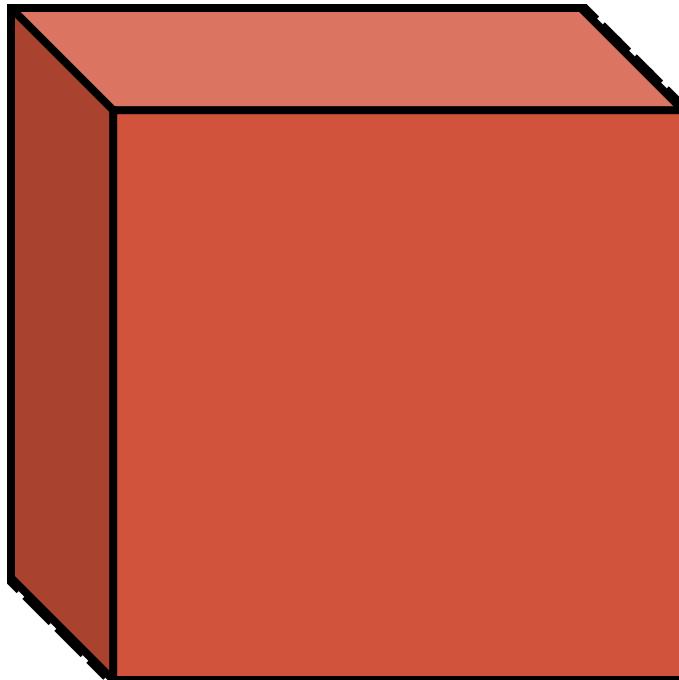
Question: How much **bigger** is the right square?



Answer: 4x

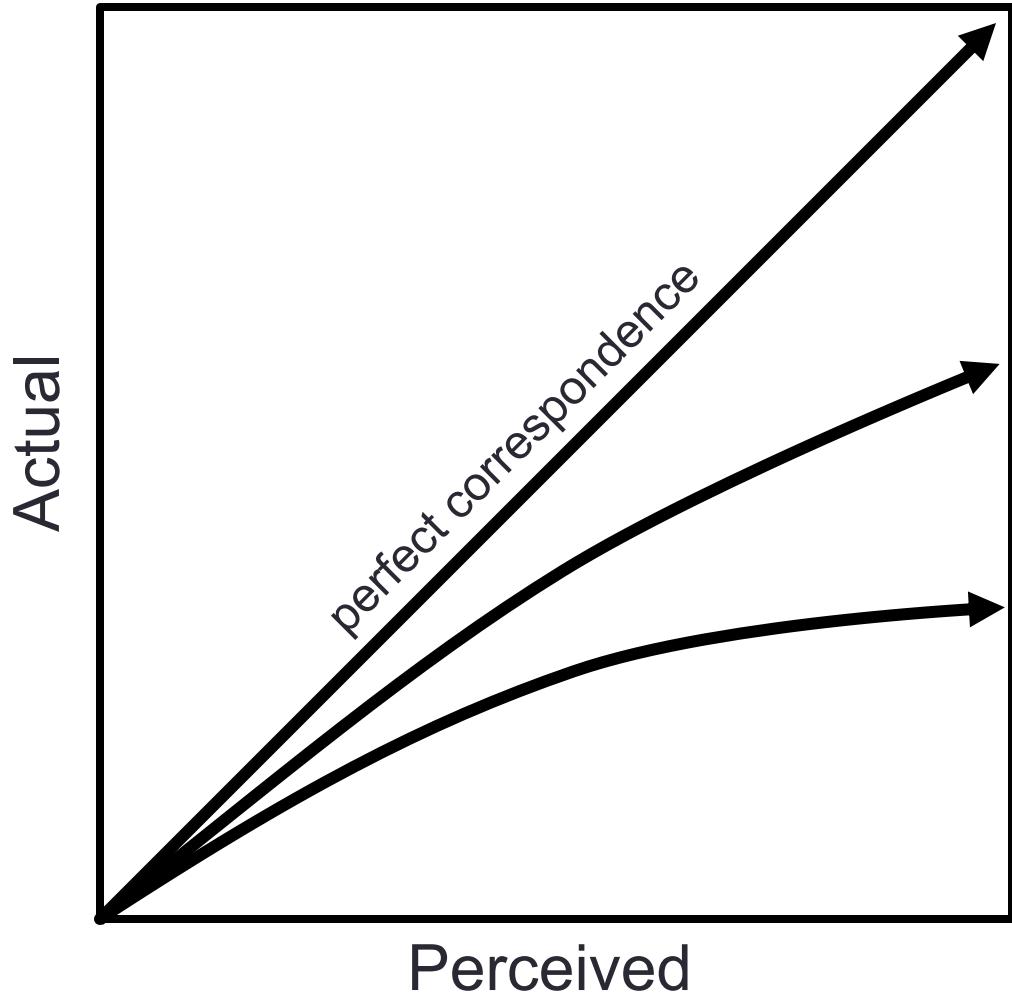
Magnitude estimation

Question: How much **bigger** is the left cube?

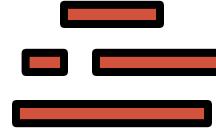


Answer: 27x

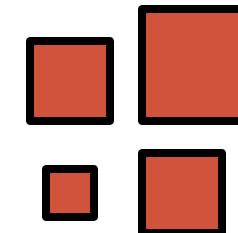
“Apparent” magnitude



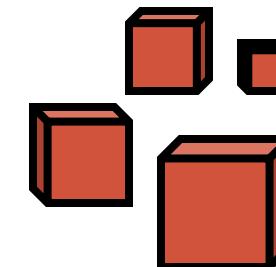
Length
estimate
correctly



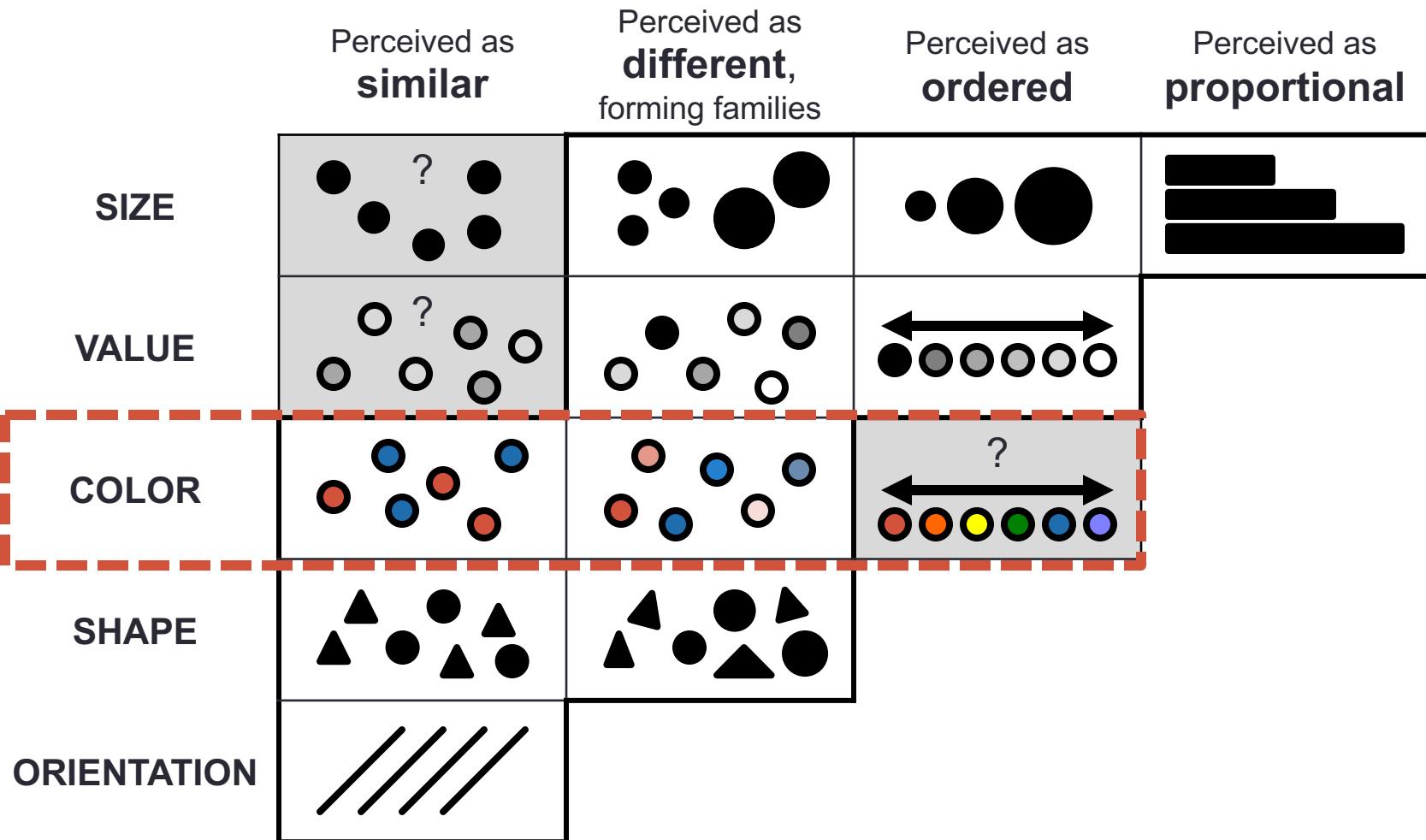
Area
under-
estimate



Volume
way under-
estimate



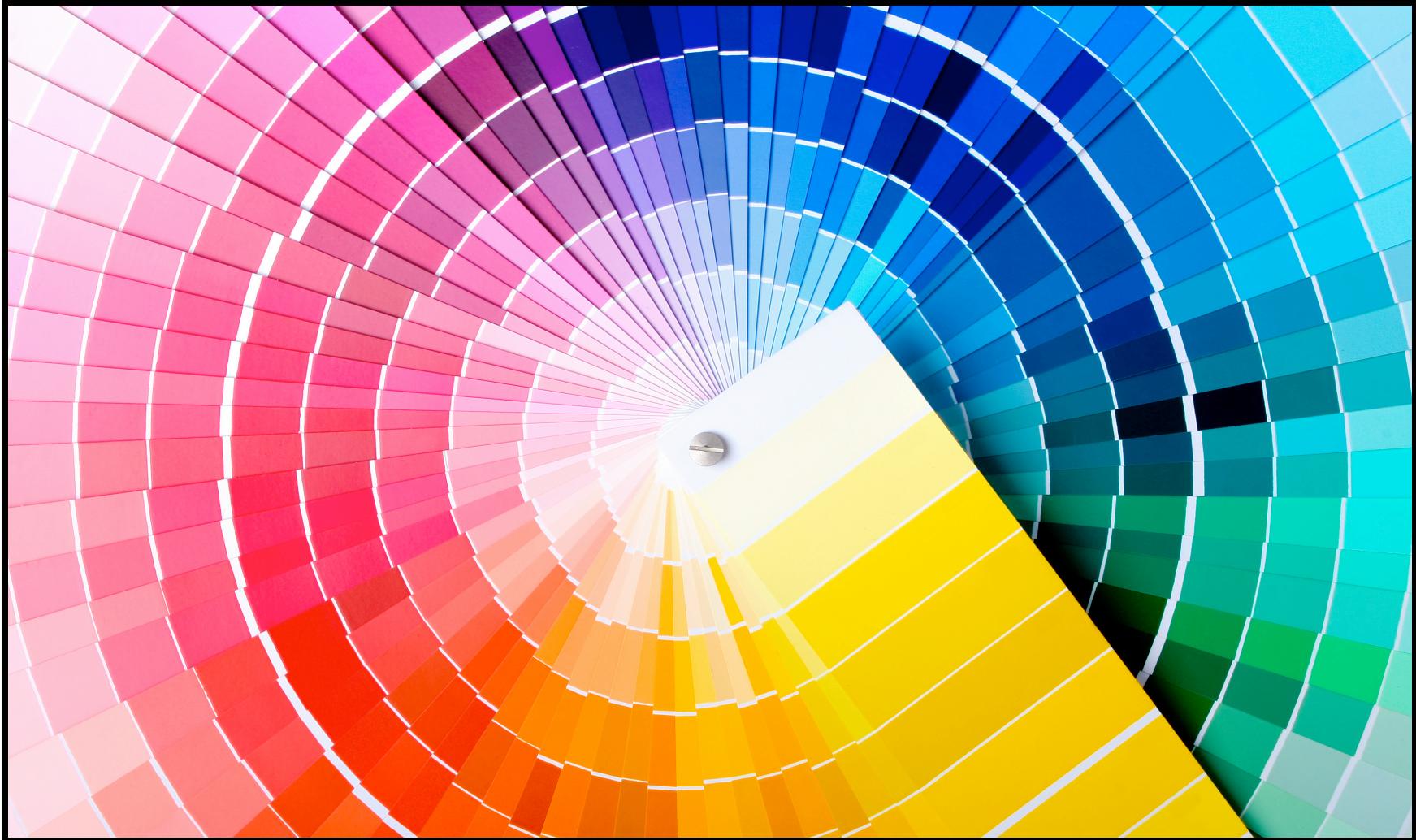
Mapping to visual dimensions



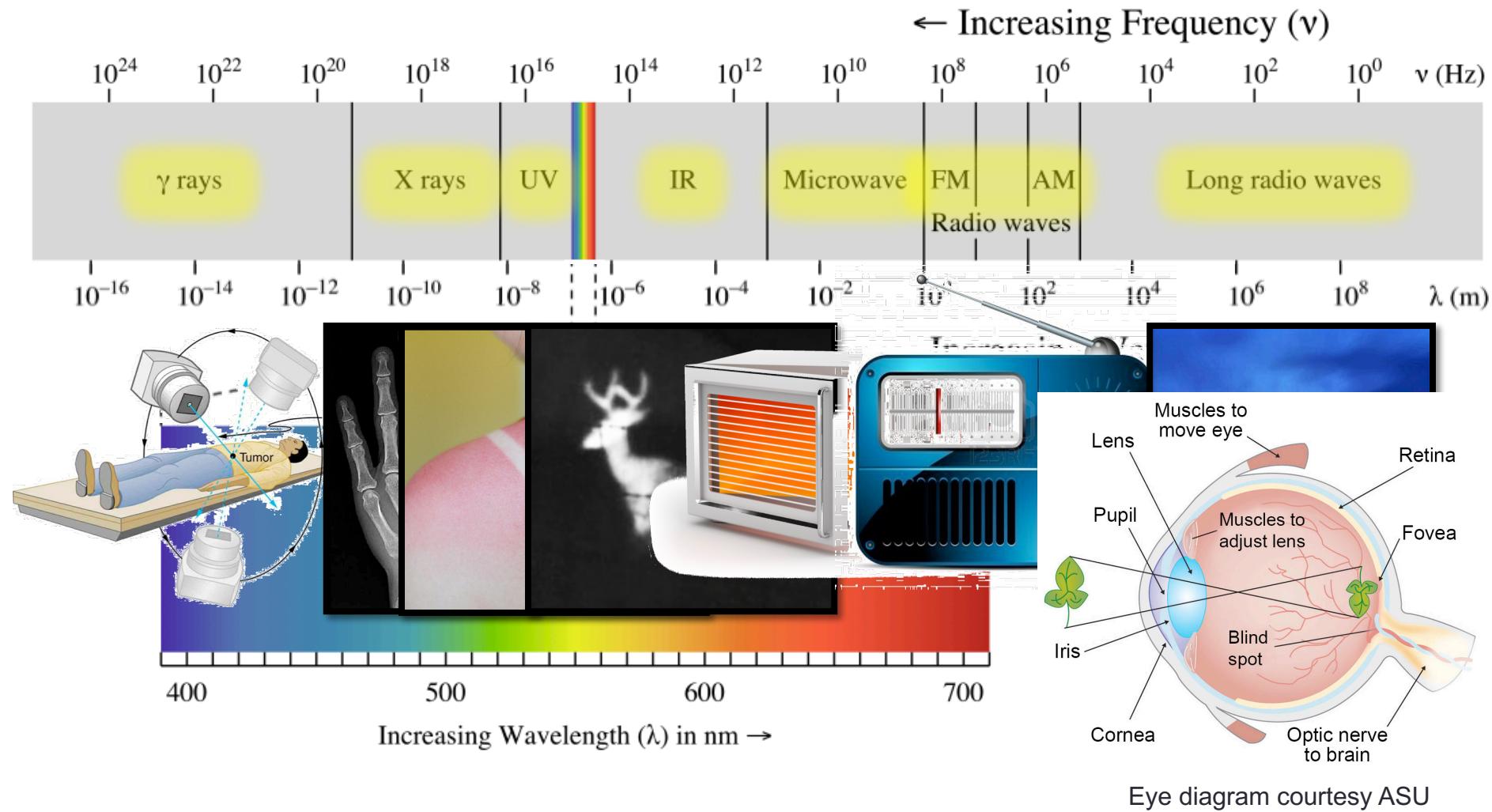
Back in 10 minutes



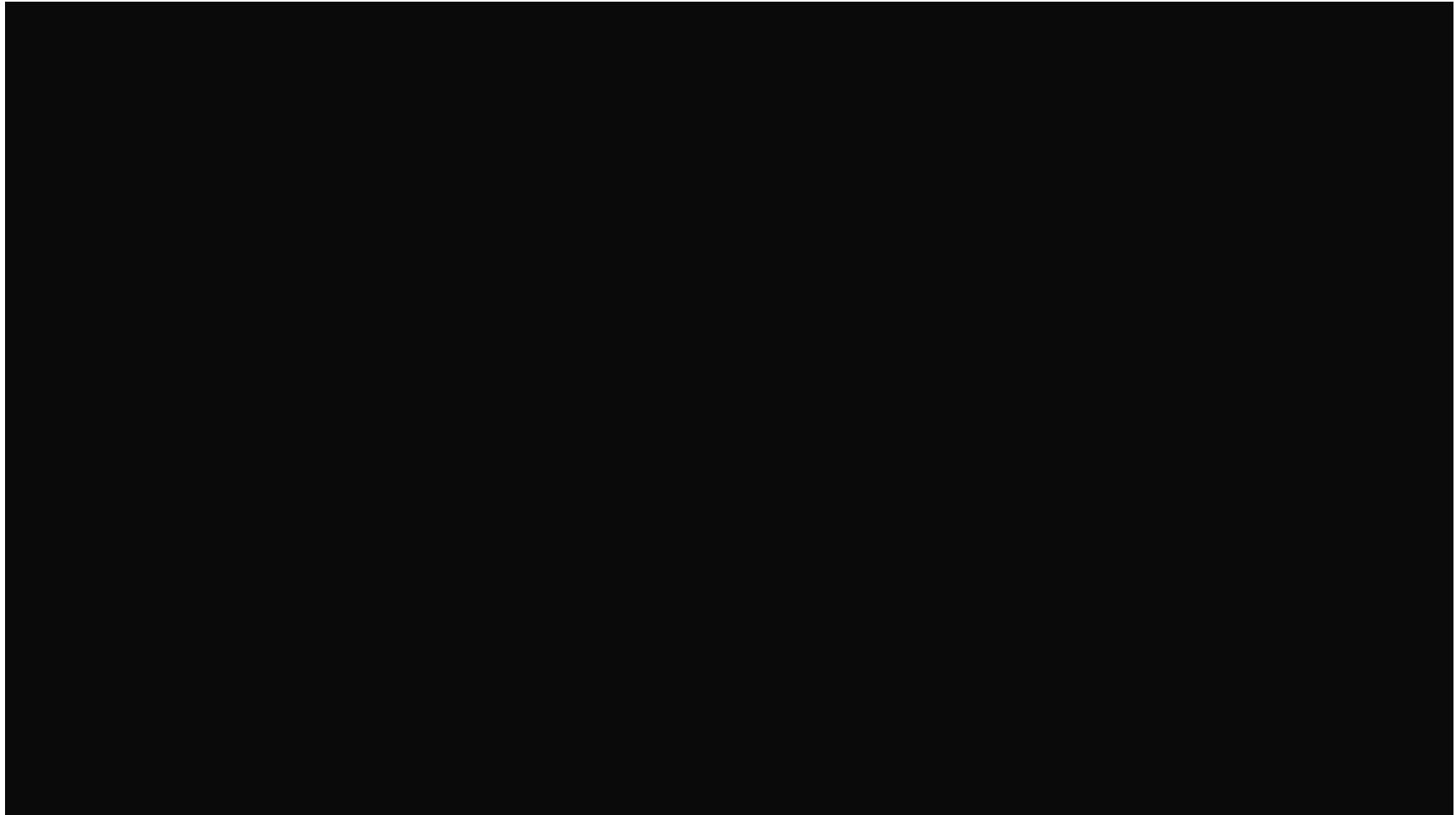
Color 101



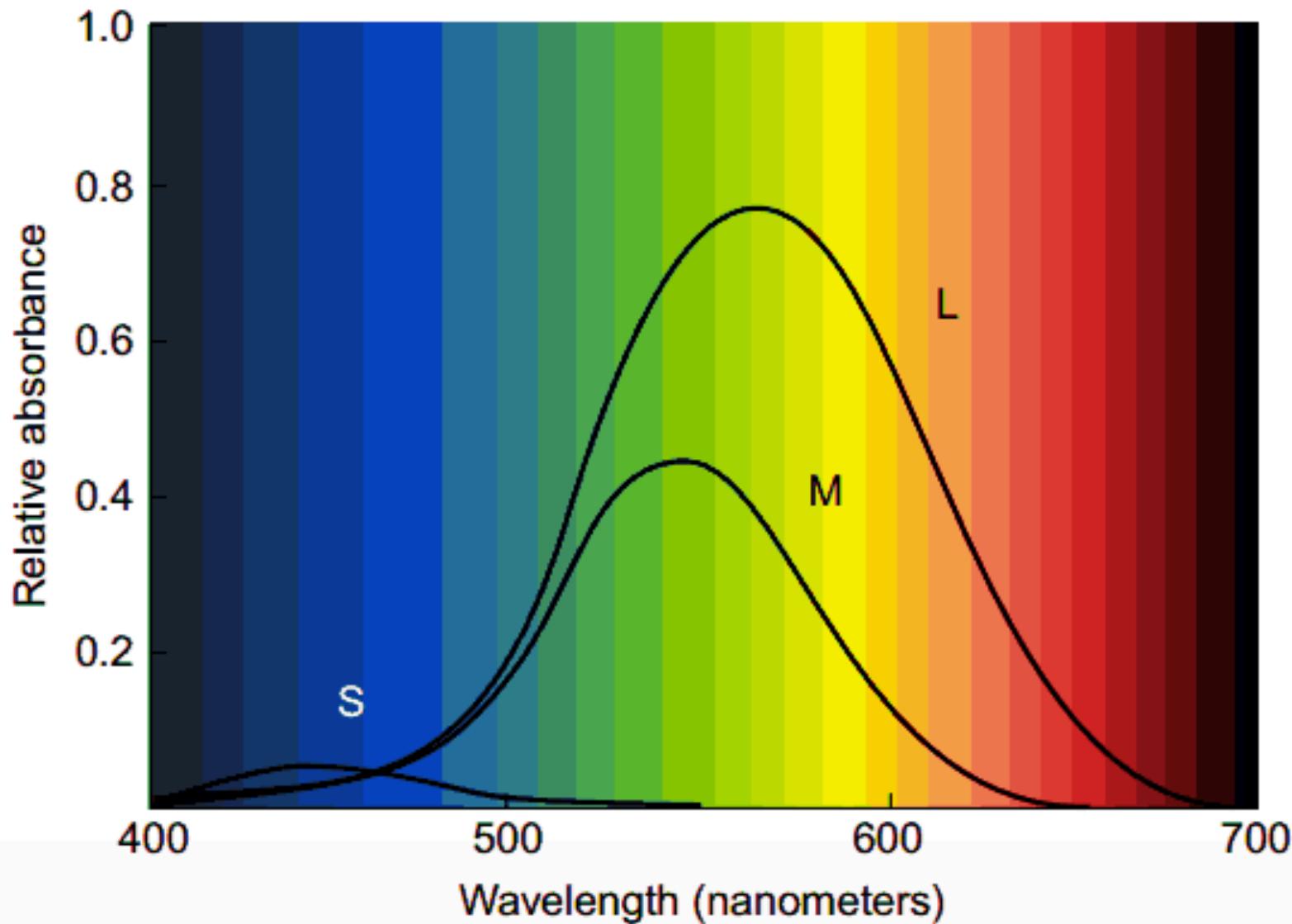
Kinds of light



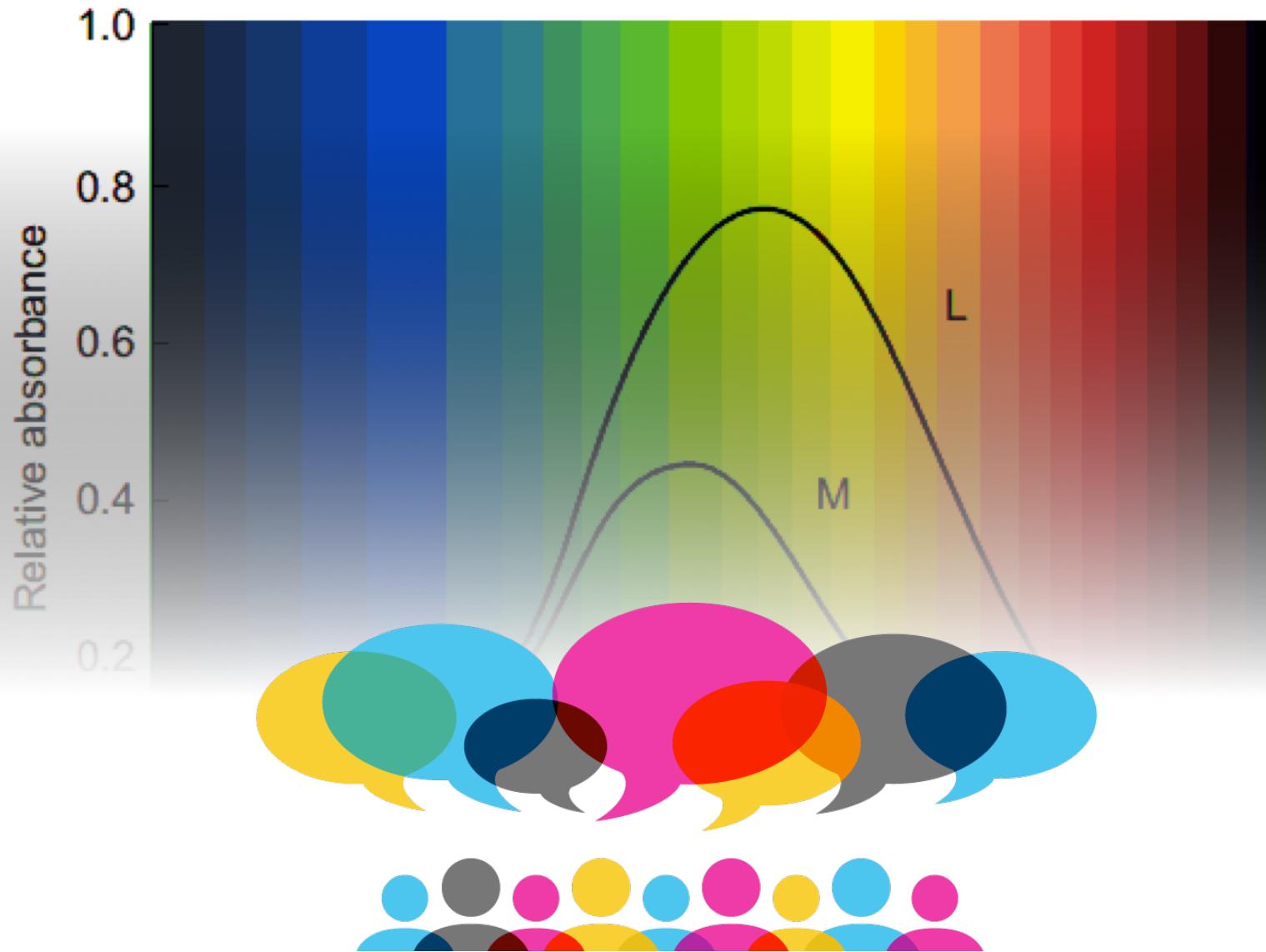
How we see color



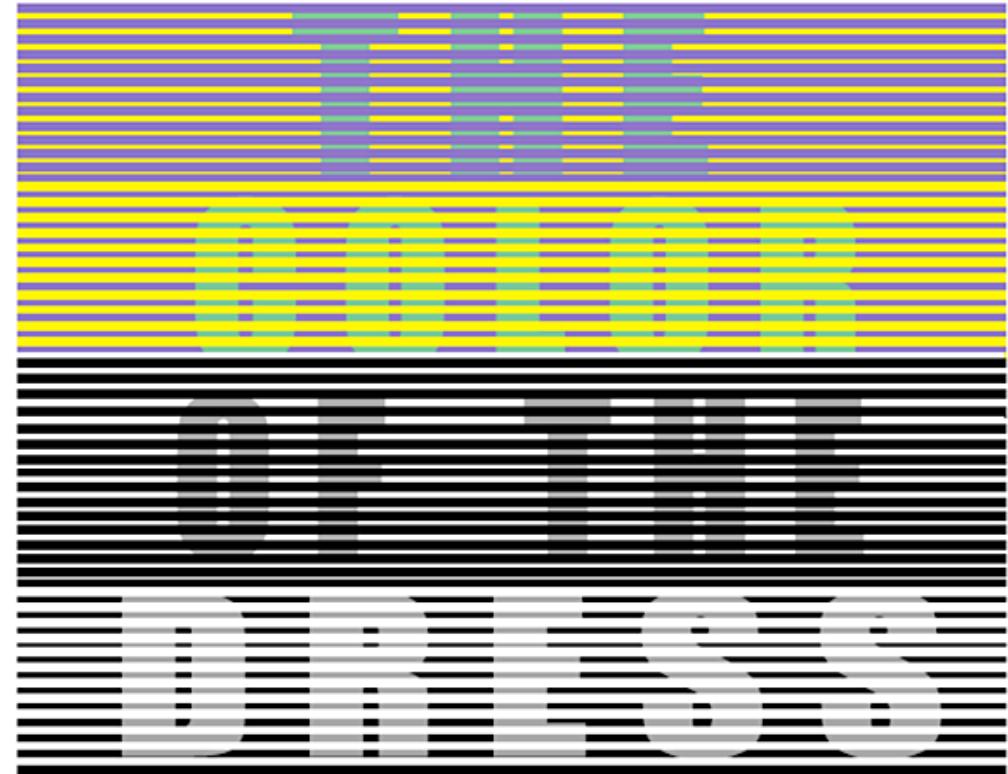
3 kinds of color sensors



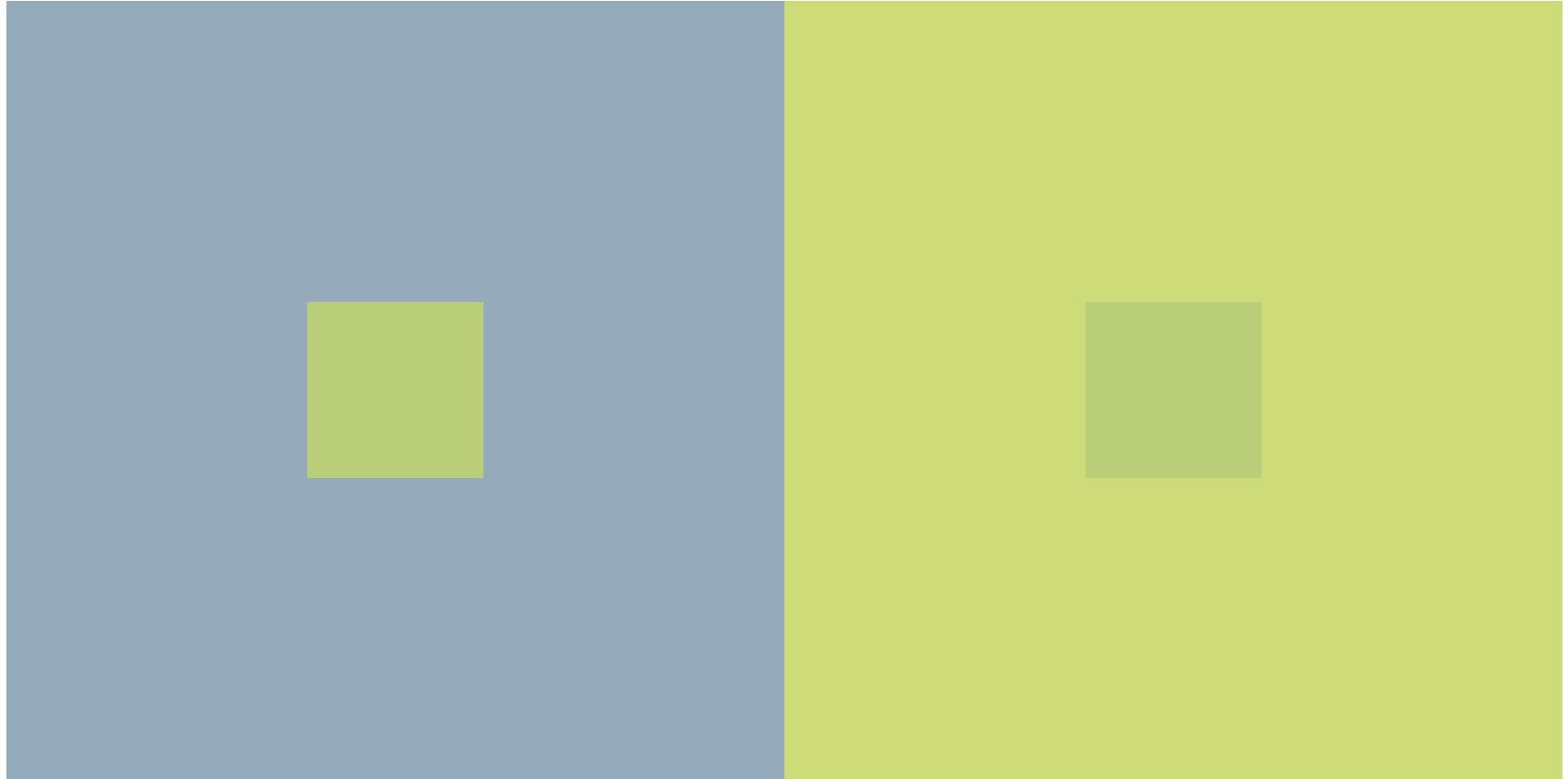
Discussion: what do you notice?



Color phenomena



Caveat 1: color is perceived in context



Which small square is **darker green**?

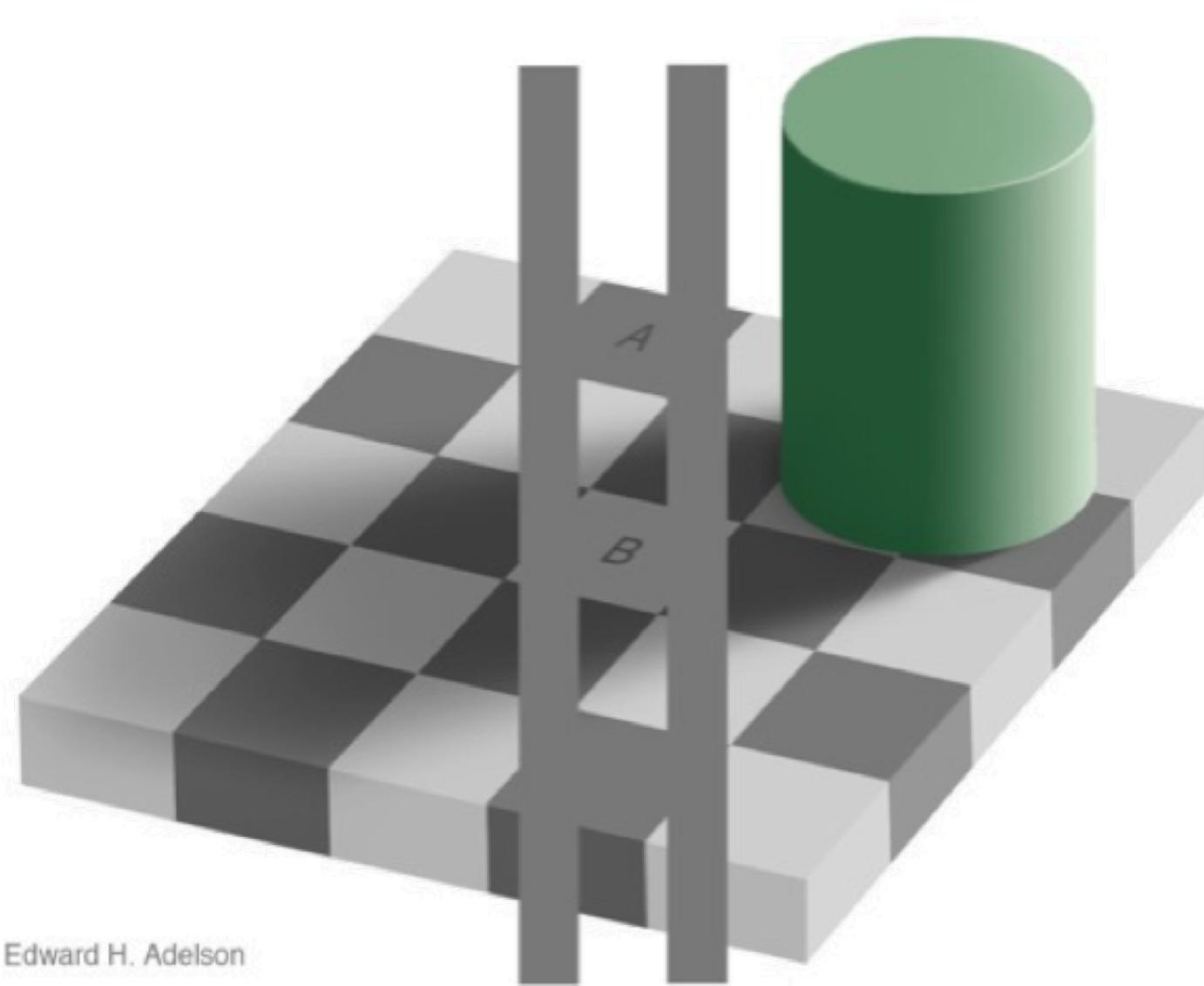
Caveat 2: difference is relative



Caveat 2a: so are brightness and contrast



Caveat 3: mental models > perception

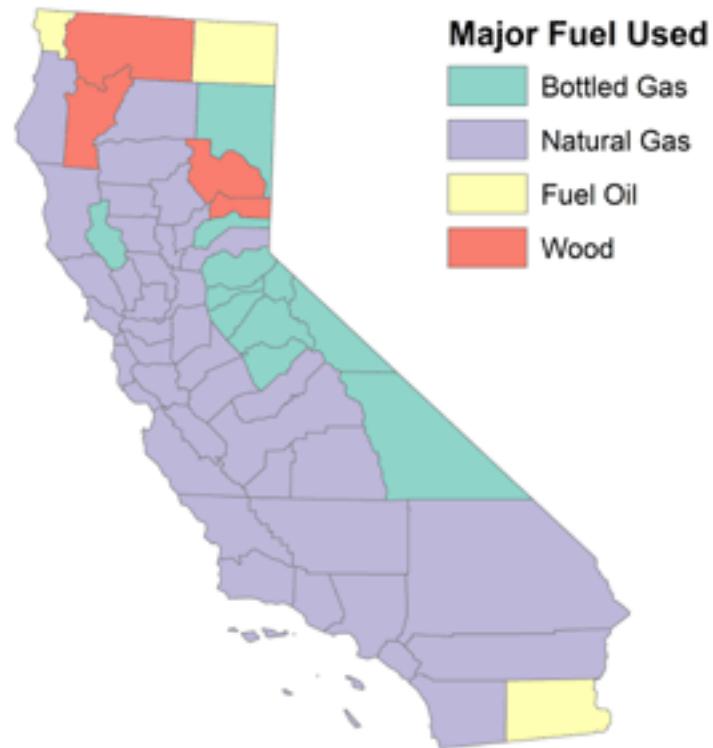


Takeaways: Perception

- Visualization is about more than just aesthetics
- There are compelling **cognitive reasons** why some visualization techniques are helpful and others aren't
- The choices we make about **visual mappings** can have a significant effect on performance

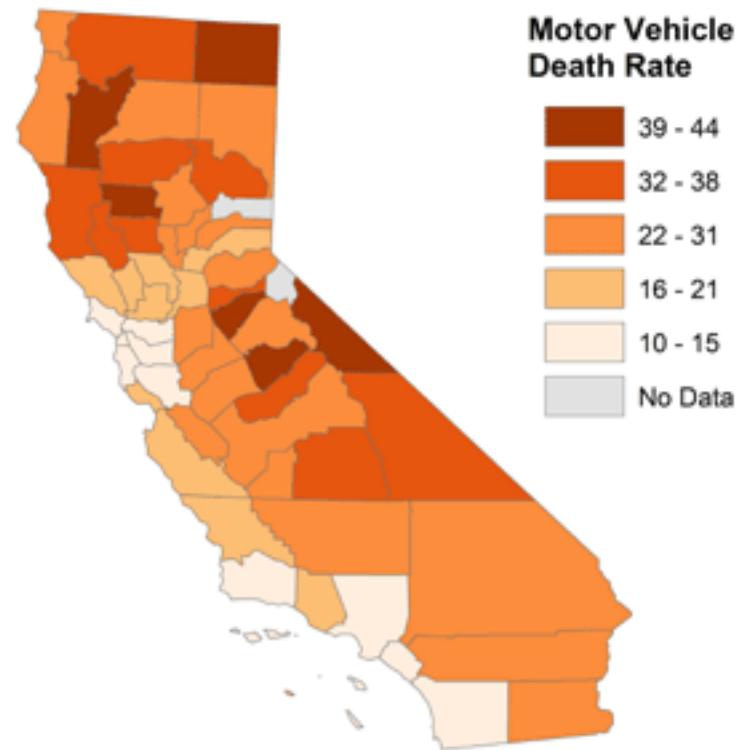
Categorical color schemes

- Different color = different category
- **Protip #1:** choose colors that are *perceptually distant*
- **Protip #2:** choose colors that are roughly the same saturation and value



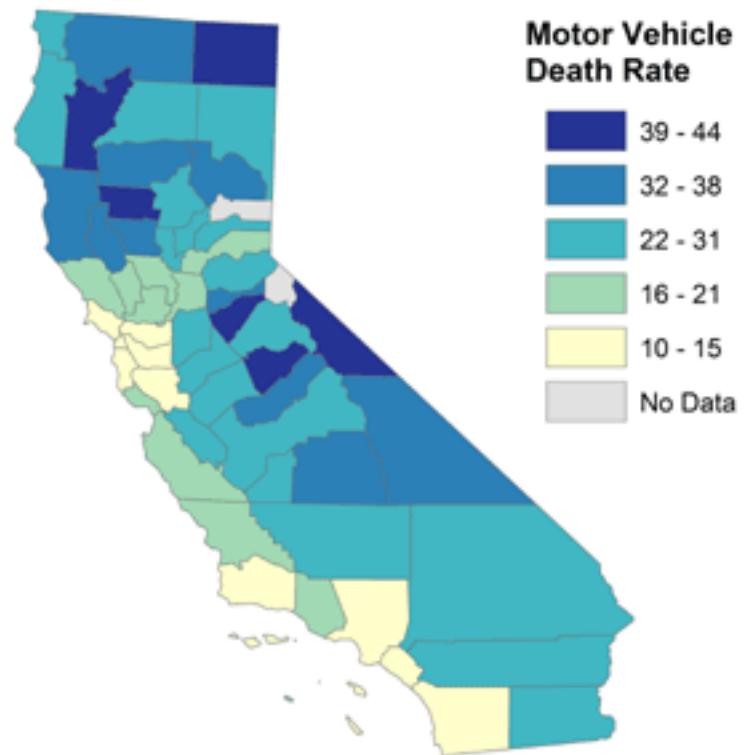
Sequential color schemes: one hue

- **Saturation** indicates difference in the amount of the phenomenon
- **Protip #1:** no more than 5-6 levels
- **Protip #2:** people interpret darker = more



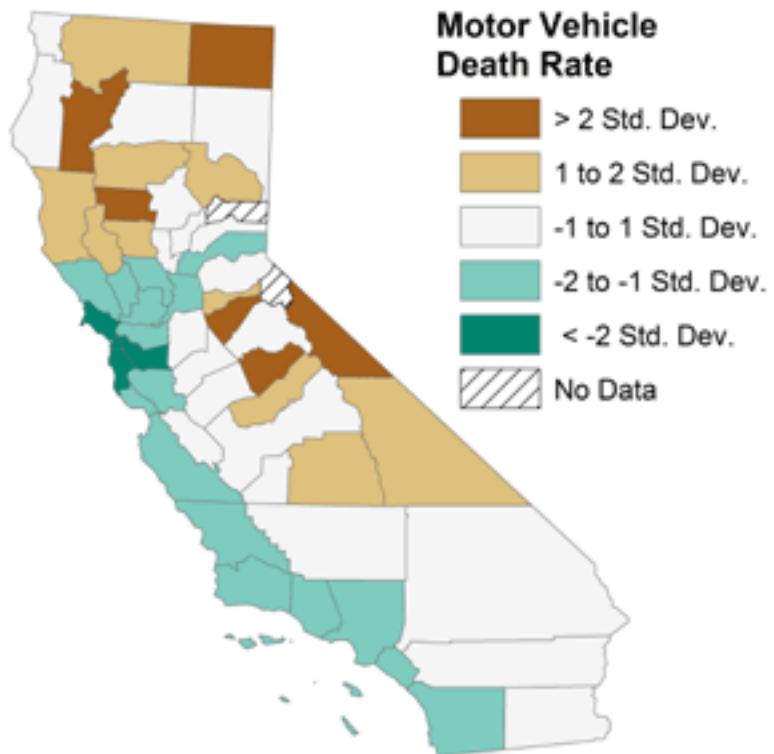
Sequential color schemes: multi-hue

- Hue indicates difference in the amount of the phenomenon
- **Protip #1:** no more than 2 anchor colors
- **Protip #2:** people interpret high saturation = more



Diverging color schemes

- Two colors used to indicate extremes of a range
- Protip #1: neutral color in the middle
- Protip #2: differentiate between “average” and “no data”



Lab 3: colorbrewer and ggthemes

ColorBrewer and ggthemes

Secure https://jcrouser.github.io/datavis/lab-colorbrewer-ggthemes.html

MassMutual DSDP - DataVis Workshop 2017

Home Schedule Resources ▾ Labs ▾

Introduction

- Setting up
- Drawing a ggplot
- Changing colors manually
- Changing colors with RColorBrewer
- Stylizing using ggthemes
- Putting it all together

ColorBrewer and ggthemes

Introduction

Goal: by the end of this lab, you will be able to use `colorbrewer` and `ggthemes` to customize the look of your visualization.

Setting up

For this lab, we're going to be using the `ToothGrowth` dataset, which is one of the example datasets included in `R`. It contains data on how fast guinea pigs' teeth grow if you give them vitamin C supplements in various forms and at various doses. You can learn more about this dataset by typing `?ToothGrowth` at the console.

