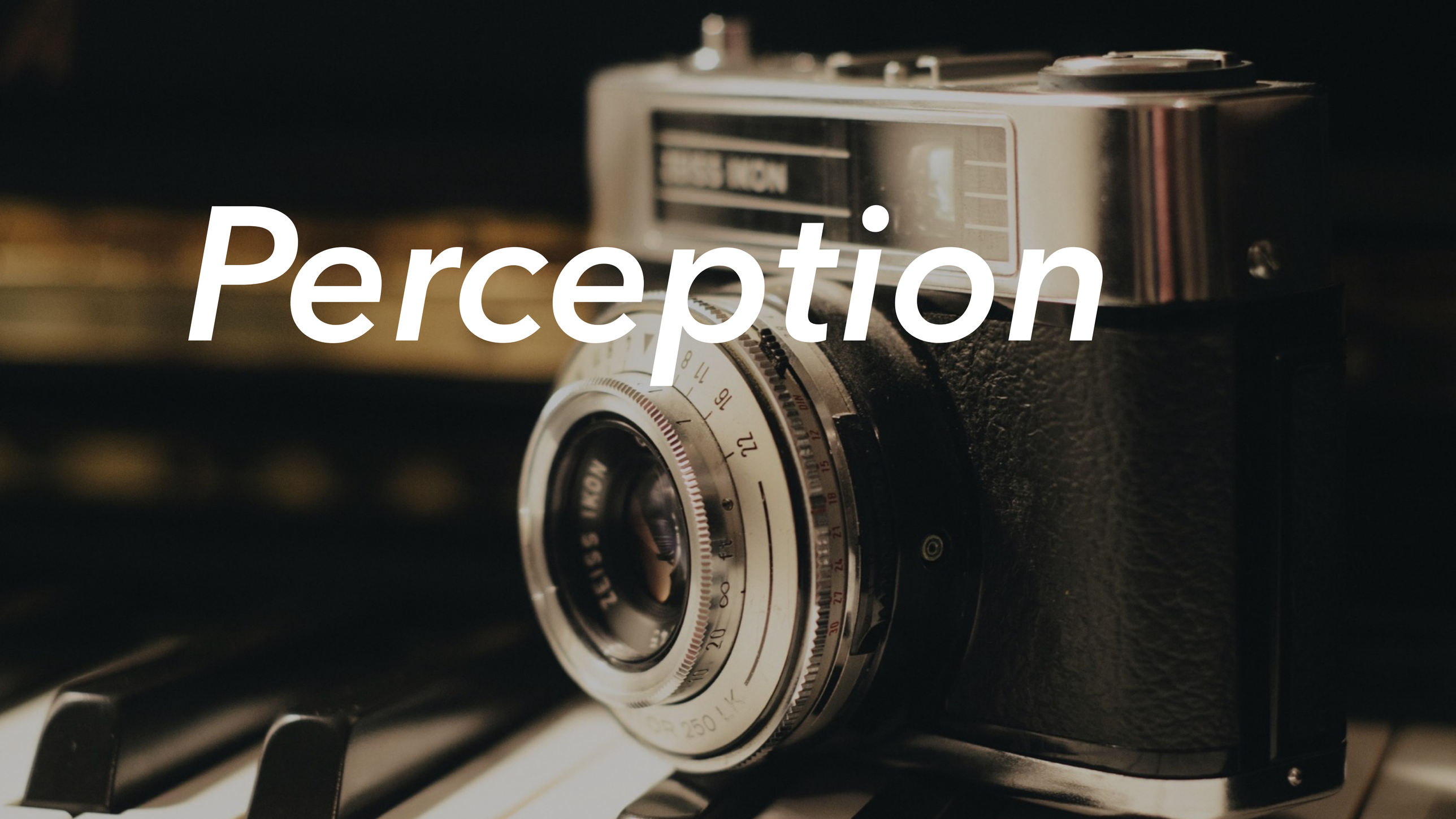
Assignment 1 and the R +ggplot2 example…

Make something beside a scatterplot

GRADE EMAIL TEST

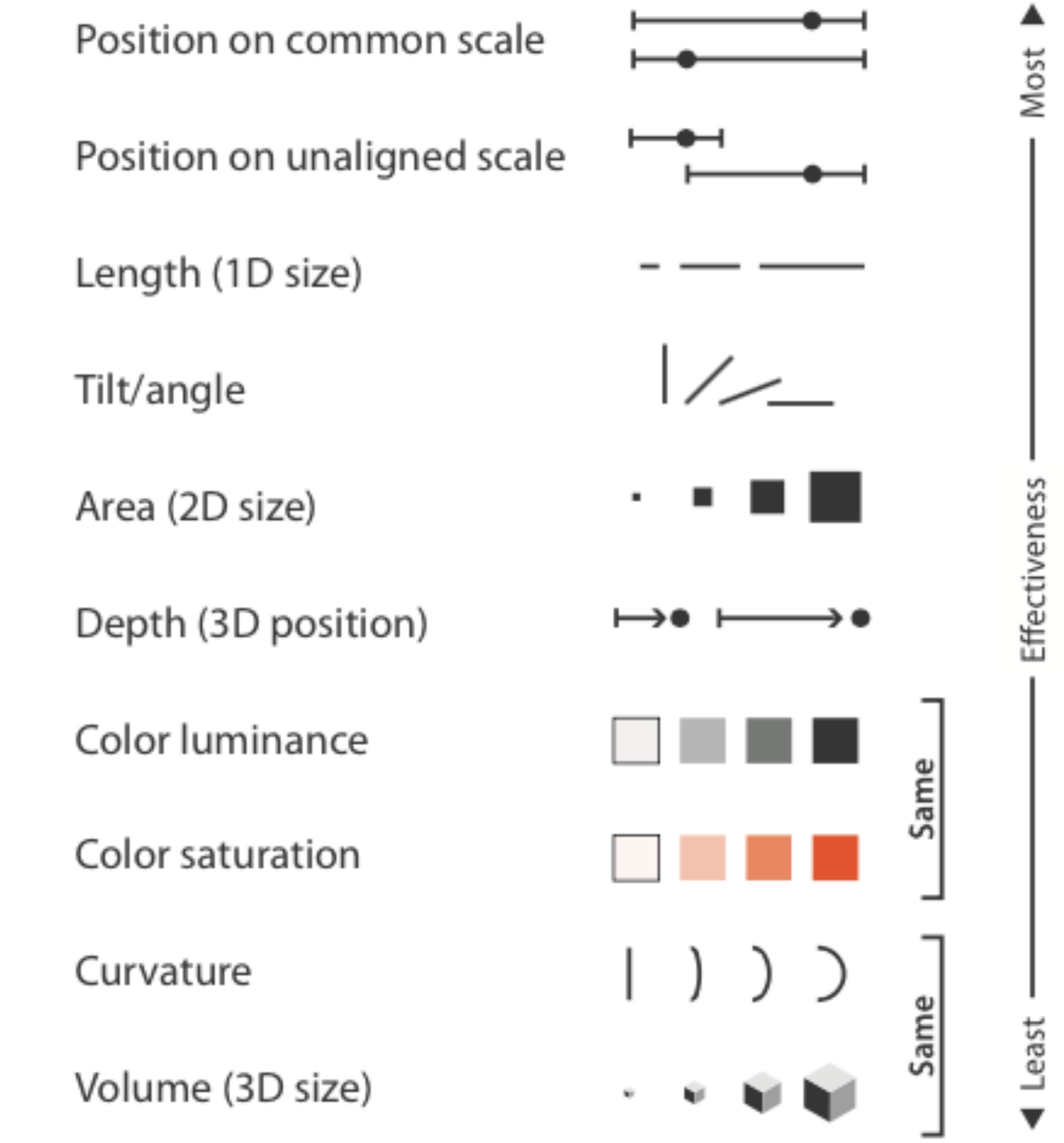
Visual Channels and Data Mapping

Perception and Cognition


Perception

Perception (Channels)

Magnitude Channels: Ordered Attributes



Position (Common Scale)

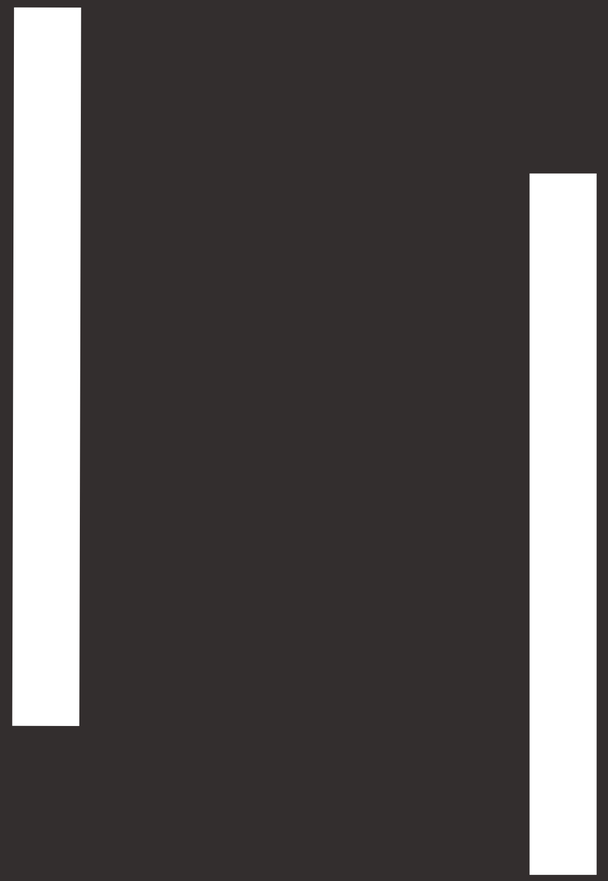
-scatterplots

-bar charts

-line charts

-???

Position (Un-aligned Scale)



-stacked bars

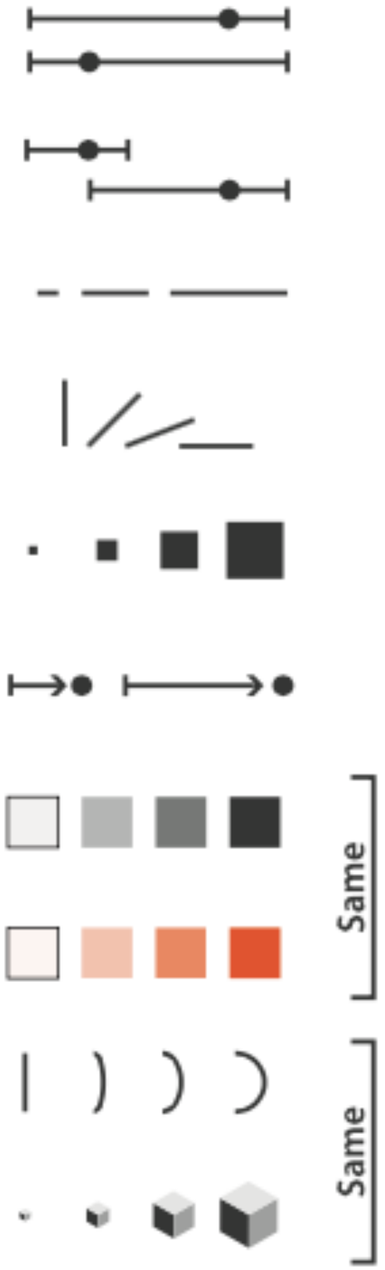
-stacked area

-???

Identity

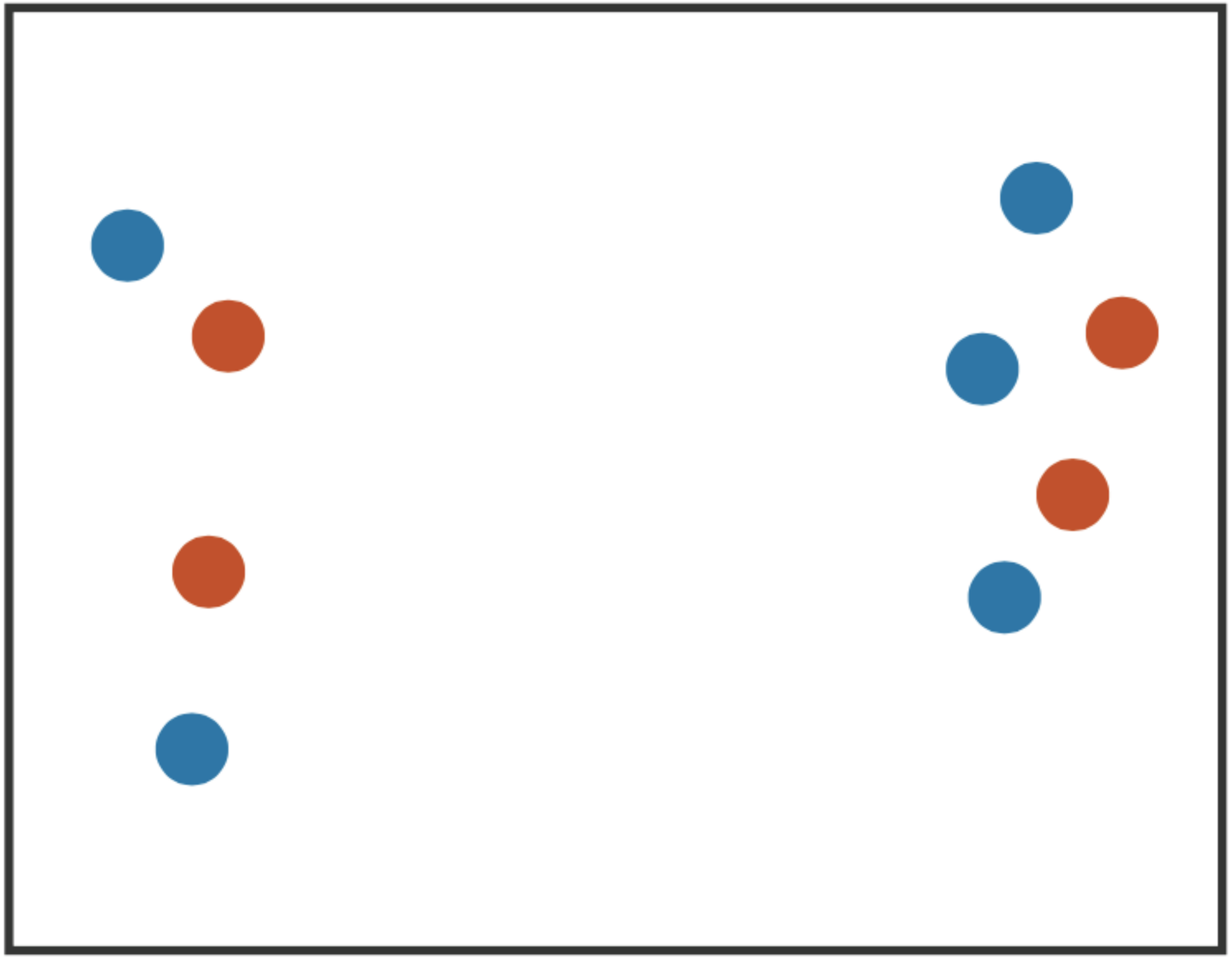
Magnitude Channels: Ordered Attributes

- Position on common scale
- Position on unaligned scale
- Length (1D size)
- Tilt/angle
- Area (2D size)
- Depth (3D position)
- Color luminance
- Color saturation
- Curvature
- Volume (3D size)



Identity Channels: Categorical Attributes

- Spatial region
- Color hue
- Motion
- Shape

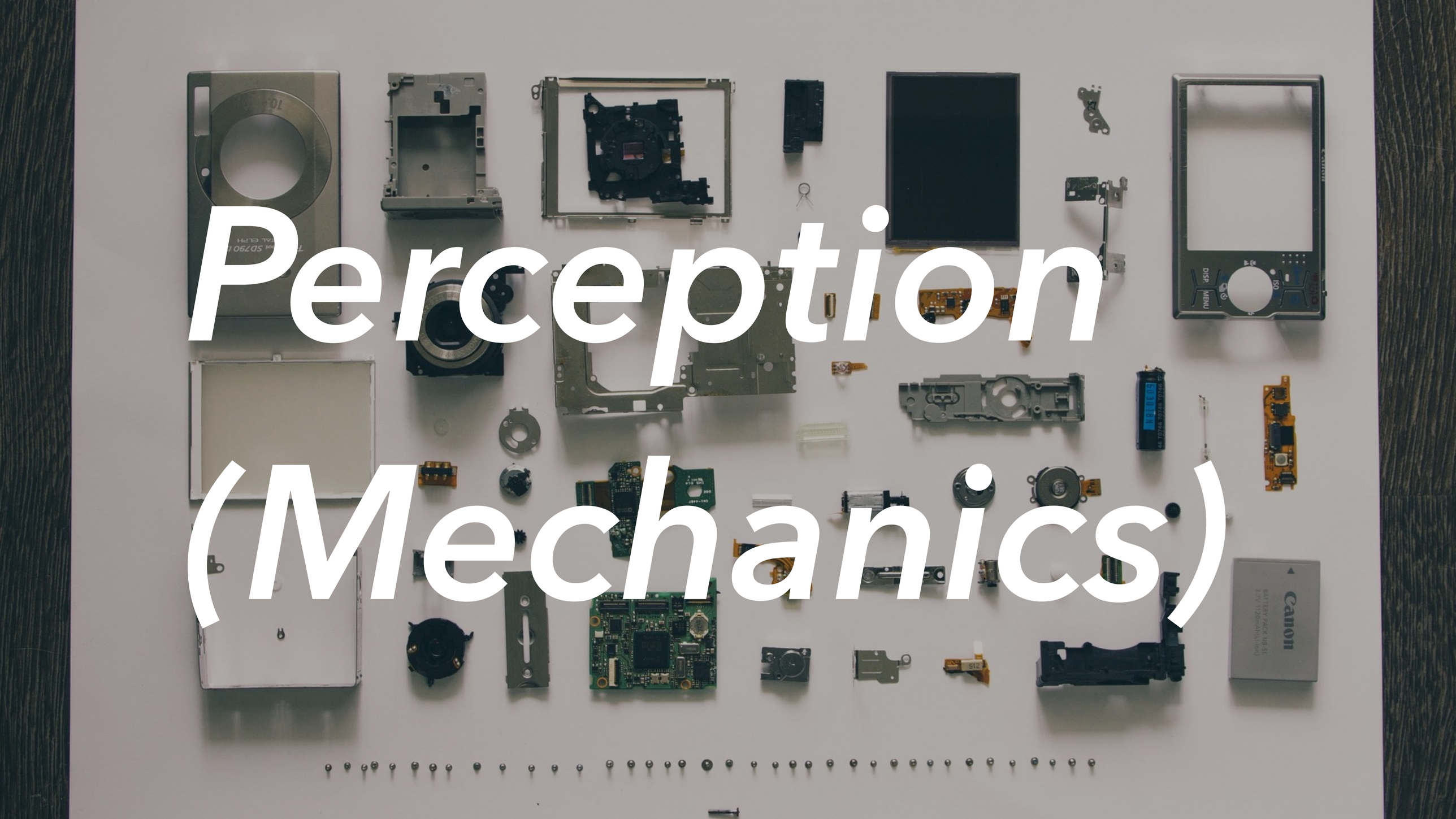


Spatial Region

Hue sucks for magnitude:

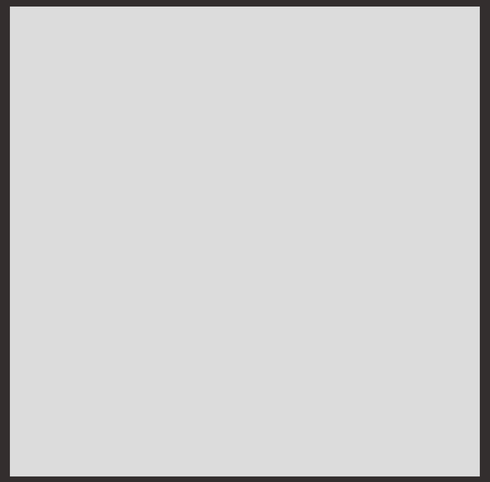
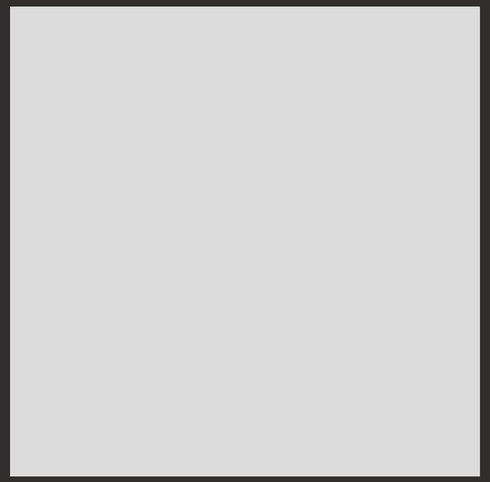
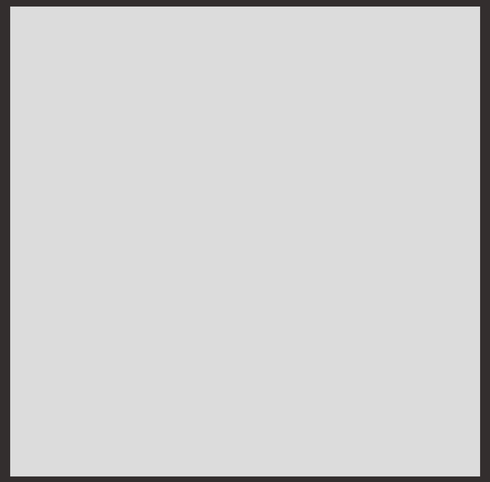
Hue sucks for magnitude:

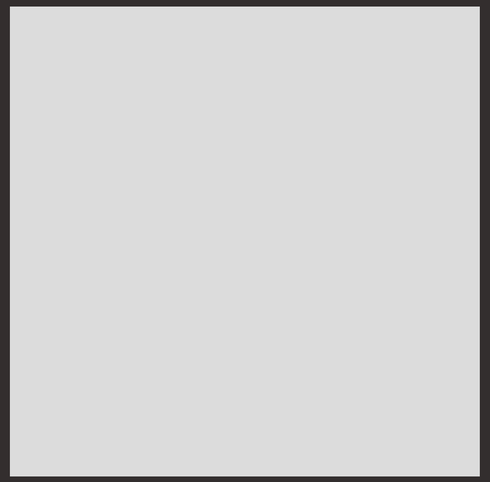
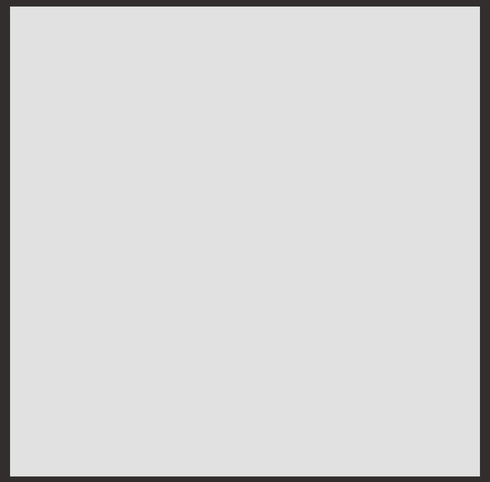
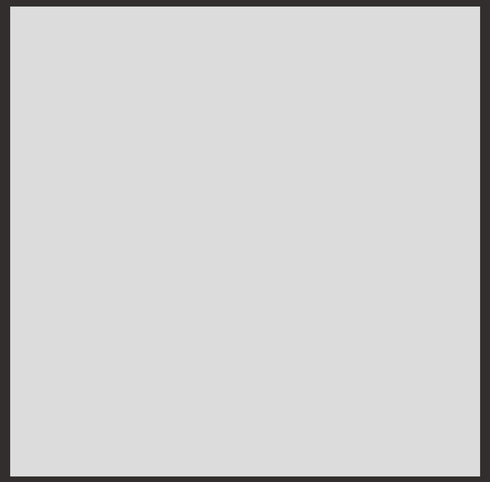
Hue doesn't suck for identity:

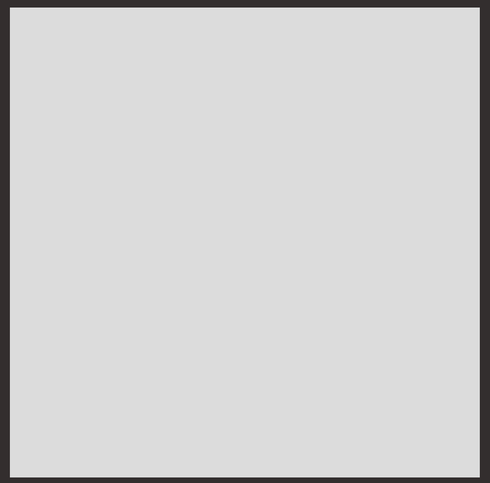

Perception
(Mechanics)

Discrimination

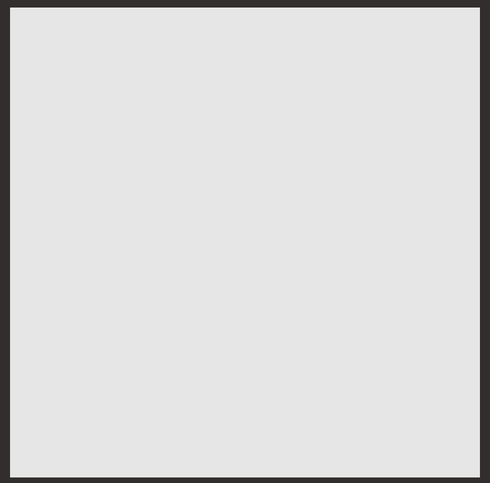
Which is brighter?

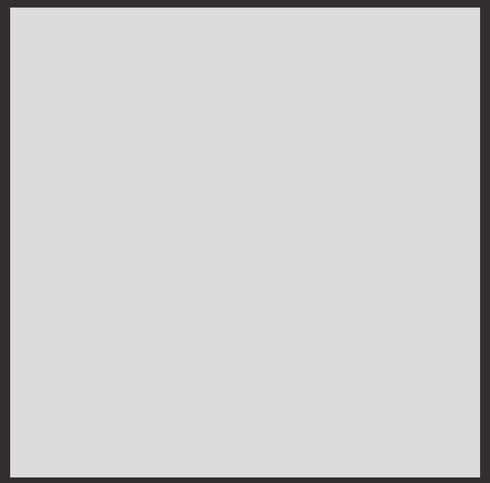






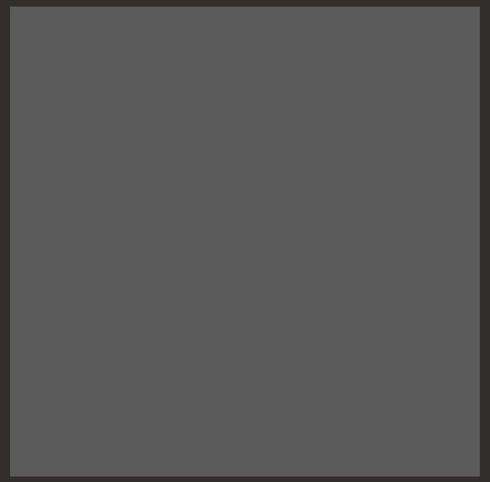
(220,220,220)



(230,230,230)



(220,220,220)

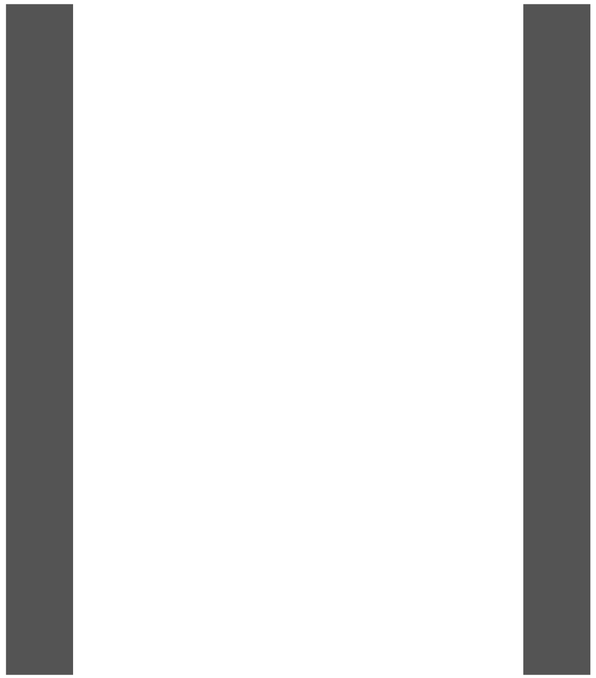

(80,80,80)

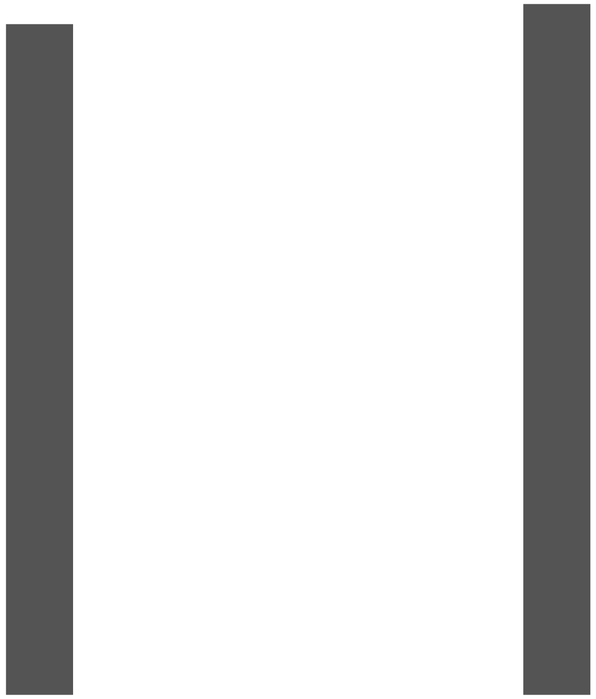
(90,90,90)

(80,80,80)

Same distance, but easier. Why?

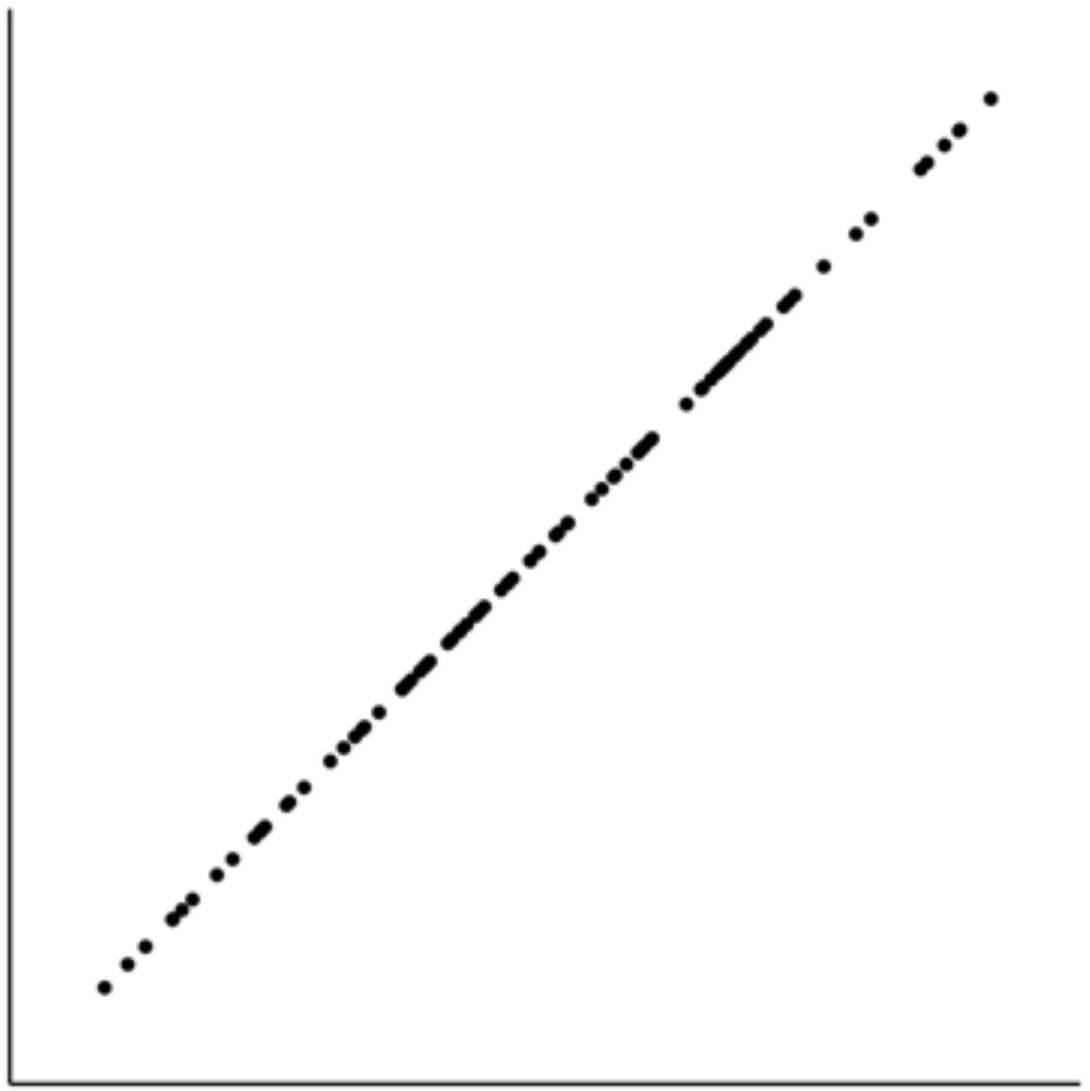
Which is longer?

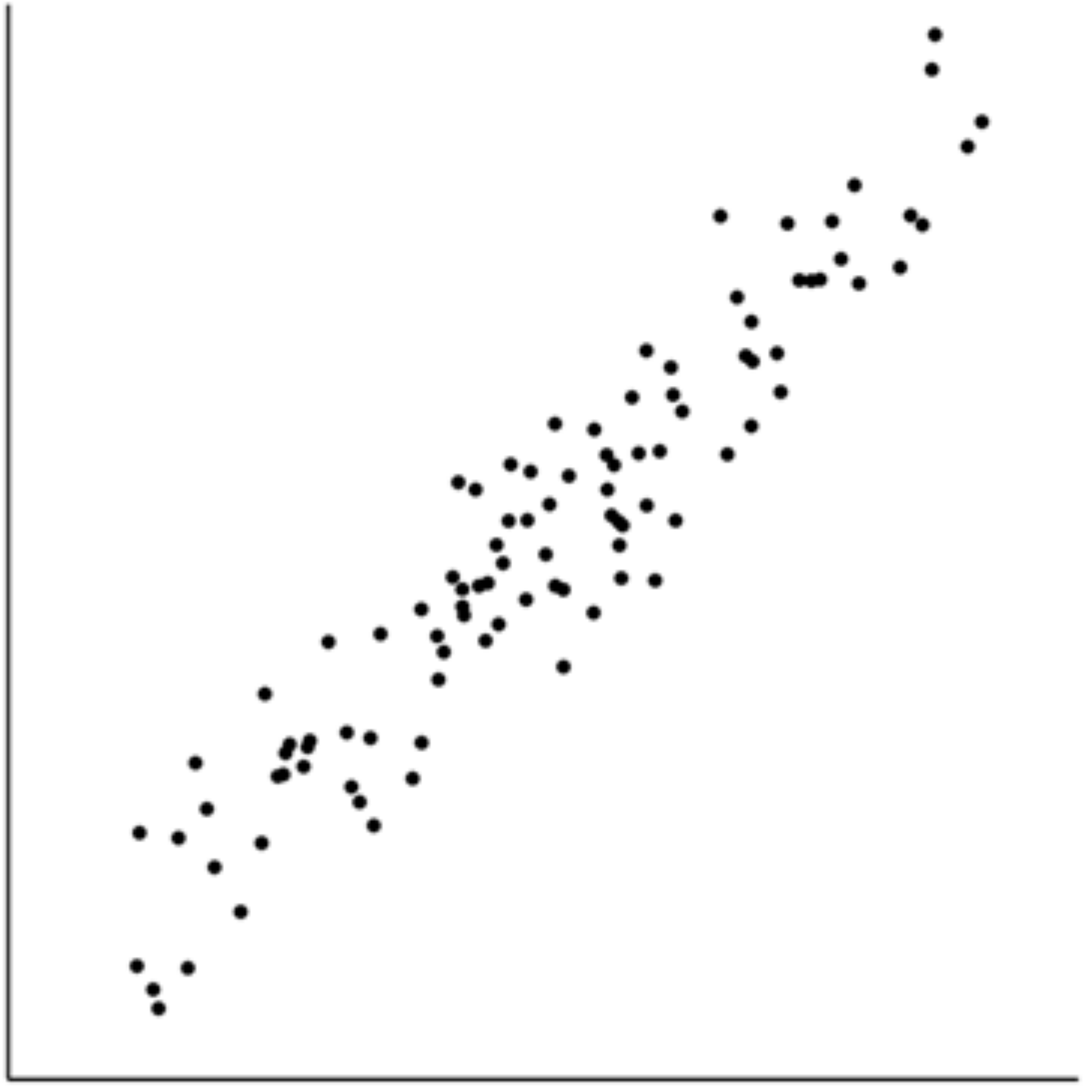




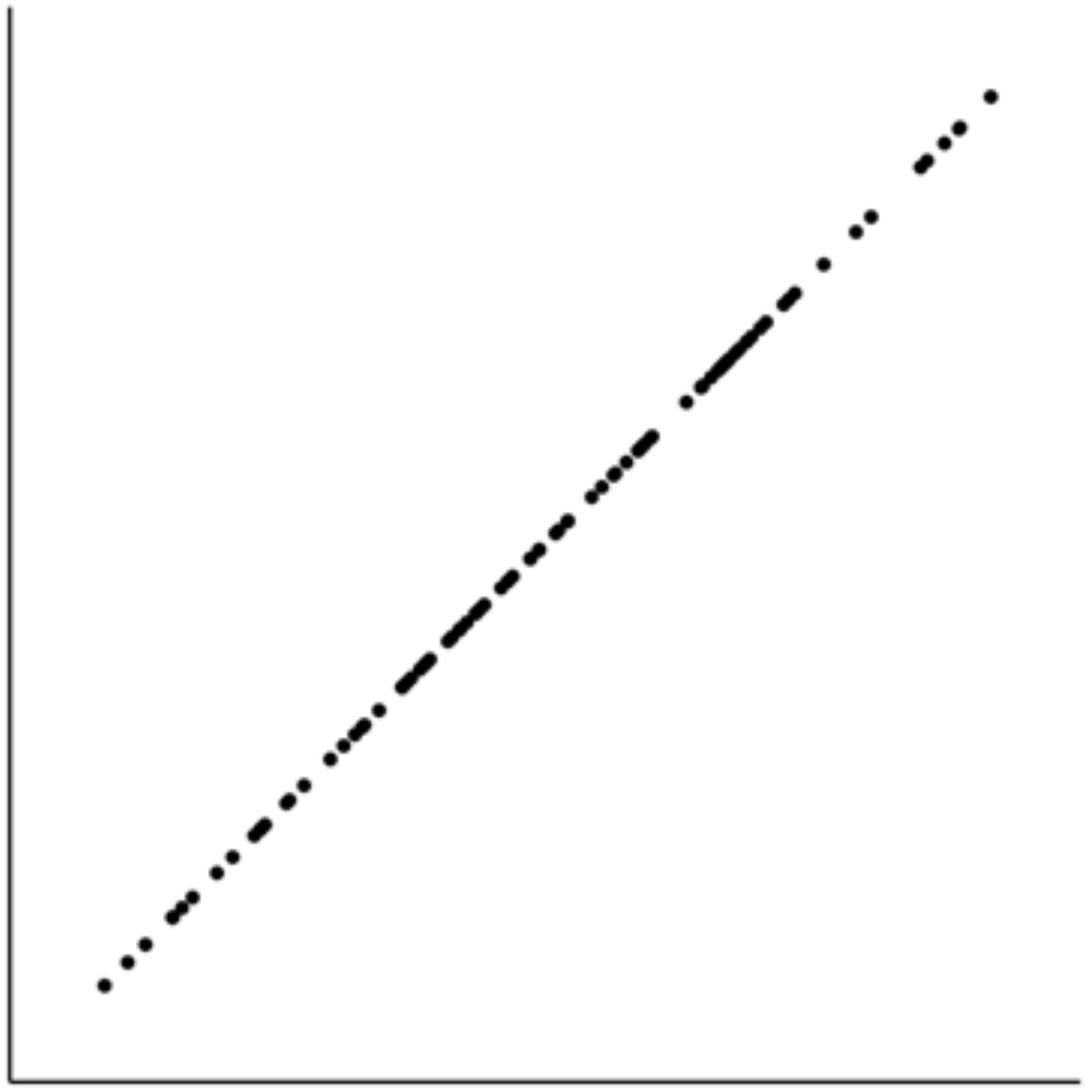
Same distance, but same. Why!?

Which is more correlated?

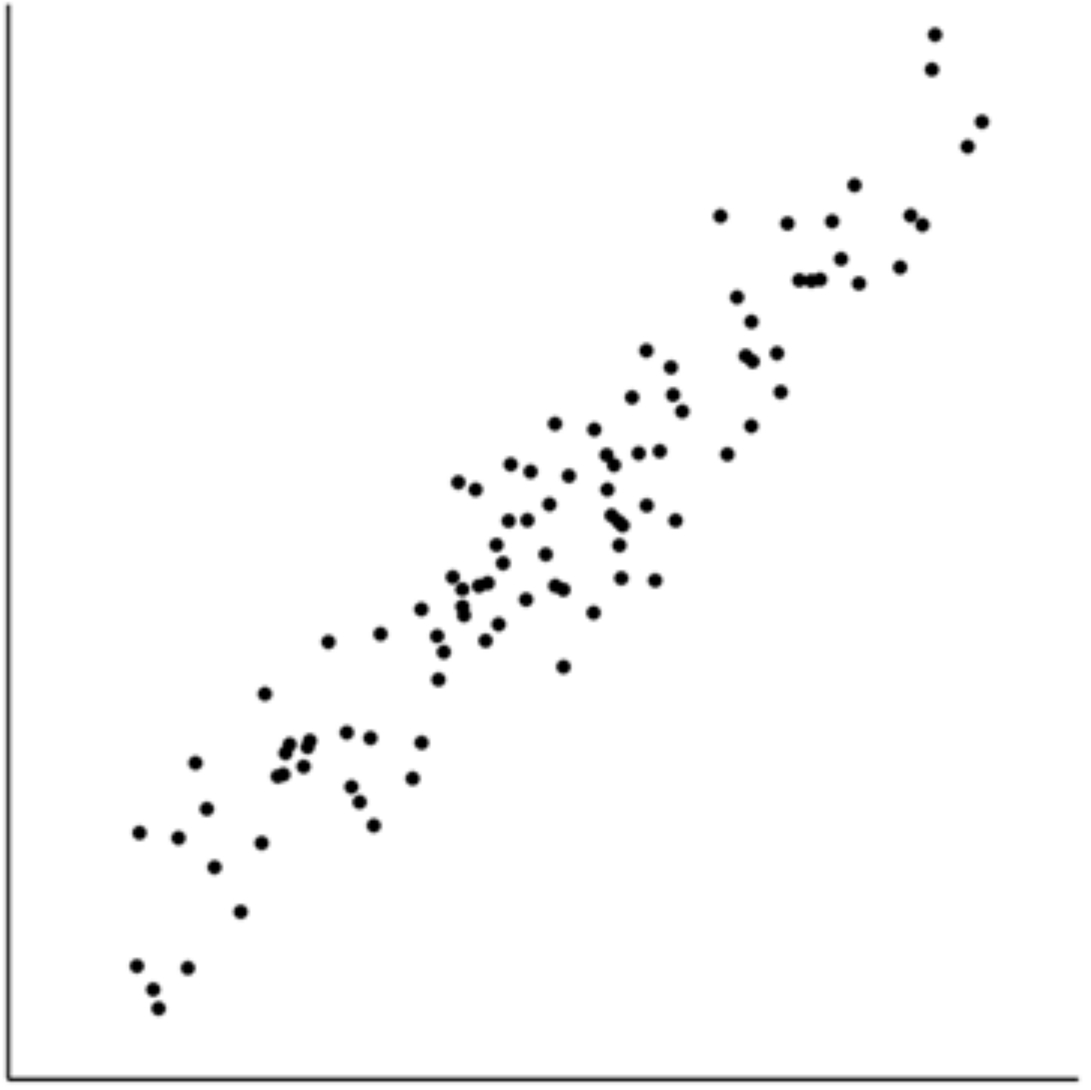


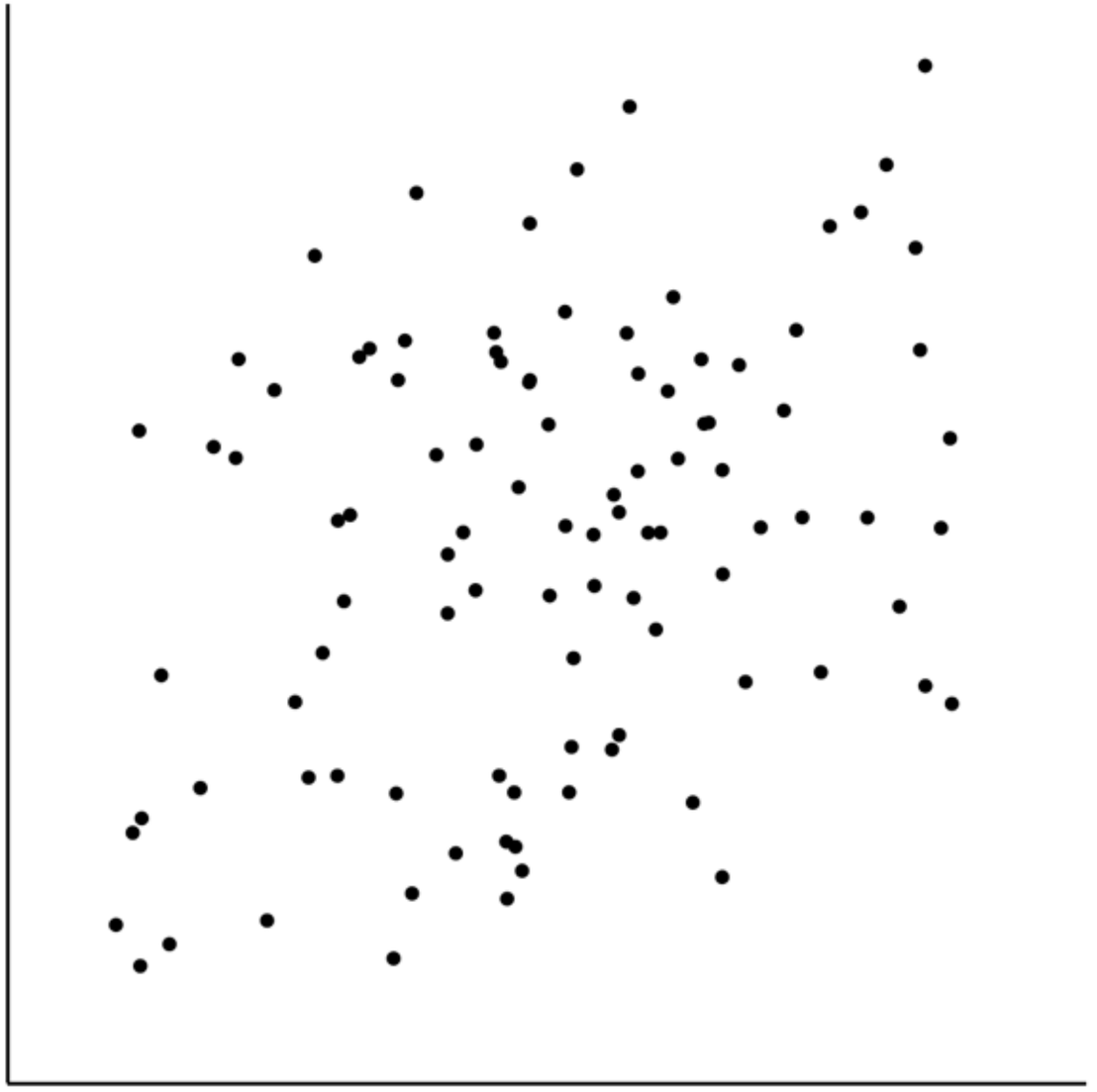


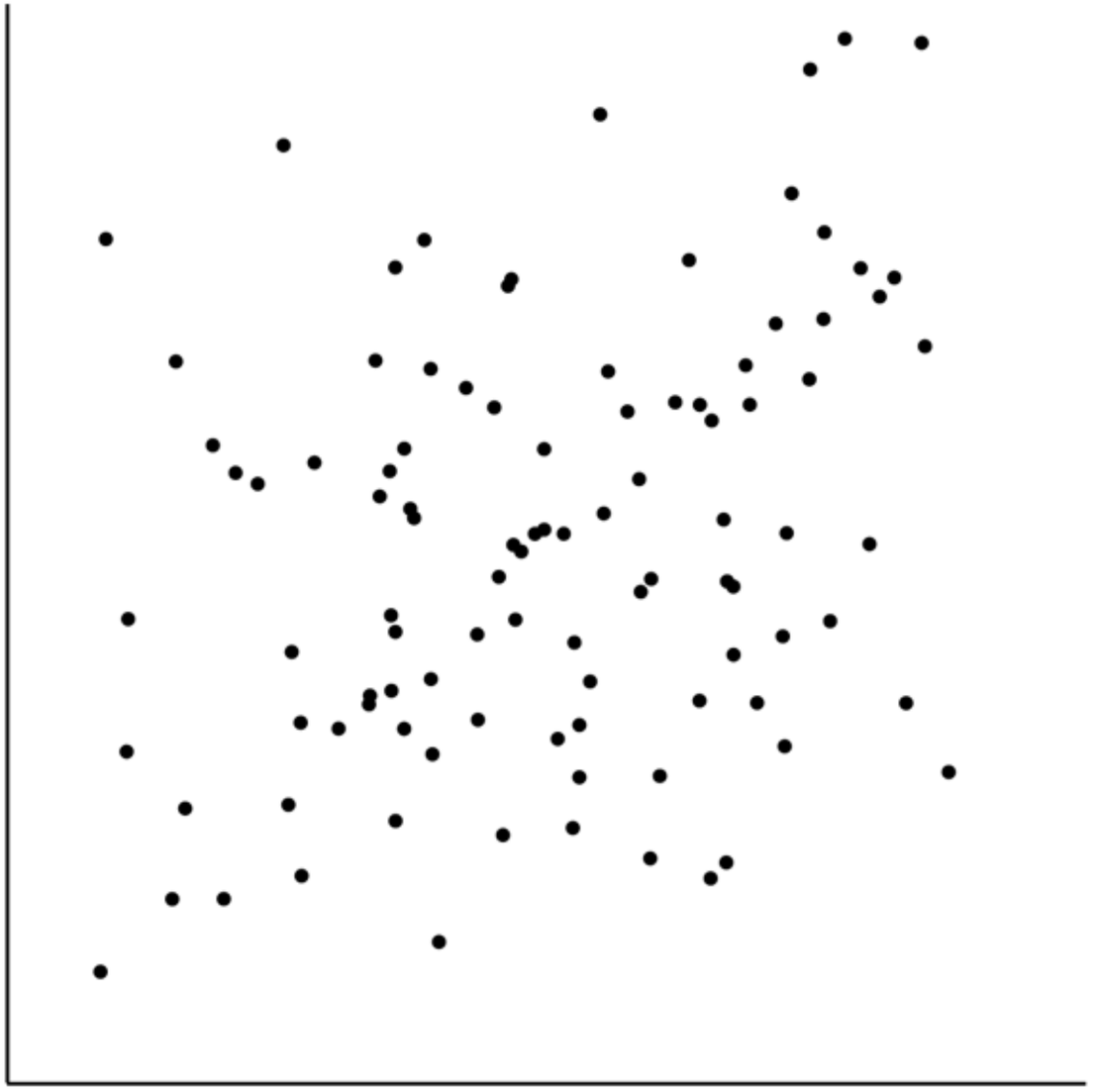
r = 1



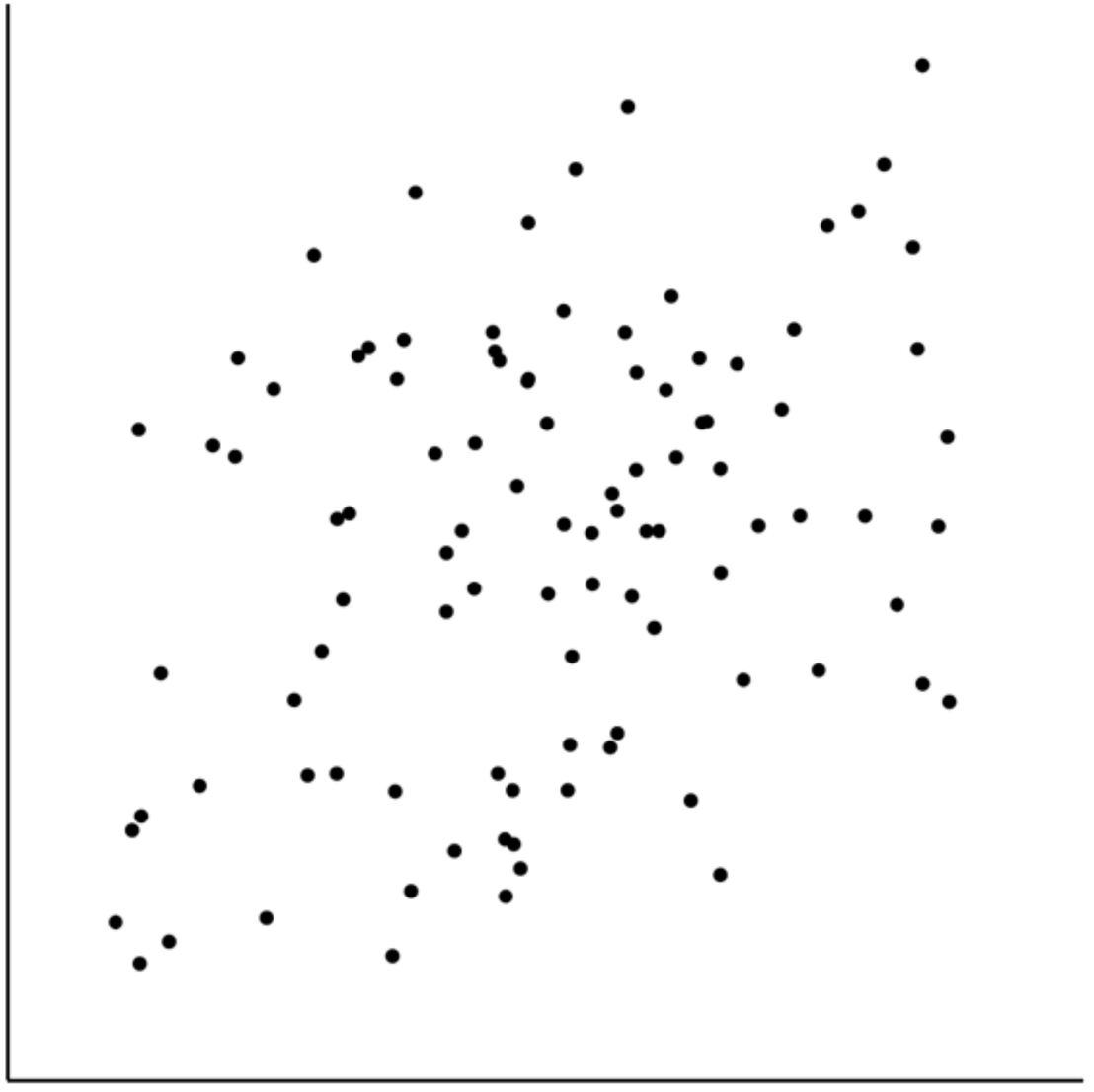
r = 0.95



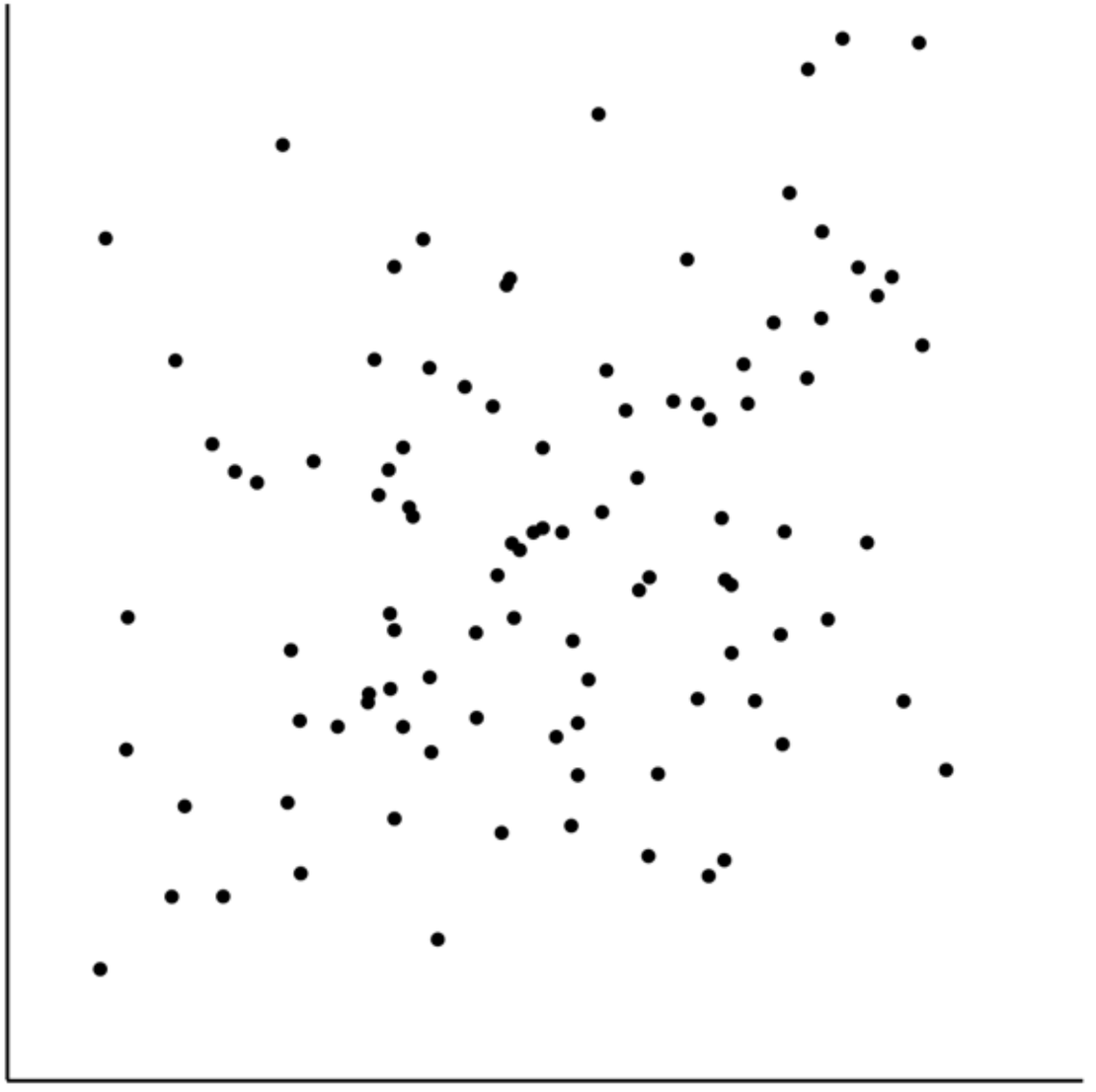




r = 0.35



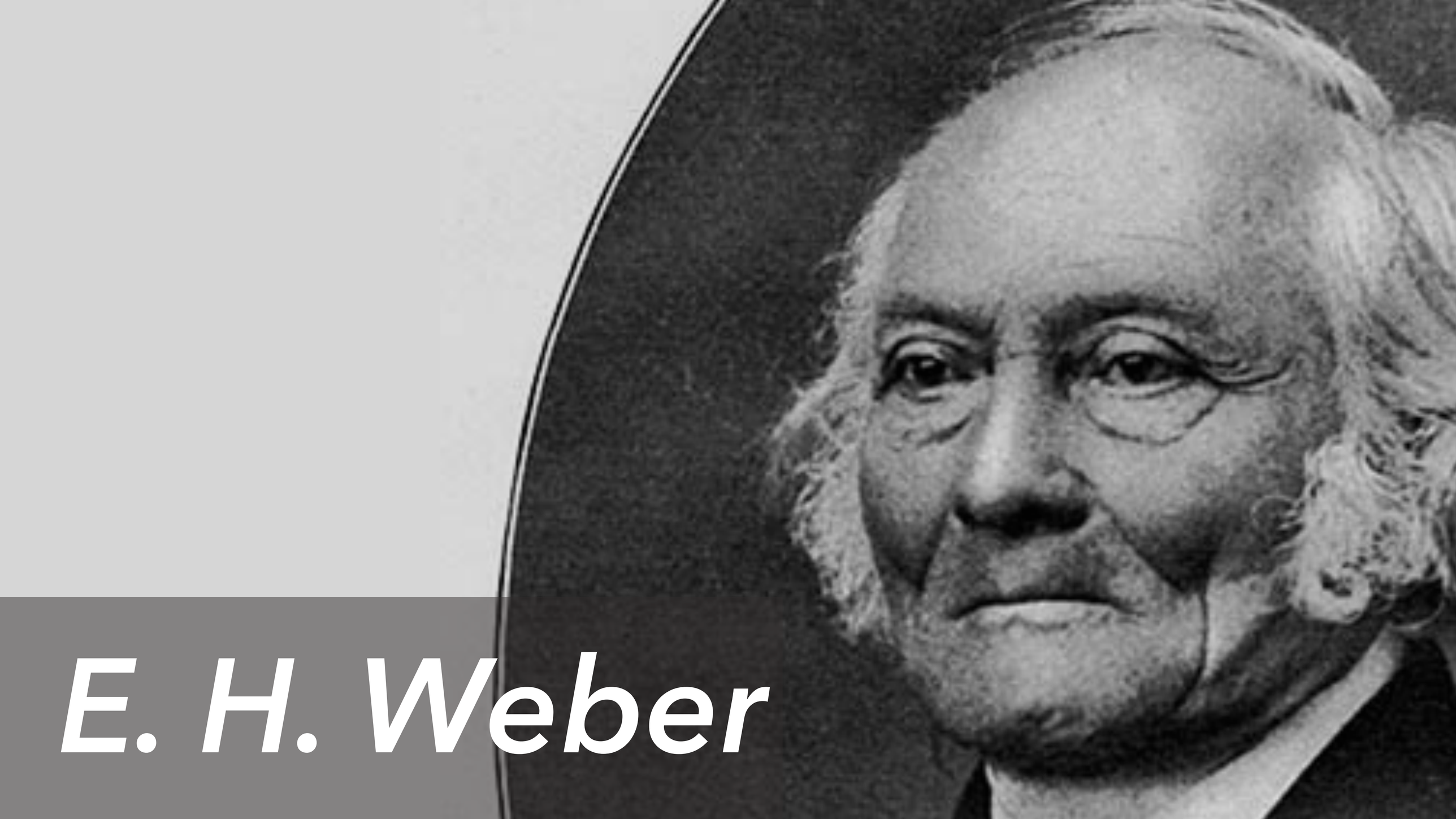
r = 0.3



just-noticeable differences (jnd)

The smallest difference necessary to perceive two stimuli as being different.

Why were some distances different?



E. H. Weber

$$\Delta P = k * \frac{\Delta I}{I}$$

Weber's Law

Perceived diff

$$\Delta P = k * \frac{\Delta I}{I}$$

Perceived diff

$$\Delta P = k * \frac{\Delta I}{I}$$

Actual intensity of Stimulus

Perceived diff

Change in Intensity

$$\Delta P = k * \frac{\Delta I}{I}$$

Actual intensity of Stimulus

imagine yourself in a dark room...

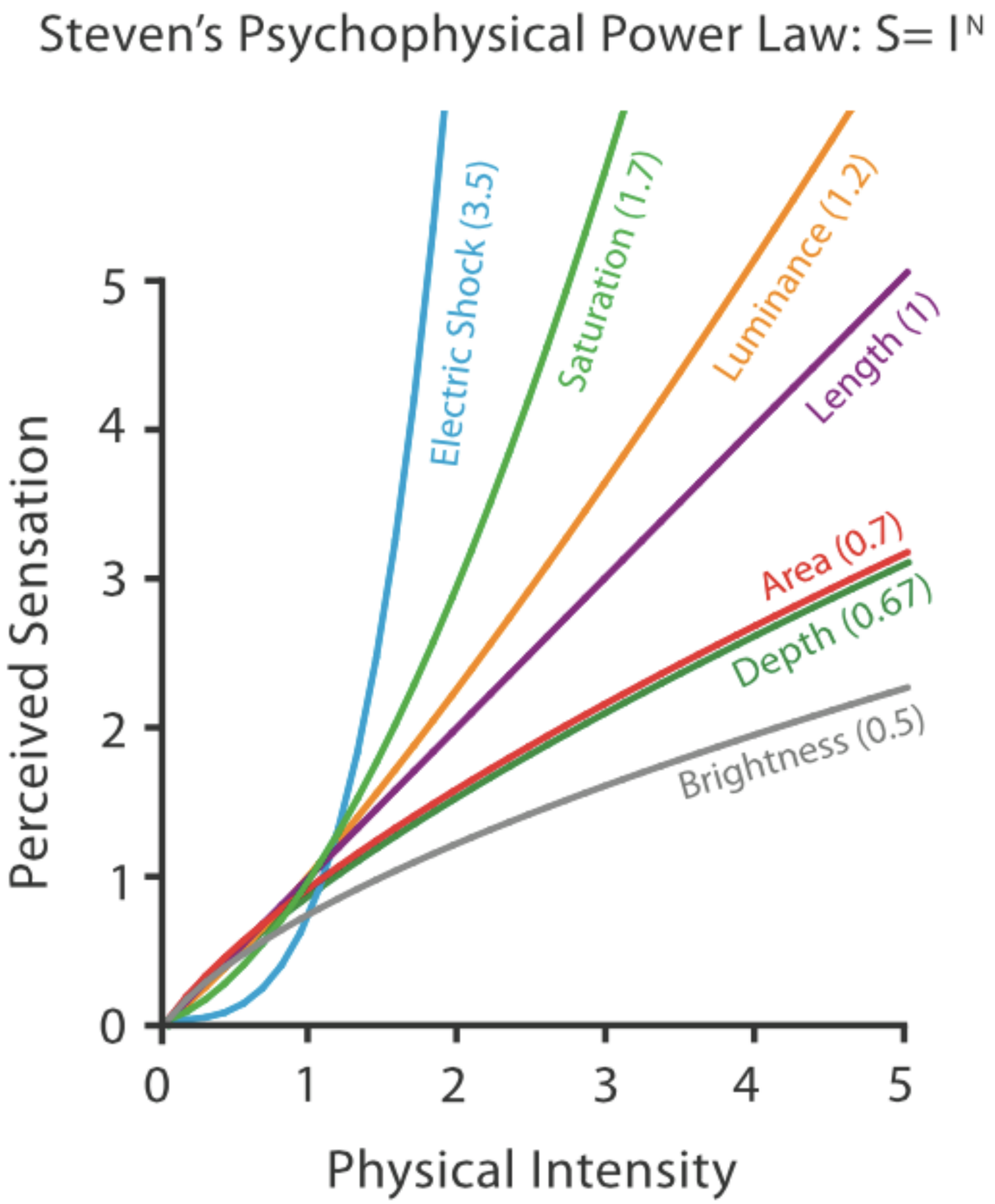
bright room, high intensity

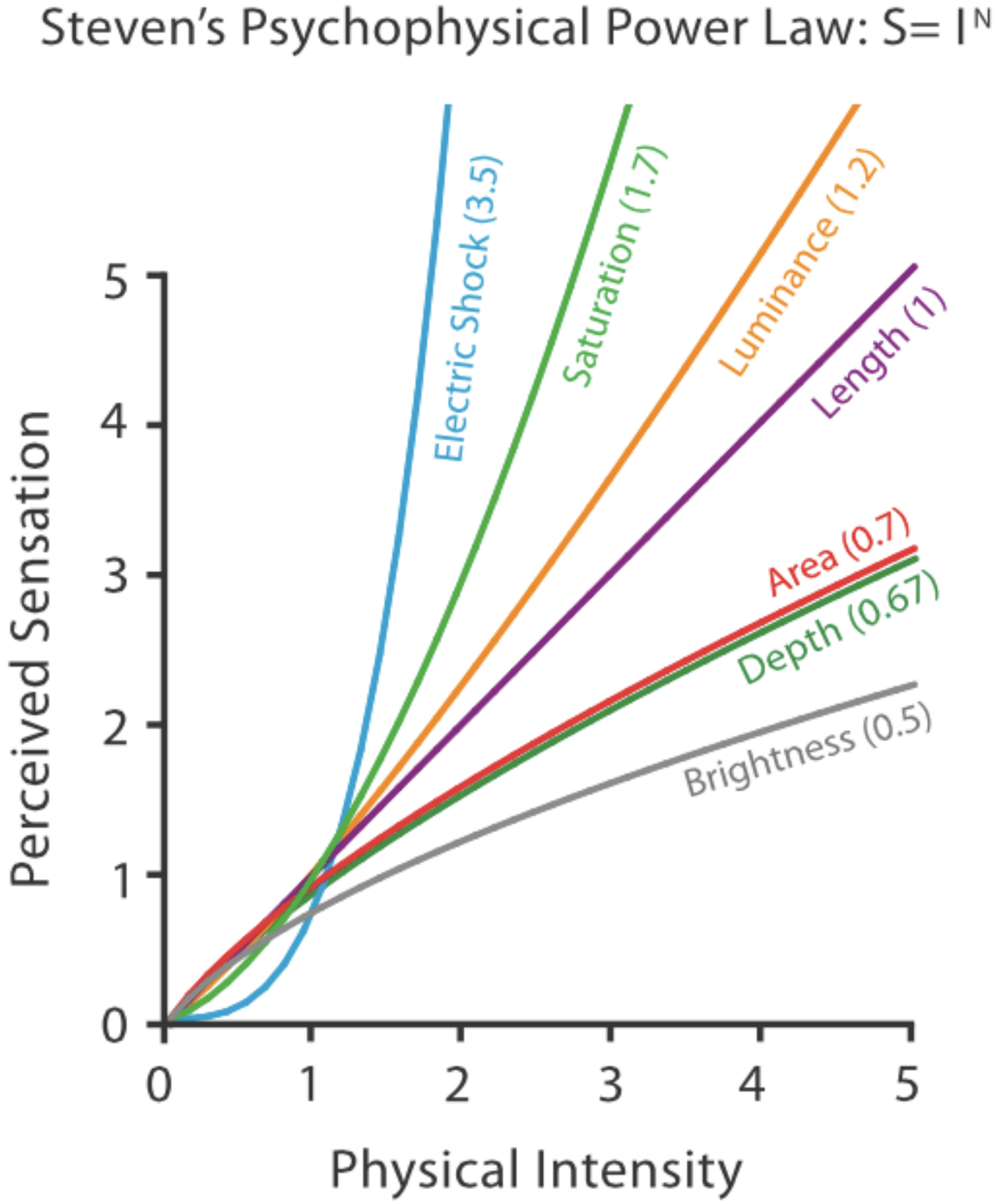
$$\Delta P = k * \frac{\Delta I}{I}$$

super bright light needed

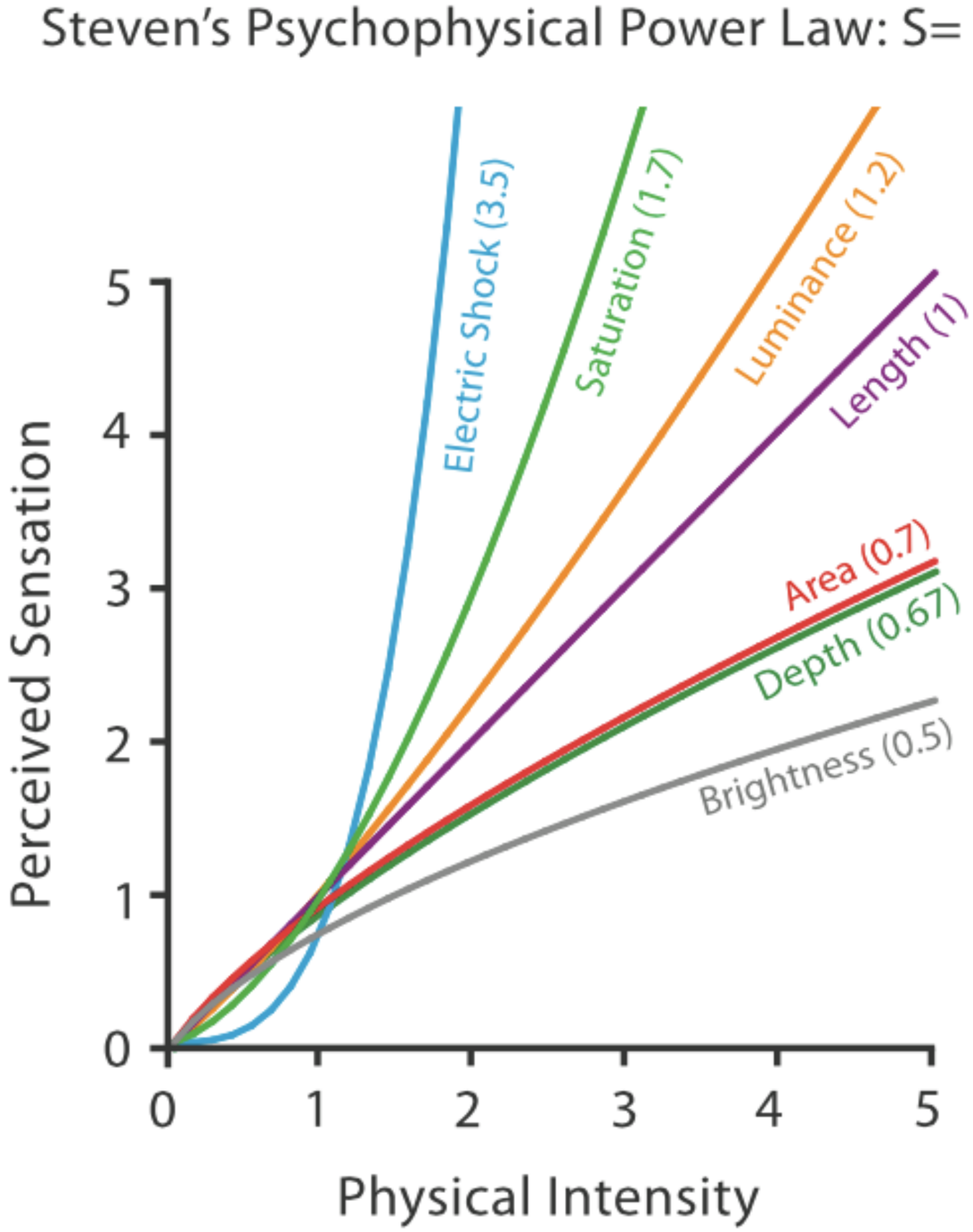
$$\Delta P = k * \frac{\Delta I}{I}$$

Estimation


Steven's Psychophysical Power Law: S= I^N
Perceived Sensation
Physical Intensity
0
1
2
3
4
5
Electric Shock (3.5)
Saturation (1.7)
Luminance (1.2)
Length (1)
Area (0.7)
Depth (0.67)
Brightness (0.5)

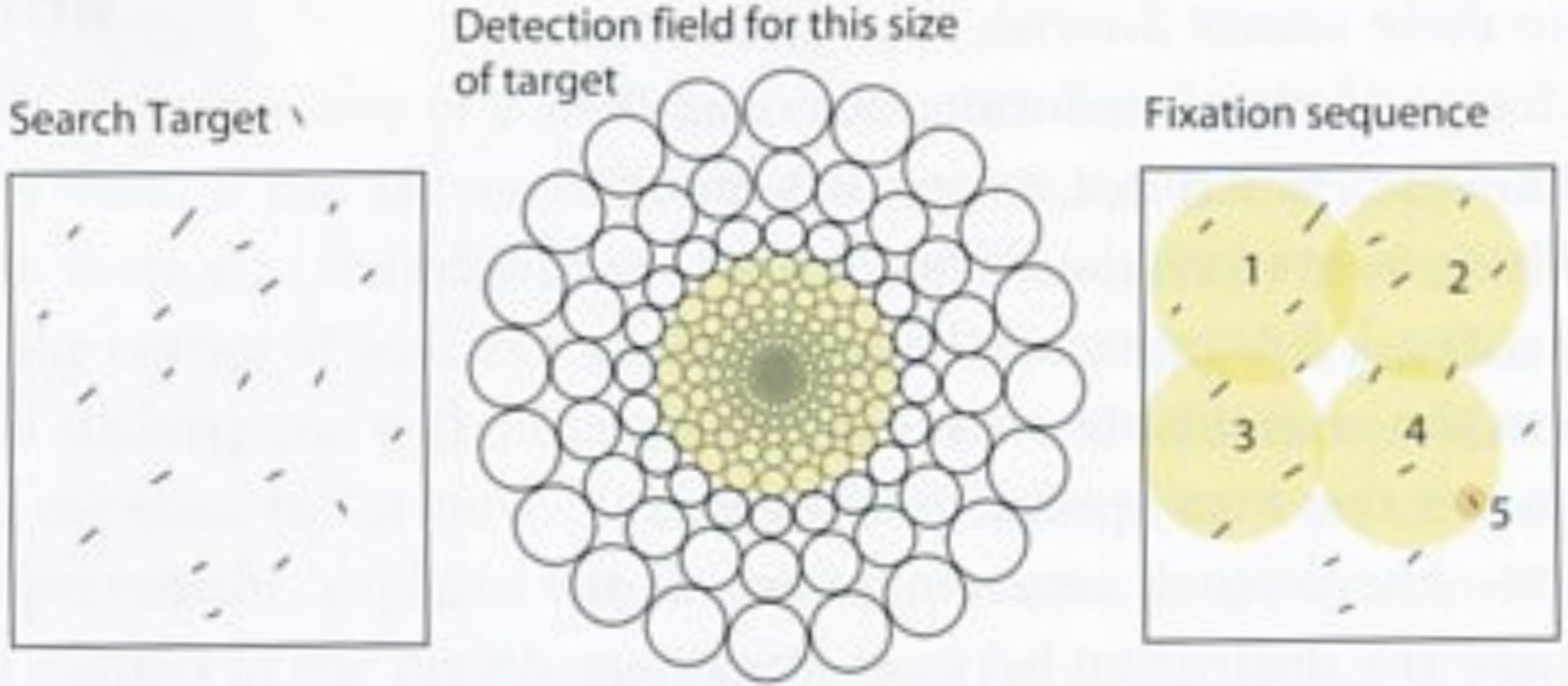


we under-estimate brightness



we are great at length

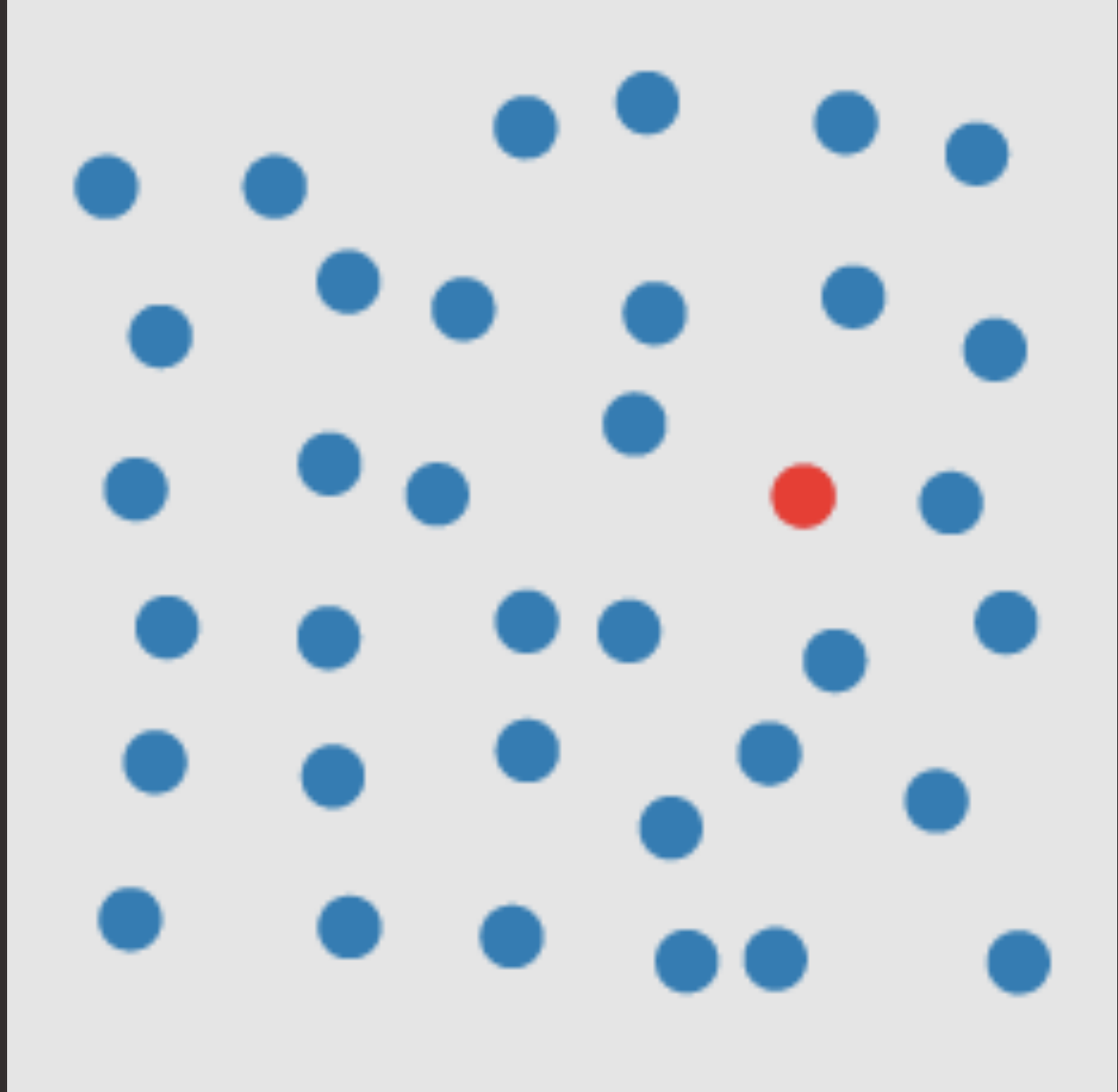
Eye-Movement



Visual-Search

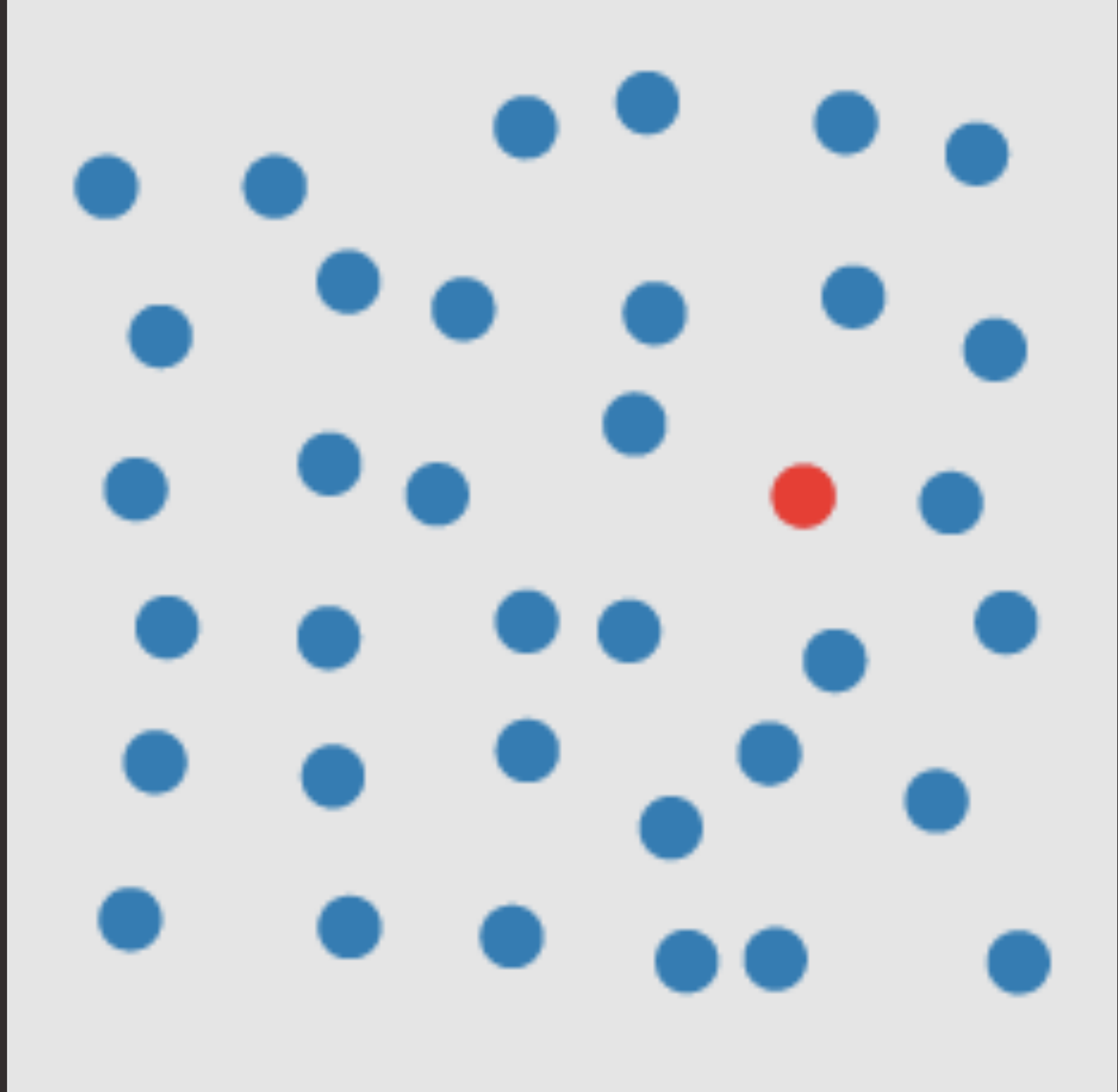
“Find the Tomato”

“Find the Tomato”



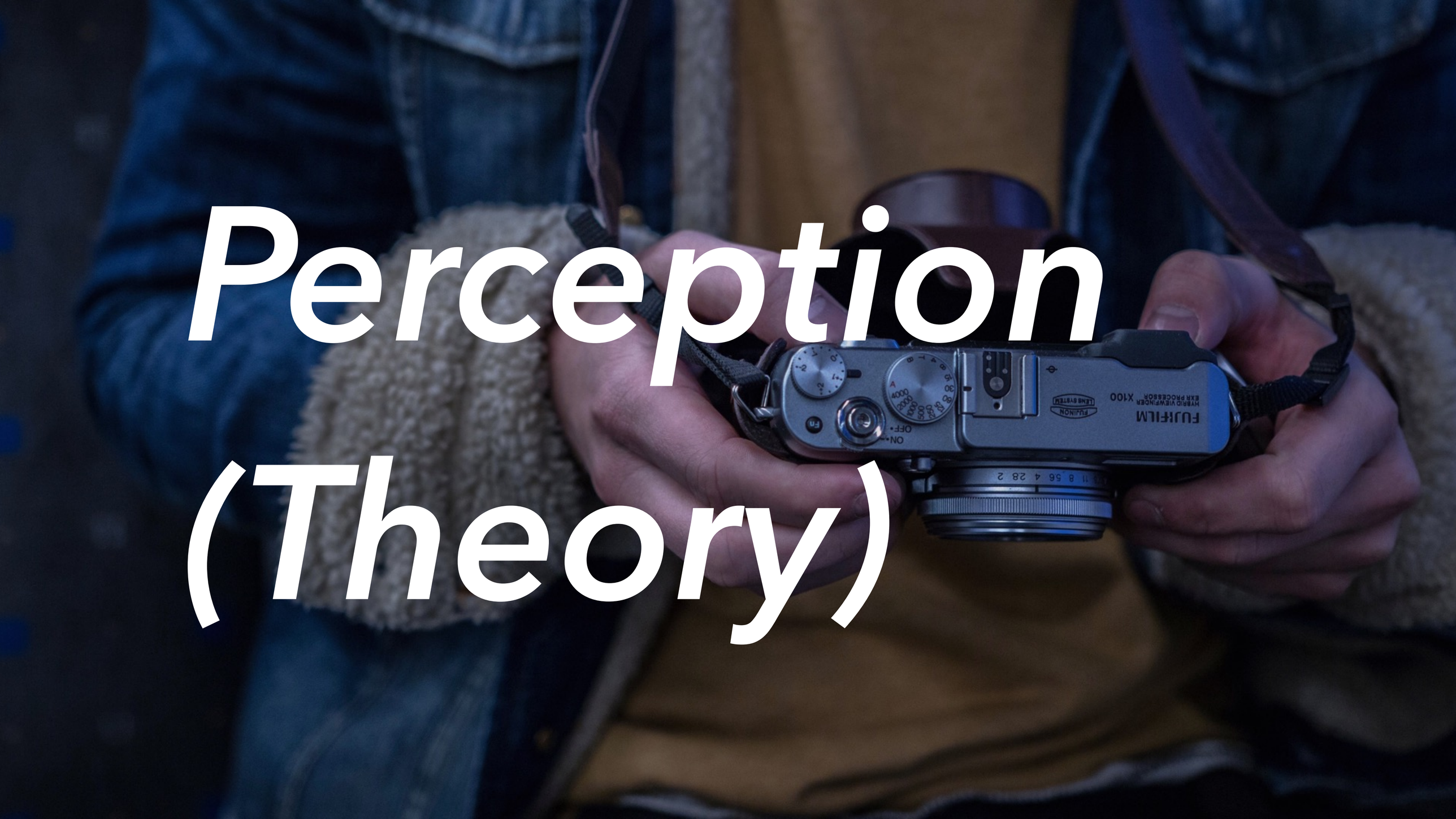
“Find the Tomato”

one O(1) eye-move!

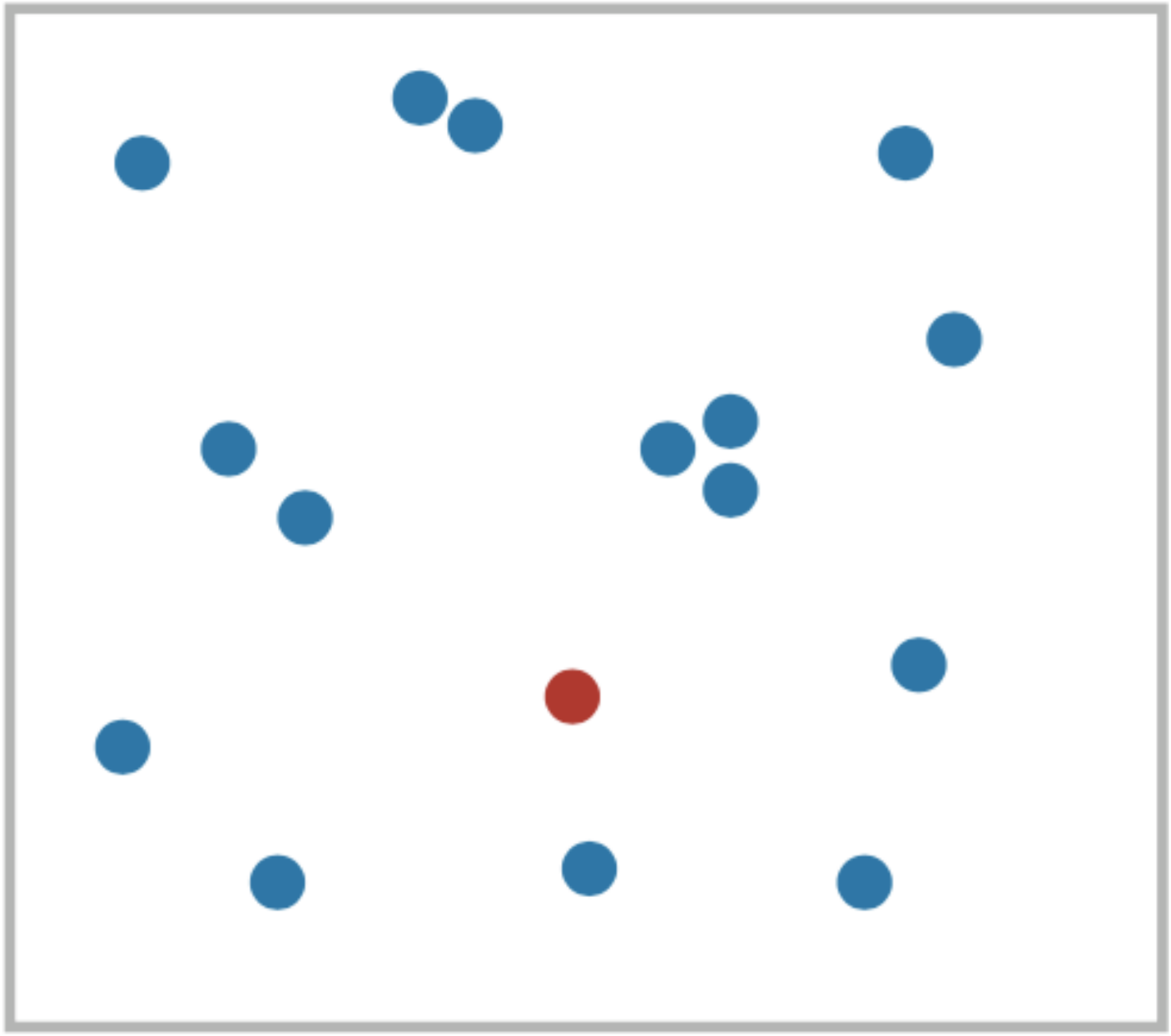


recap

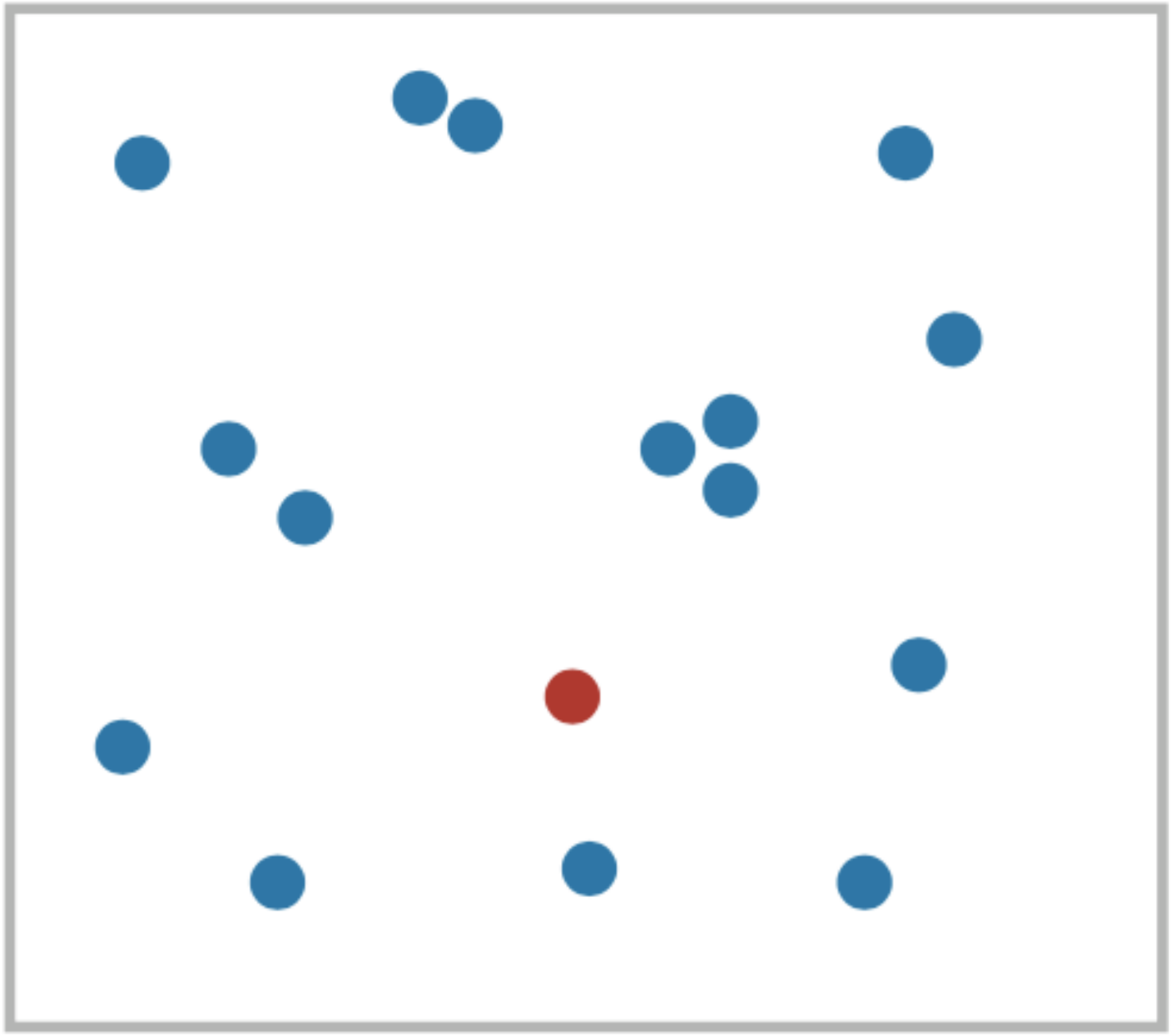
Discrimination	*Weber's Law (jnd)*
Estimation	*Stephen's Power Law*
Targeting	*Eye-Movement*



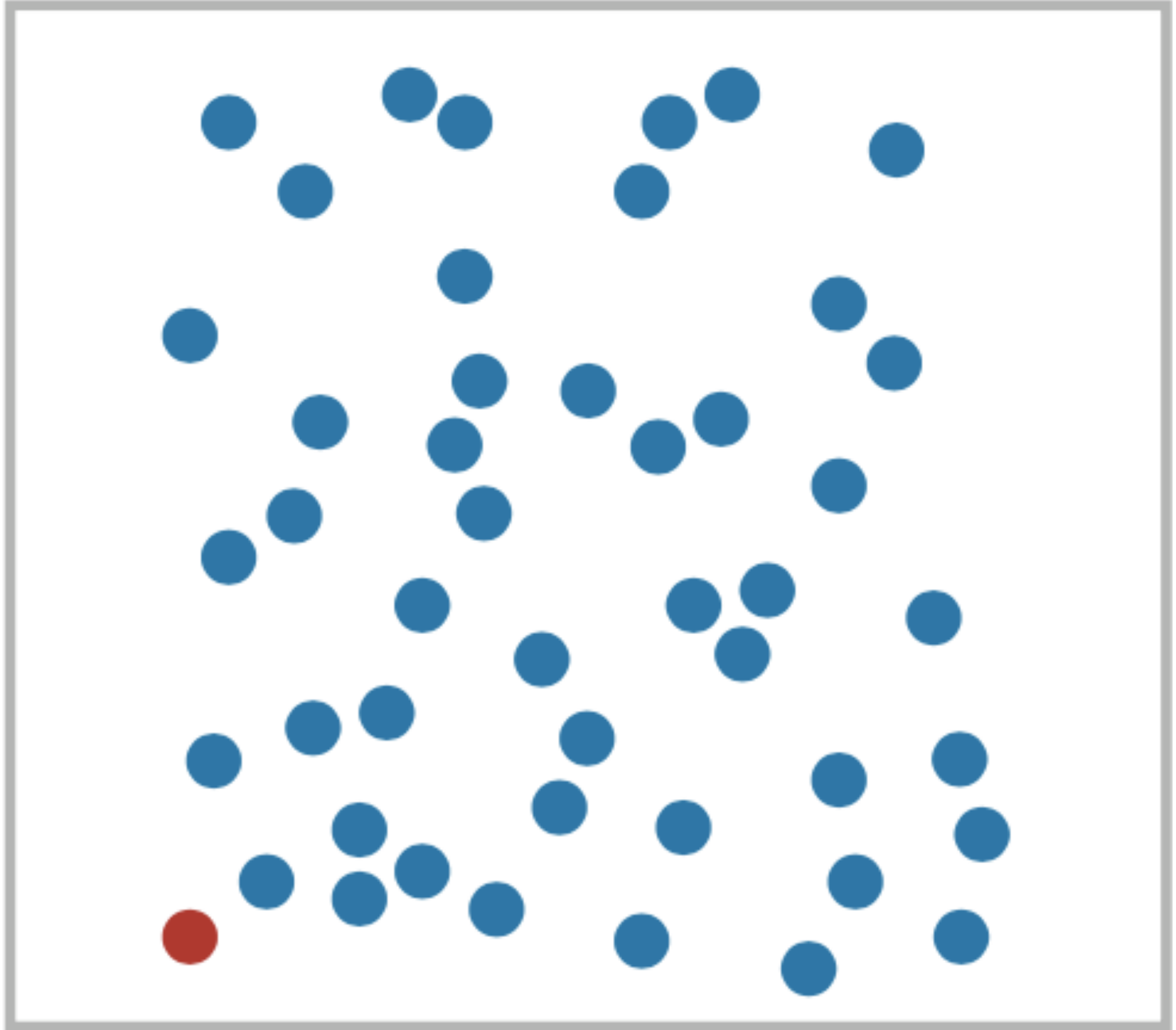
Perception (Theory)

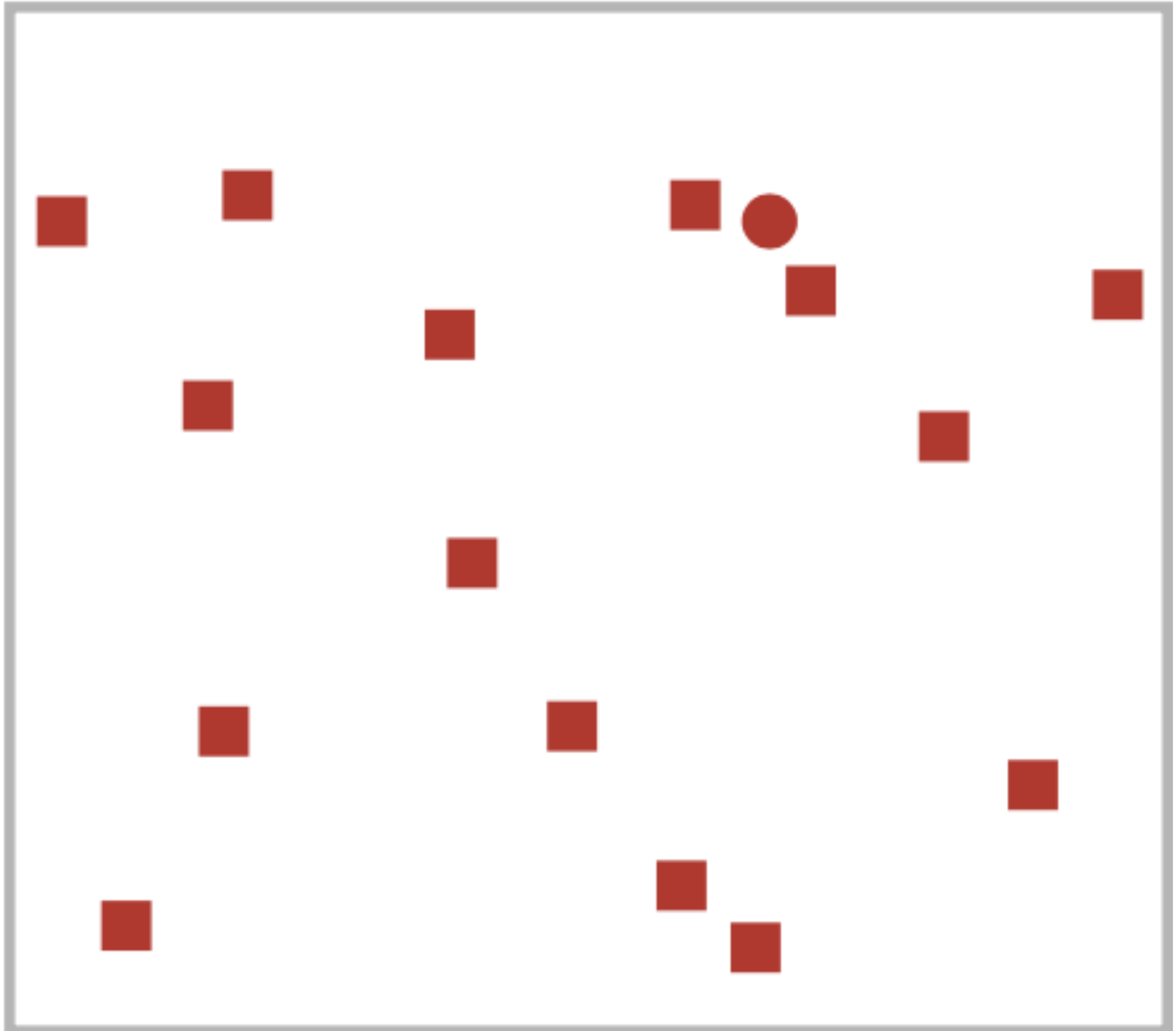


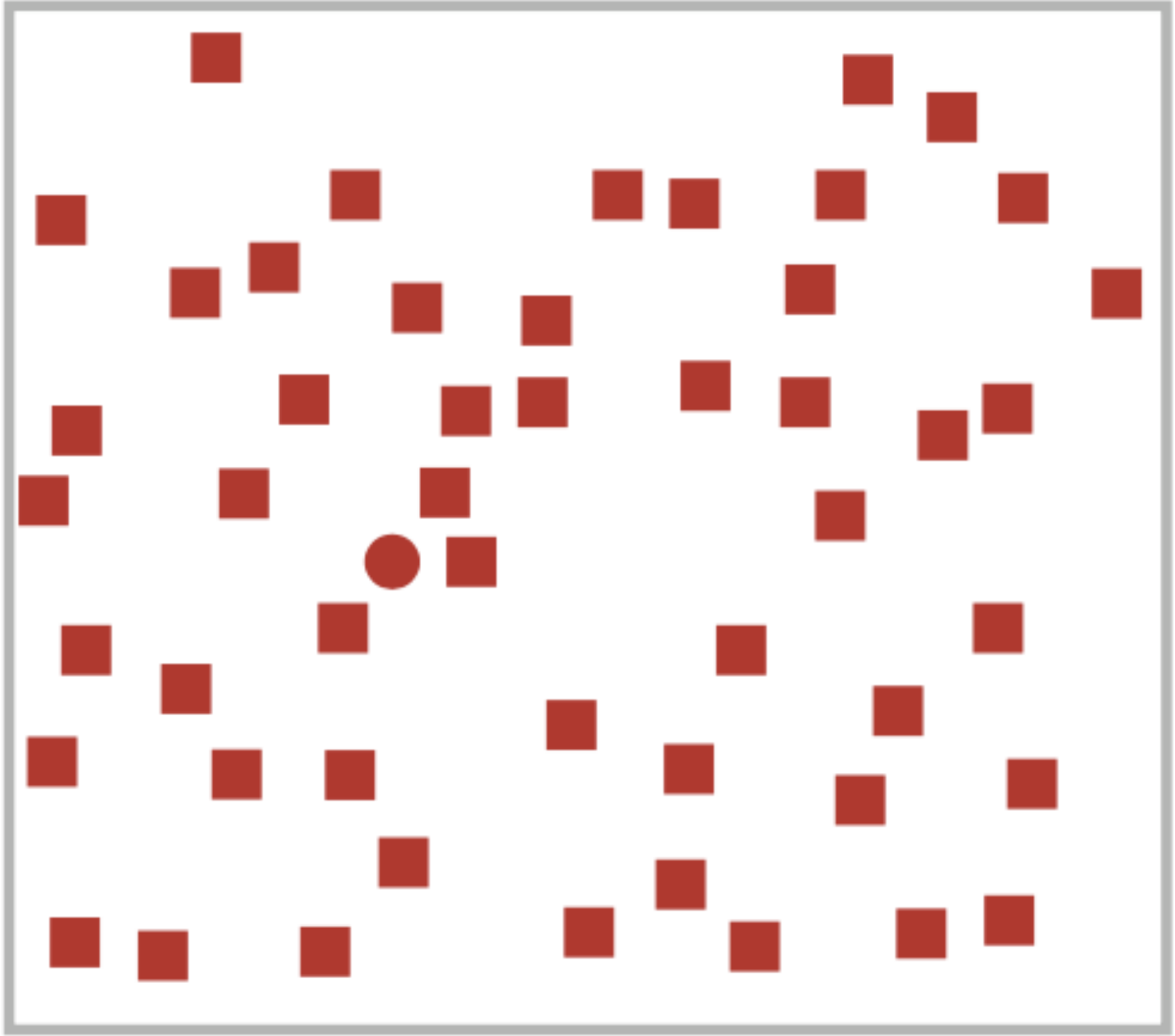
Find the Tomato, part 2



Let's add more distractors…



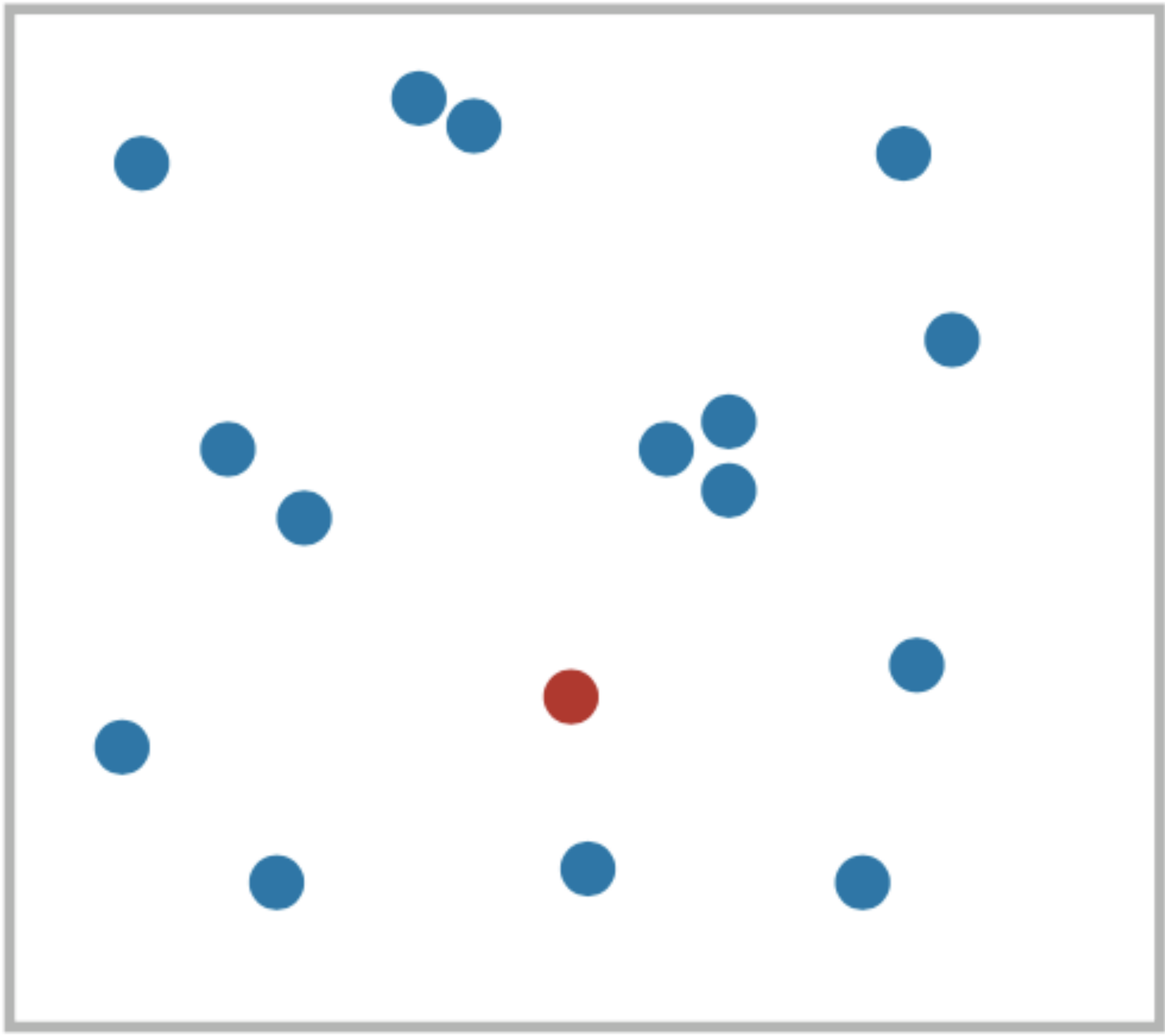


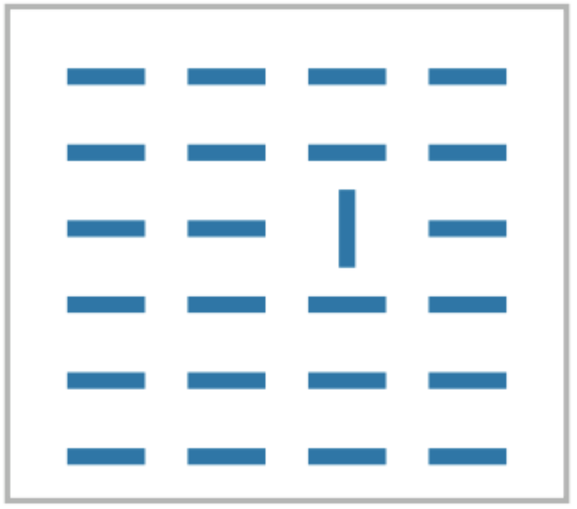


How would a computer search?

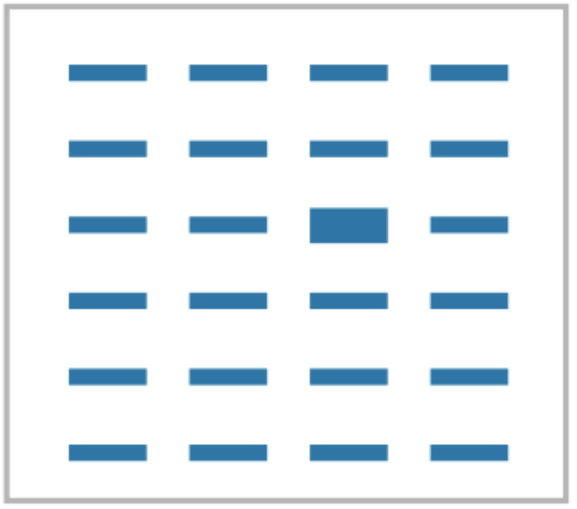
Pre-attentive processing

hard-wired many-channels

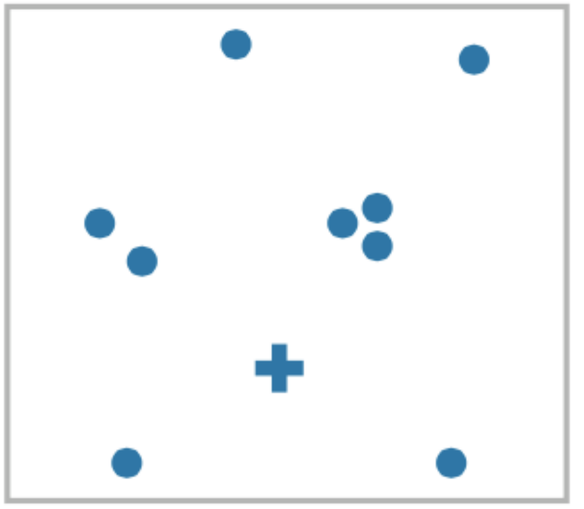




(a)

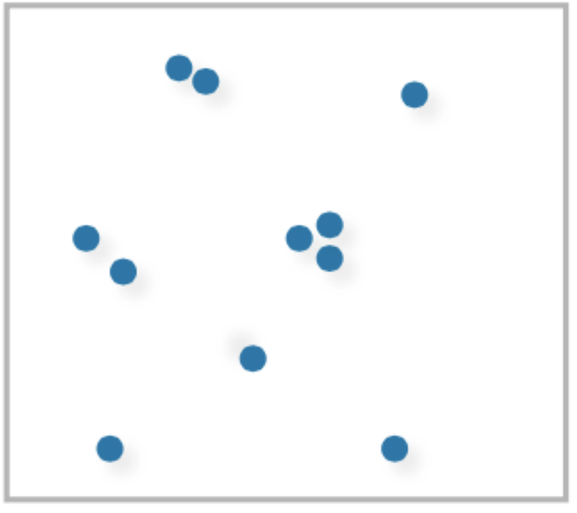


(b)

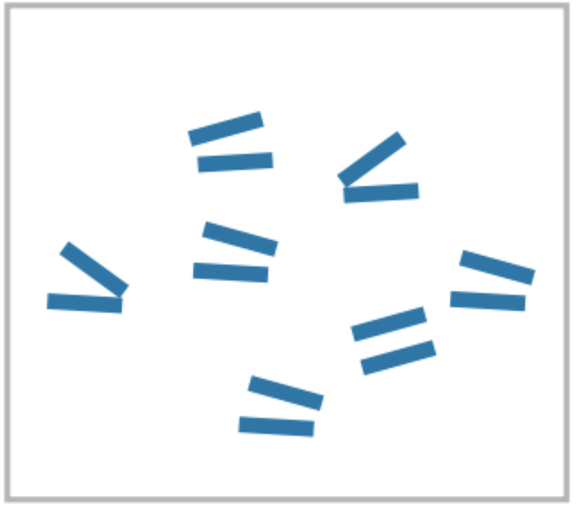


(c)

(d)



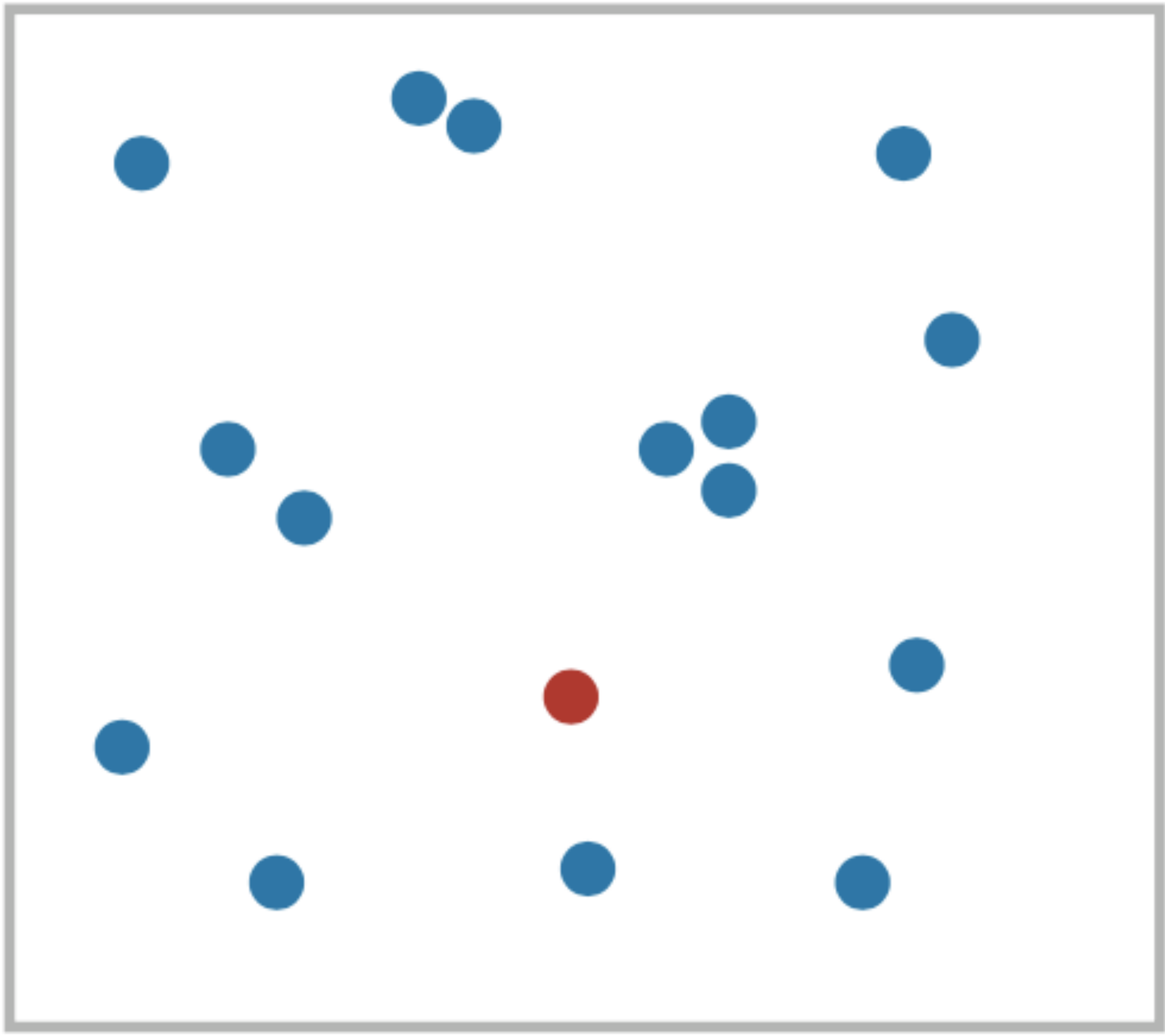
(e)

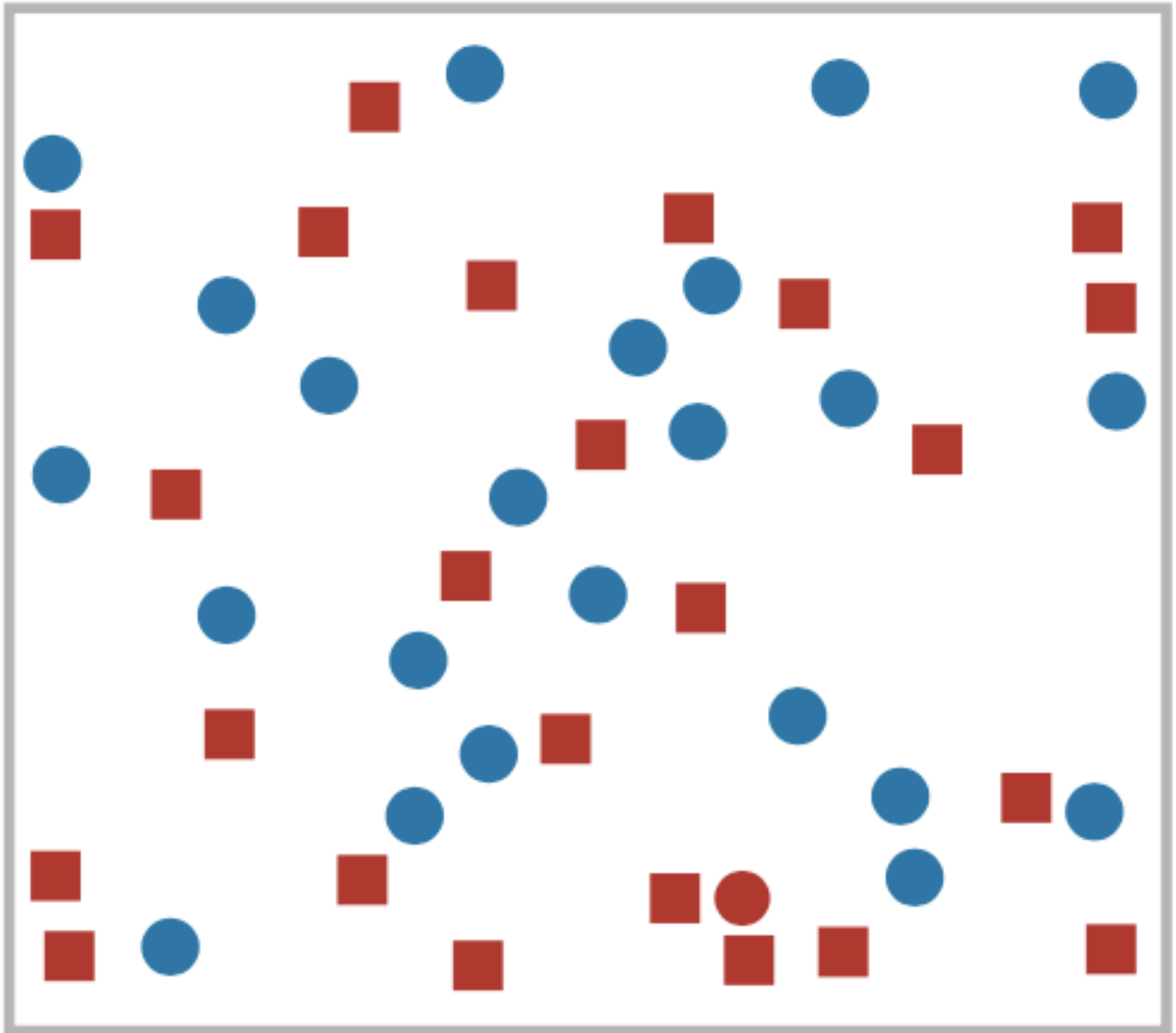


(f)

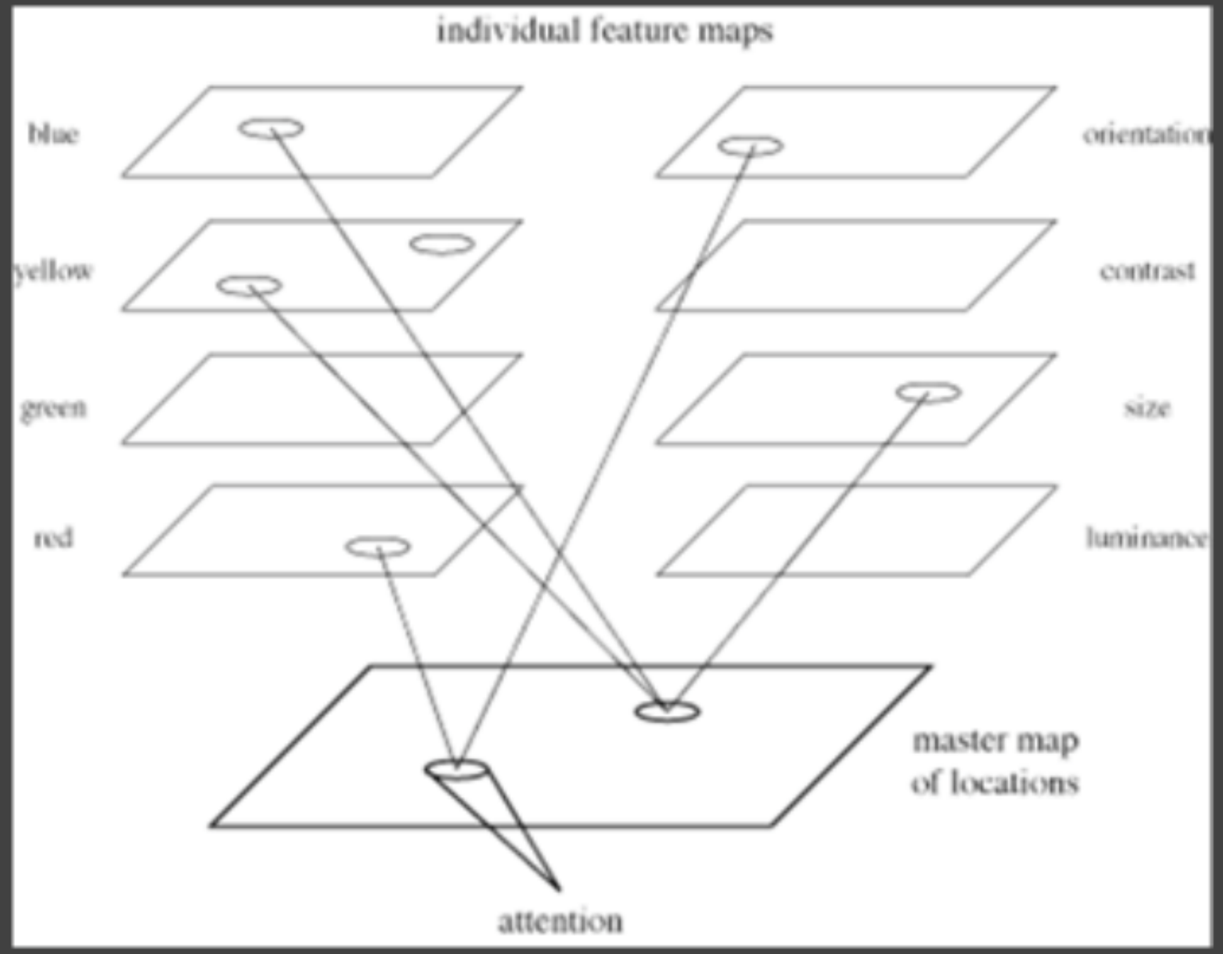
Pre-attentive processing

hard-wired
many-channels
easy to mess up

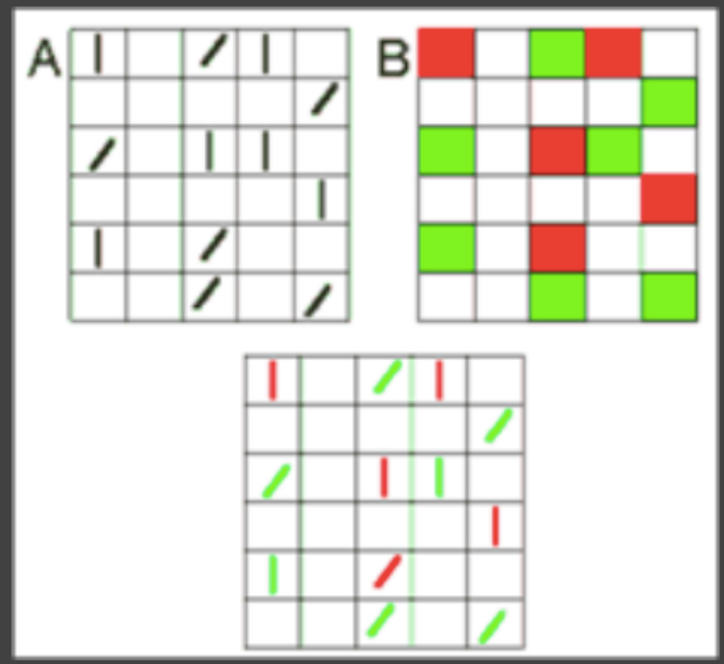




Feature Integration Theory

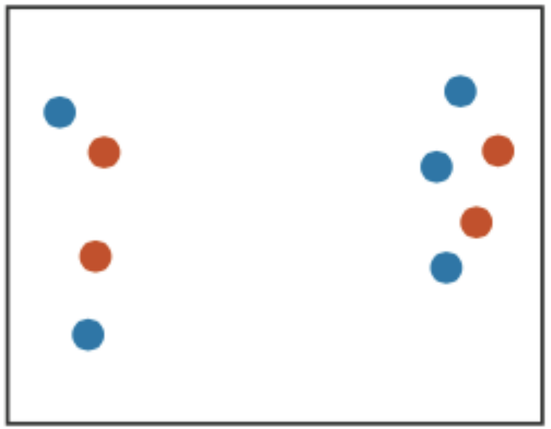


Treisman's feature integration model [Healey 04]



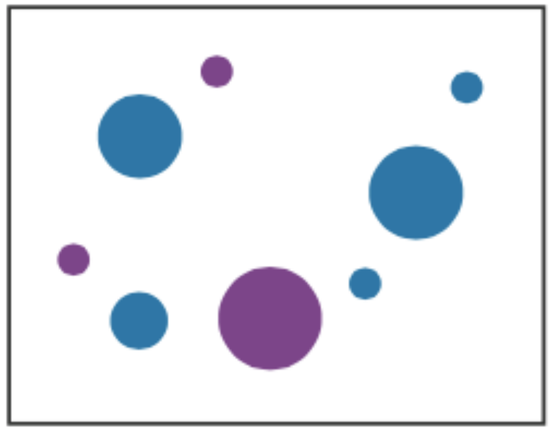
Feature maps for
orientation & color [Green]

Position
+ Hue (Color)



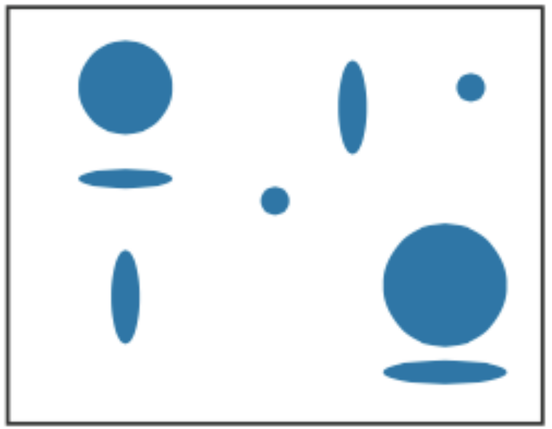
Fully separable

Size
+ Hue (Color)



Some interference

Width
+ Height



Some/significant interference

Red
+ Green

Major interference

Separable vs. Integral


Cognition

Change Blindness

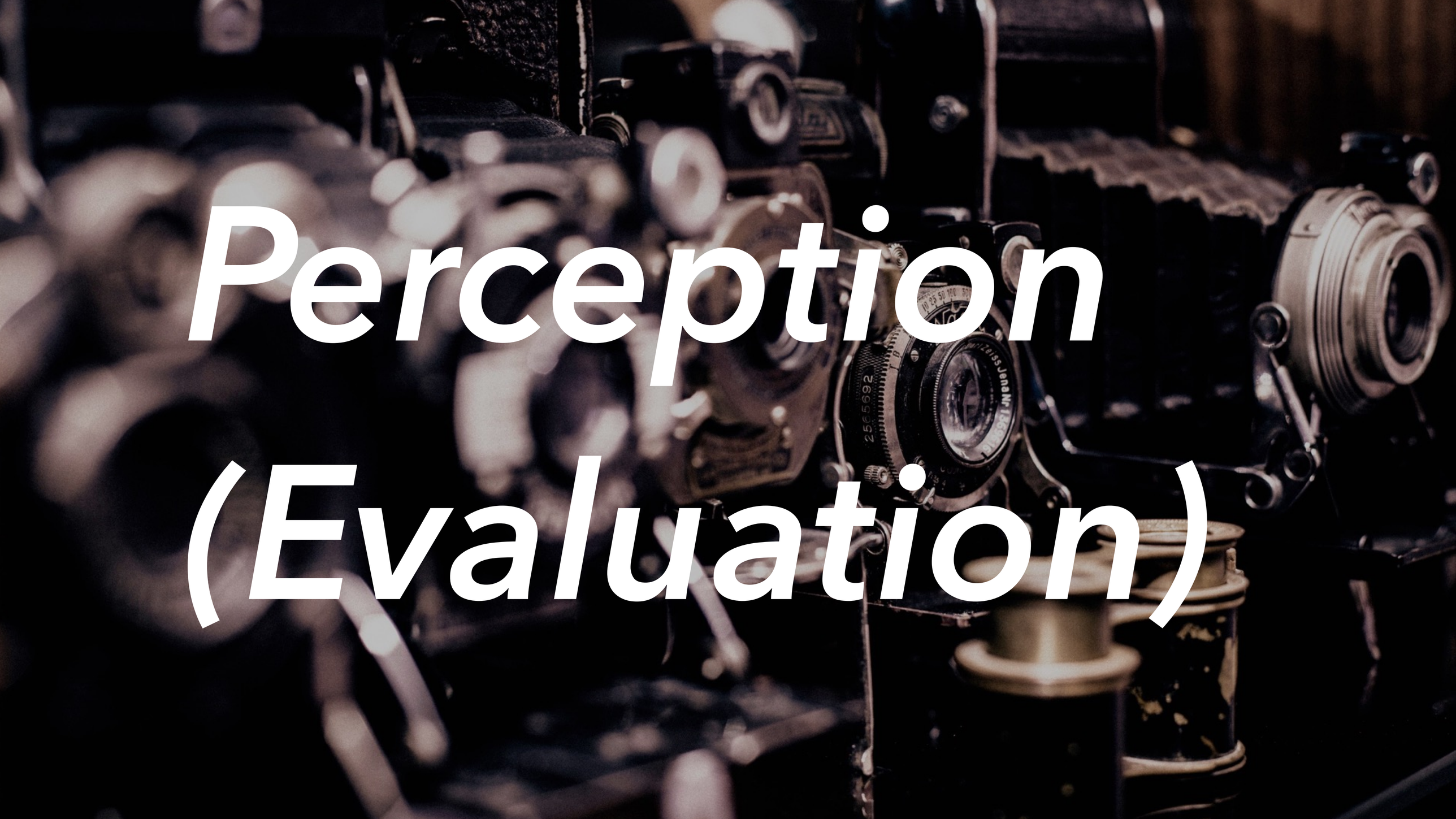
Attention

Working Memory

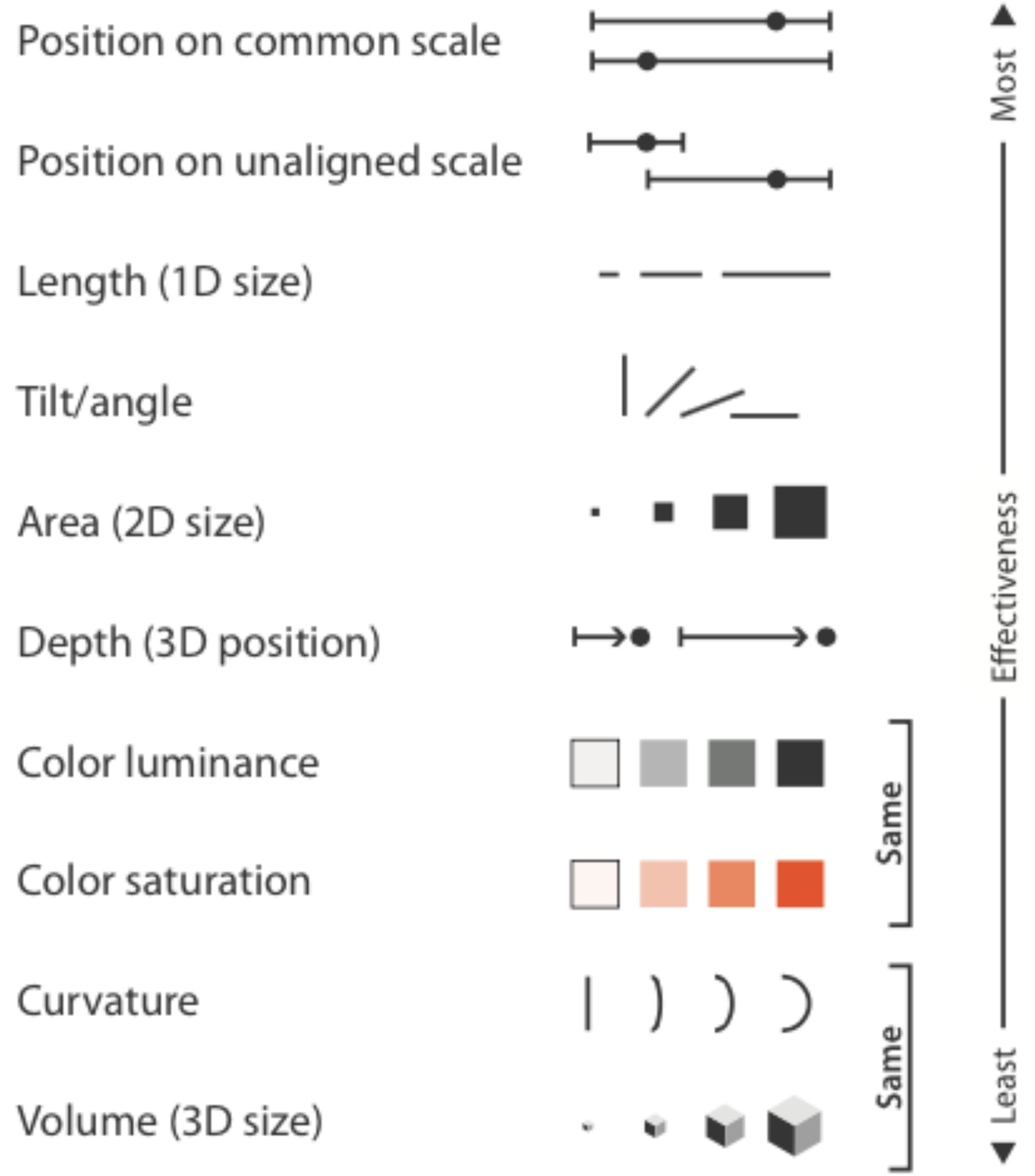
Latency

Time Constant	Value (in seconds)
perceptual processing	0.1
immediate response	1
brief tasks	10

Table 6.1. Human response to interaction latency changes dramatically at these time thresholds. After [Card et al. 91, Table 3].

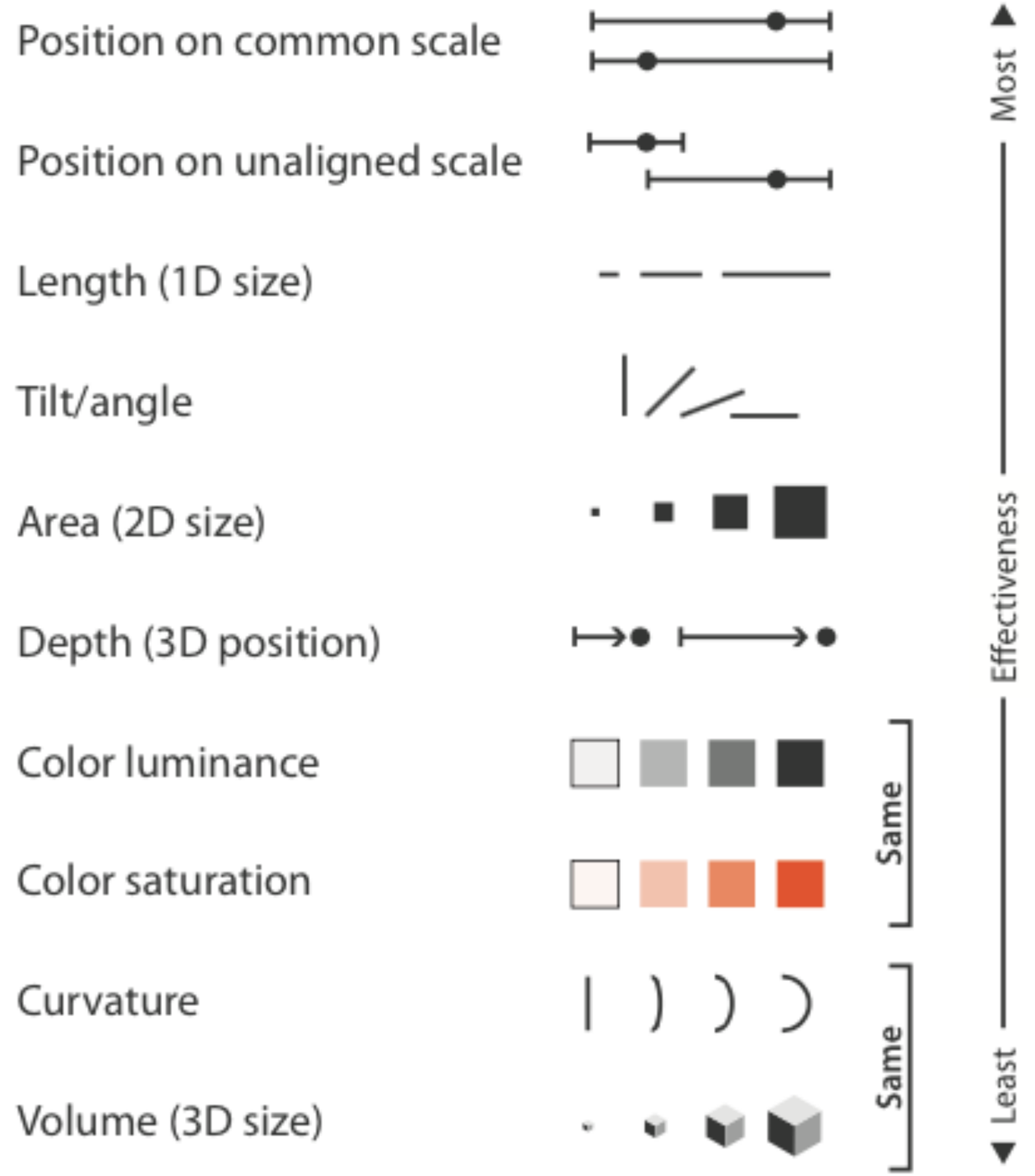

Perception
(Evaluation)

Magnitude Channels: Ordered Attributes

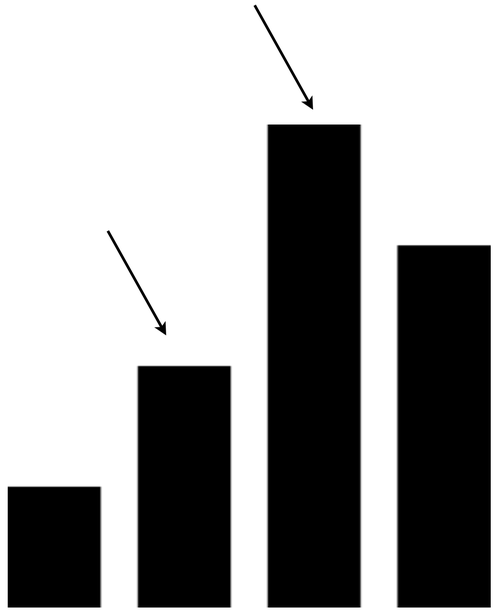


How do we get this?

Magnitude Channels: Ordered Attributes

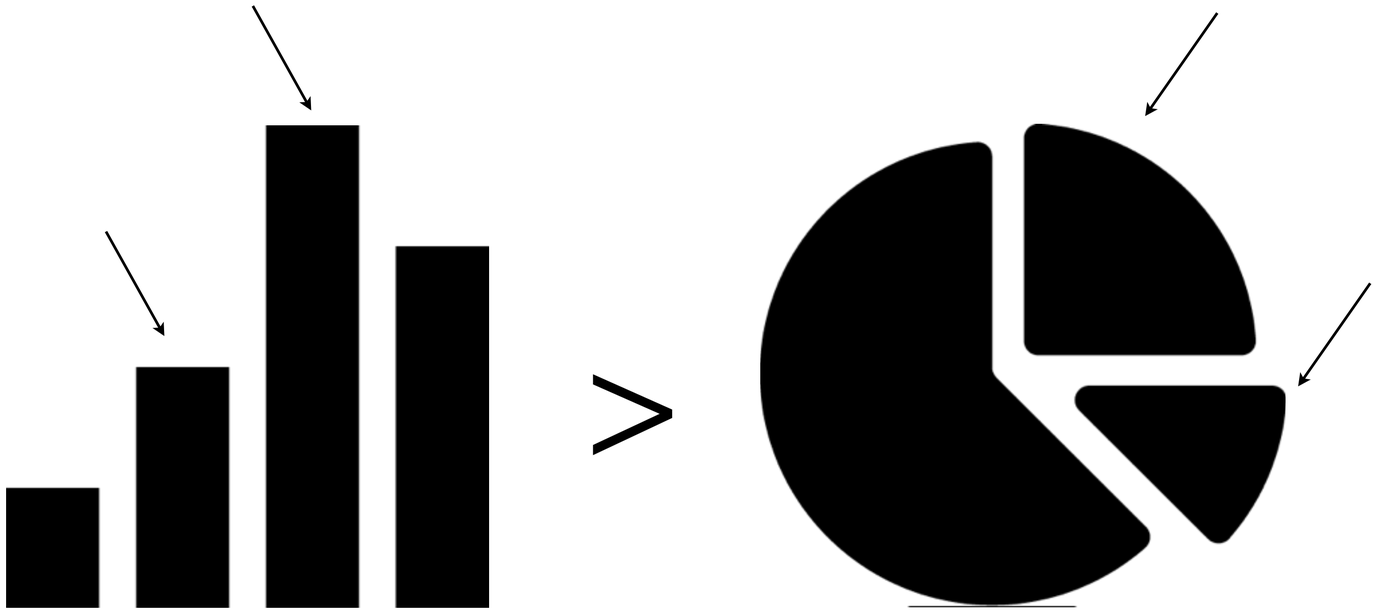


How do we get this?



a. Which of the two is larger?

b. What percentage is the smaller of the larger?



Position

Angle

(Cleveland & McGill,1984)

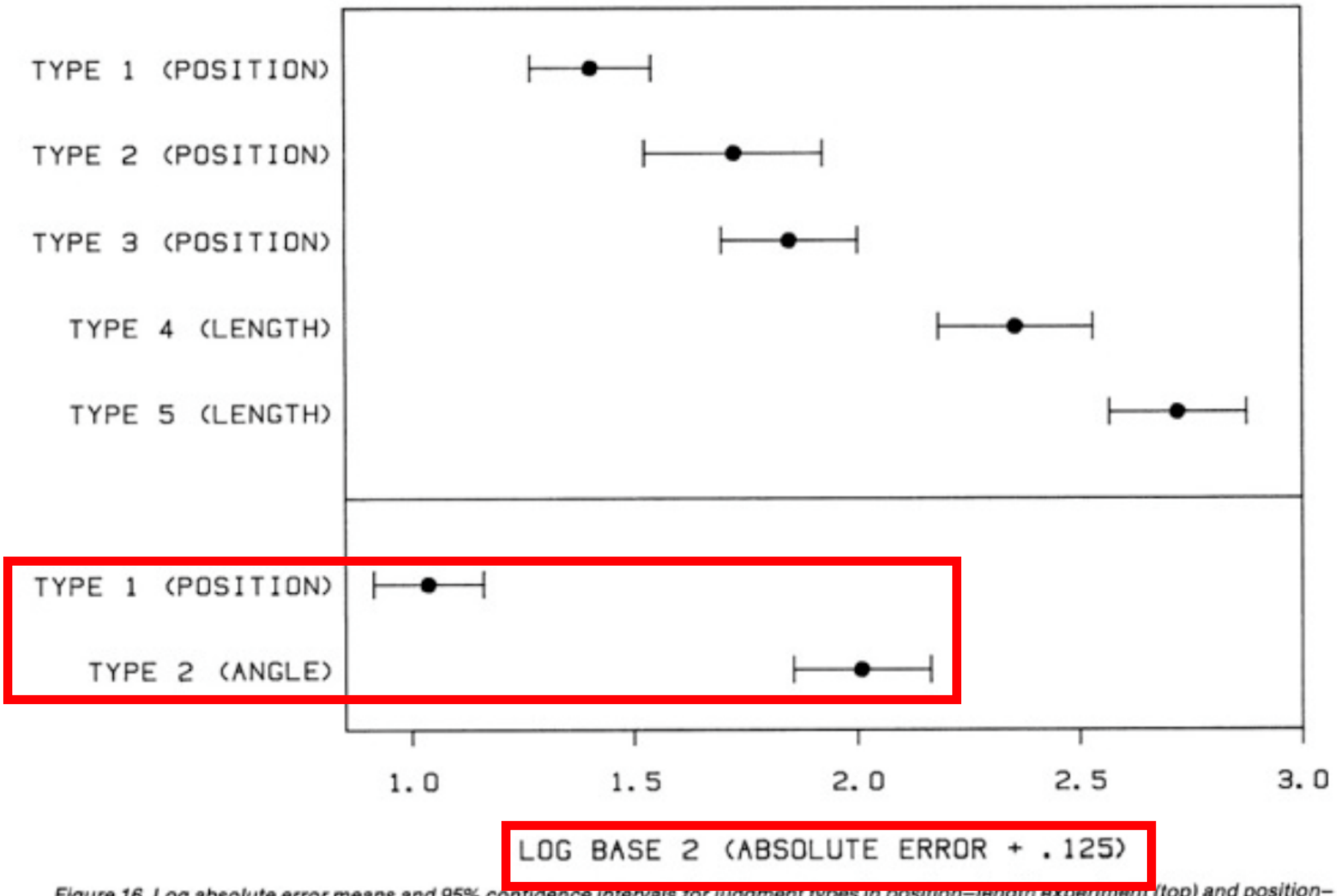
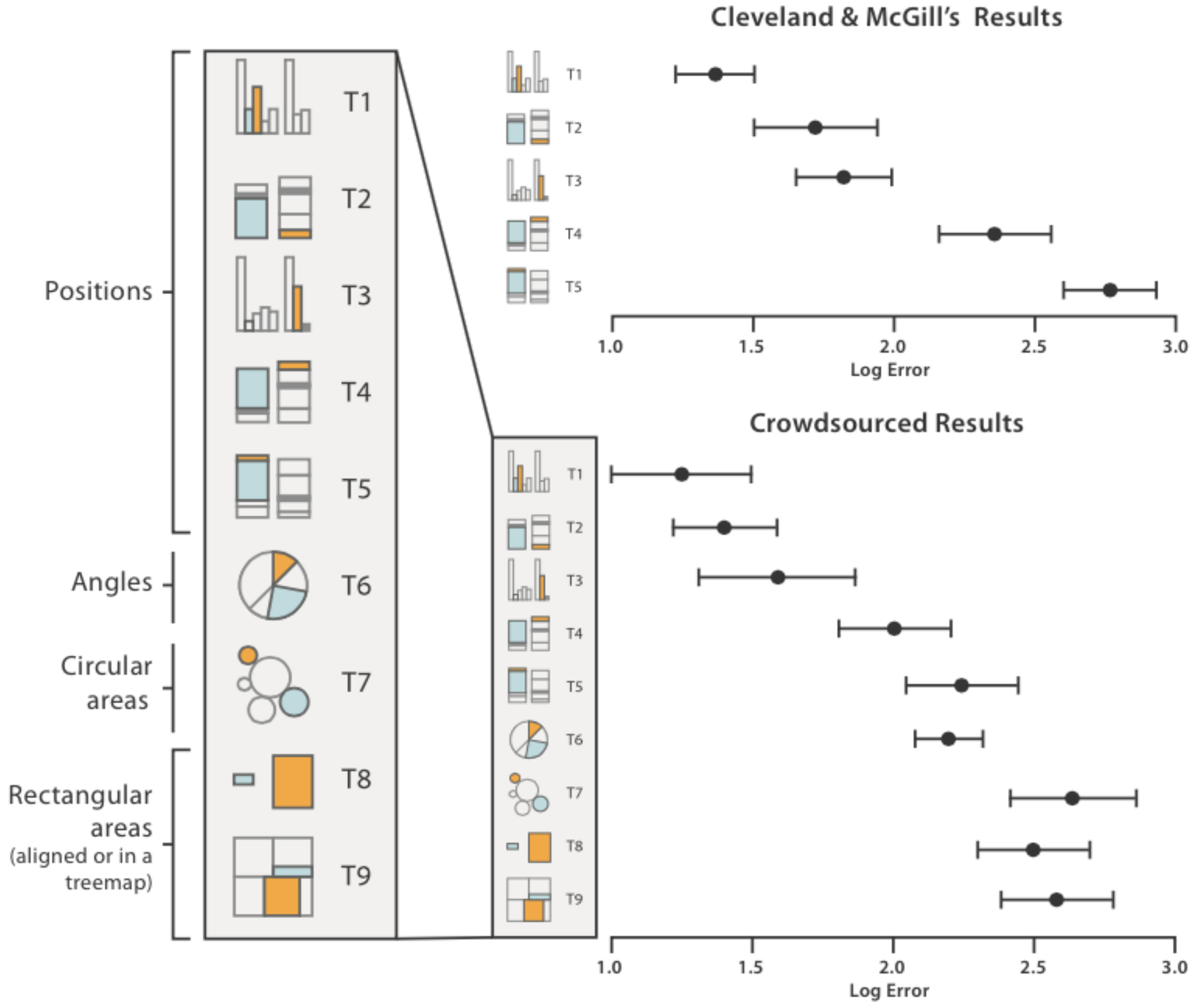
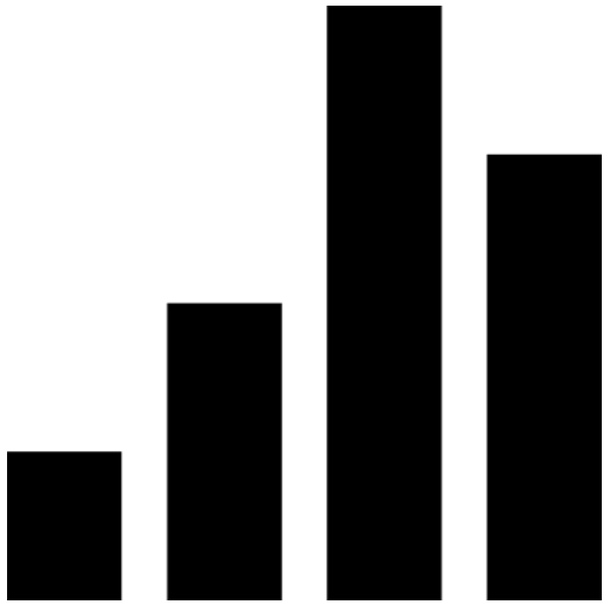


Figure 16. Log absolute error means and 95% confidence intervals for judgment types in position–length experiment (top) and position–angle experiment (bottom).


Cleveland & McGill's Results
Crowdsourced Results
Positions
Angles
Circular areas
Rectangular areas (aligned or in a treemap)
T1
T2
T3
T4
T5
T6
T7
T8
T9
1.0
1.5
2.0
2.5
3.0
Log Error

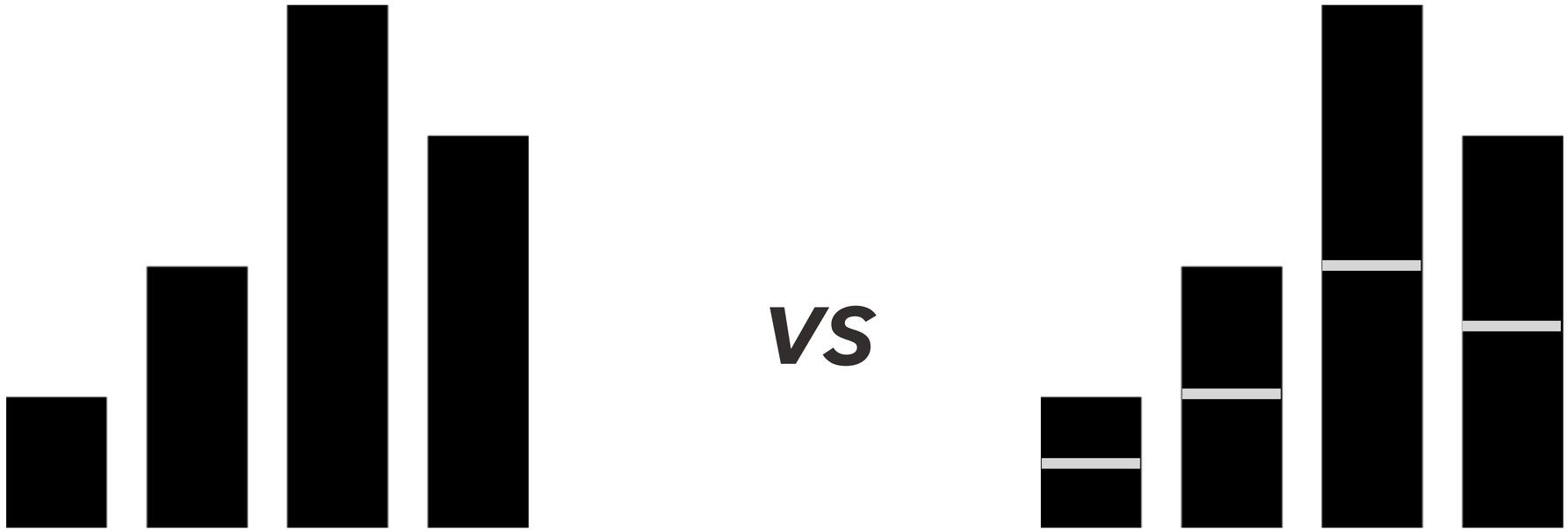
What changes can help perception?



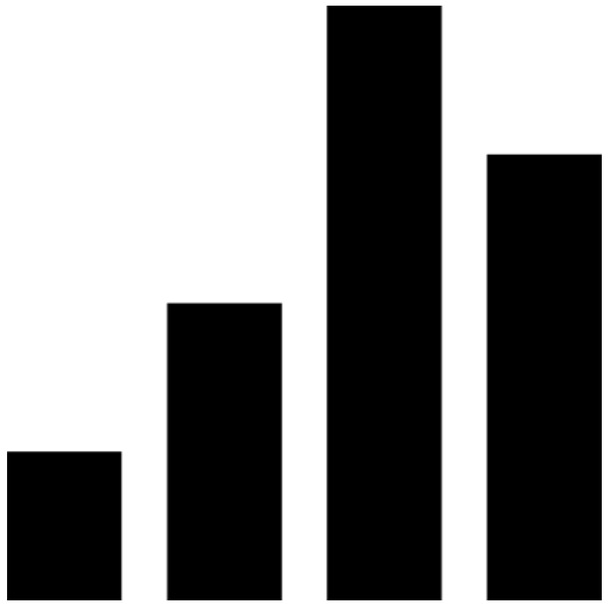
vs

???

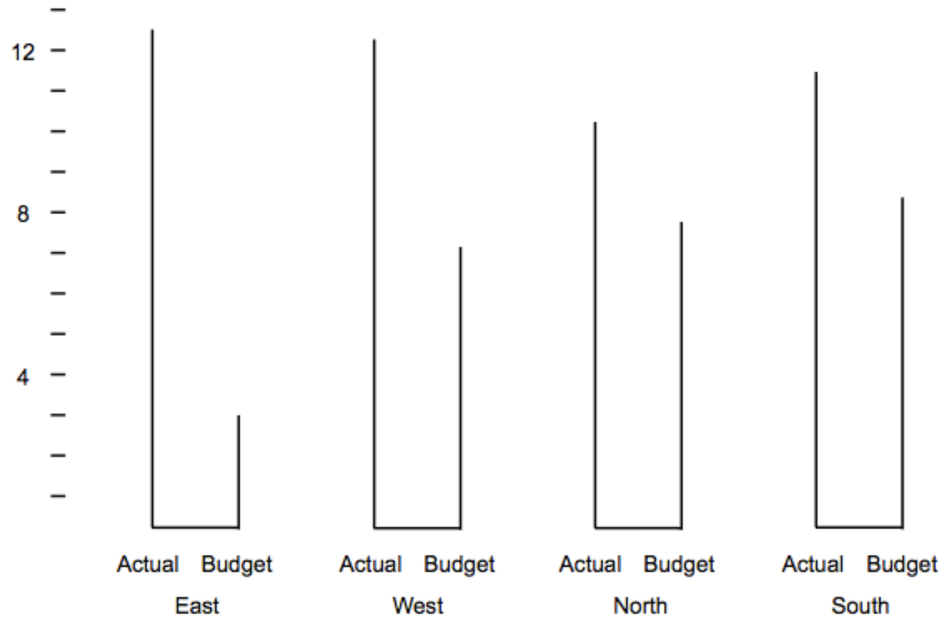
What changes can help perception?



What changes can help perception?



vs




evaluation

how do we know which vis is best?

algorithm level

encoding/ interaction level

data/task level

domain level

Domain situation

Observe target users using existing tools

Data/task abstraction

Visual encoding/interaction idiom

Justify design with respect to alternatives

Algorithm

Measure system time/memory

Analyze computational complexity

Analyze results qualitatively

Measure human time with lab experiment (*lab study*)

Observe target users after deployment (*field study*)

Measure adoption