

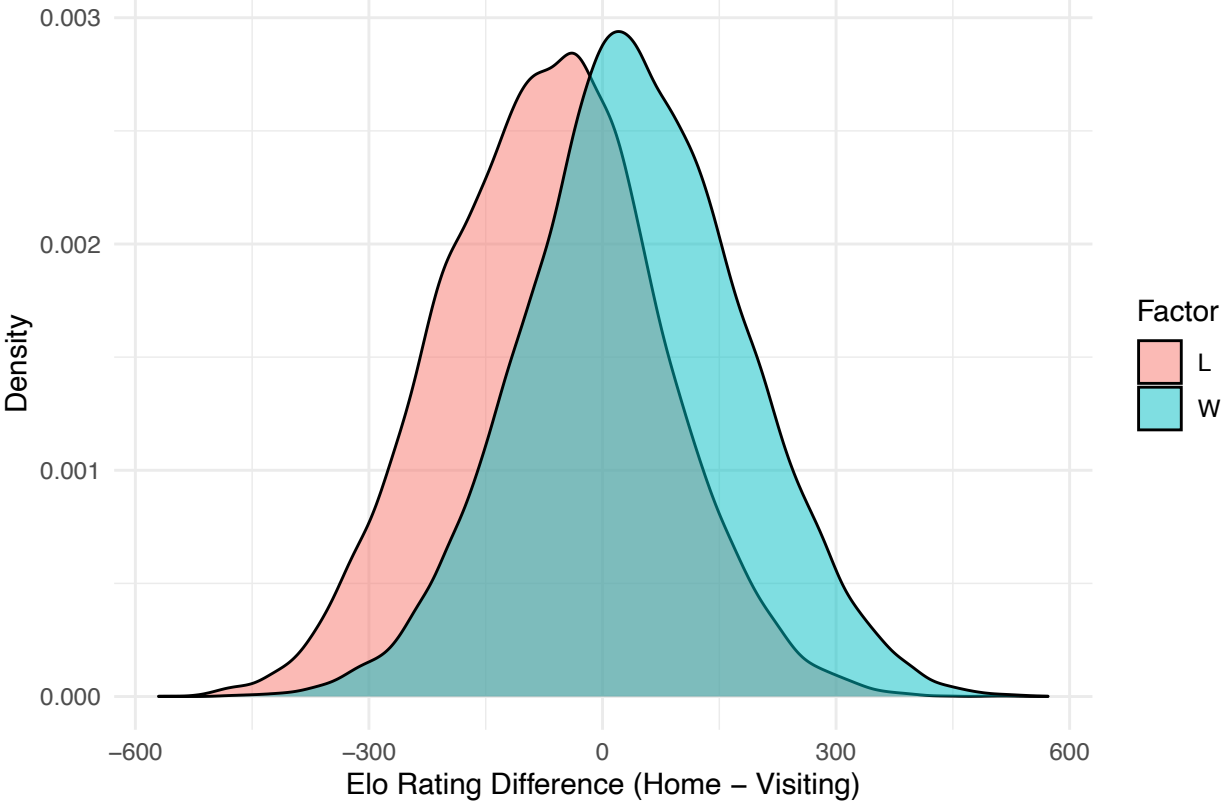
Lecture 03 – Fundamentals of Data Visualization

Today's Learning Objectives:

1. Practice constructive criticism on peer work.
2. Define semiotics.
3. Discuss two competing philosophical positions of semiotics and the evidence for each.
4. Describe the properties of sensory and arbitrary representations.
5. Define Gibson's Affordance Theory.
6. Describe the stages of visual perception.
7. Describe some of the costs and benefits of visualizations.

Visualization Critique #1:

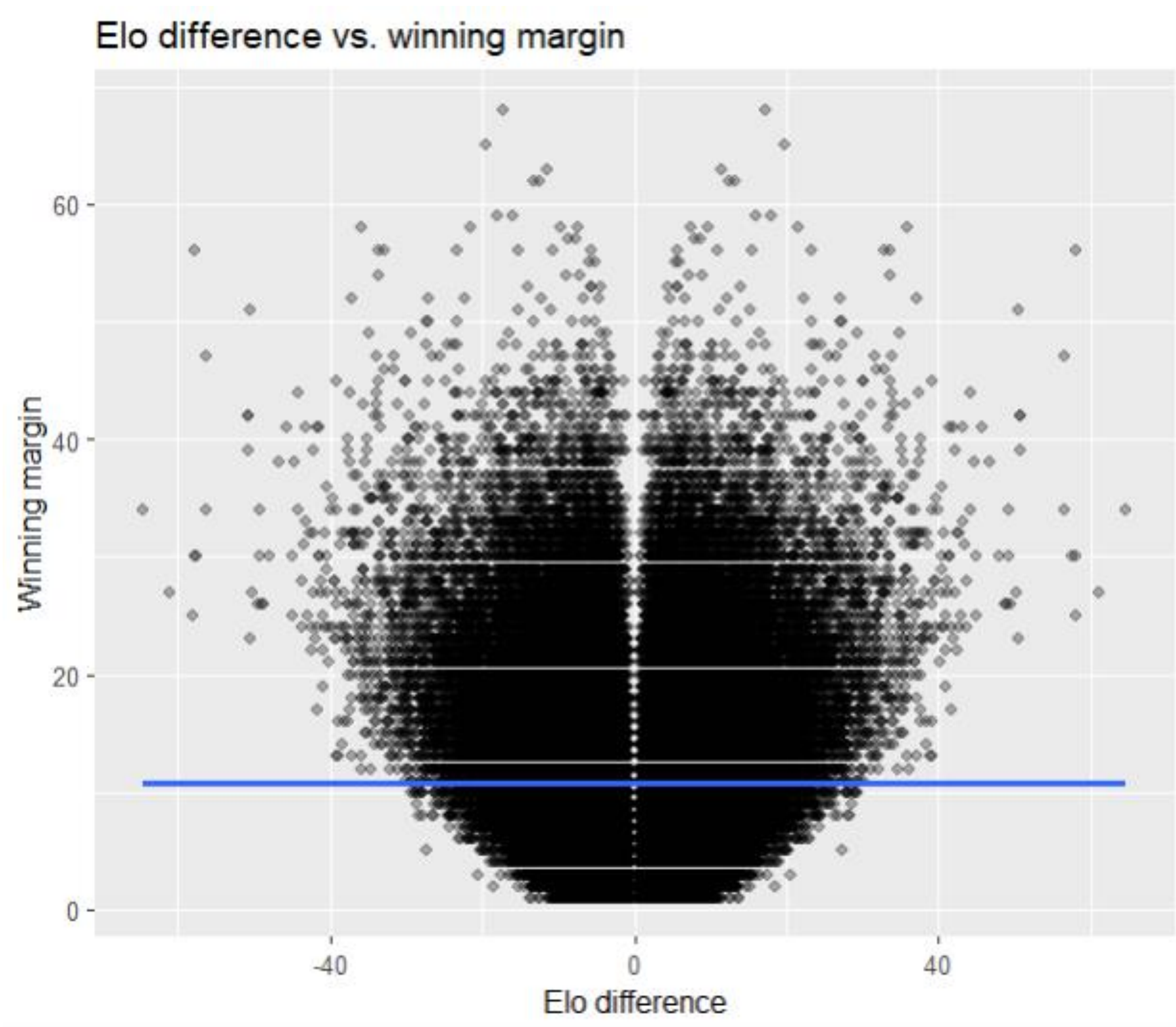
Density Estimation of W/L Based on Elo Rating



Does NBA Elo Rating Reliably Predict Point Differential?



Visualization Critique #2:



Fundamentals of Data Visualization

Discussion:

Why produce visualizations?

Fundamentals of Data Visualization

- **Semiotics:** the study of symbols and how they convey meaning.

Discussion:

What are the two philosophical positions set out in the first chapter of the book? Which do you personally align with at this point?

- **sensory:** aspect of graphic that is gathered by perceptual processing and does not need to be learned (ex: a picture of a dog can be matched to a dog without learning about what a picture is or how to read it).
- **arbitrary/cultural:** aspect of graphic that must be learned (ex: “dog” doesn’t look like a dog, so you have to learn the word first before you get its meaning).

Properties of Sensory Representation

- *Understanding without training*: meaning is perceived without additional training.
- *Resistance to alternative denotation*: some symbols have inherent meanings and contradicting them is perilous!
- *Sensory immediacy*: the processing of some sensory information is hardwired and fast, use this to your benefit.
- *Cross-cultural validity*: sensory code will be valid and understood across cultural boundaries.



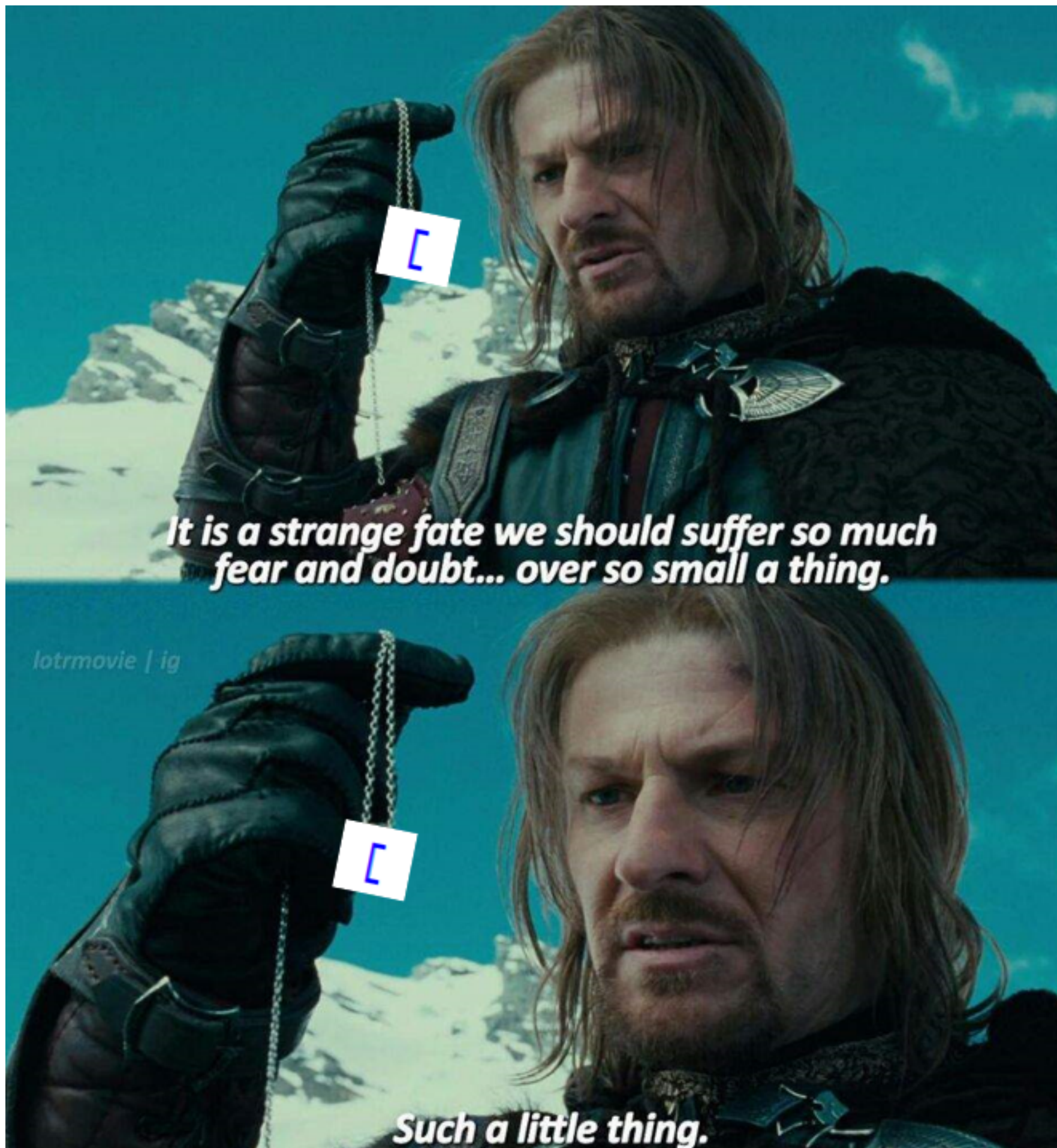
Properties of Arbitrary Representation

- *Hard to learn:* often takes years of specialized training in order to keep learn cultural/arbitrary symbols.
- *Easy to forget:* arbitrary conventions can be easily forgotten if not over-learned, can interfere with each other.
- *Embedded in culture and applications:* cultural meaning needs to be learned, but it is pervasive once established.
- *Formally powerful:* can be constructed to be rigorous, precise, and powerful meaning (as much so as spoken language), but are often difficult to learn.



Group work:

Find a meme and discuss which aspects are sensory versus arbitrary representations of the meme.



Gibson's Affordance Theory

- “Affordance” is a perceived possibility for action in an object.
- Perceive objects and their affordances directly (not by putting together evidence from senses), makes for a very top-down approach to understanding vision.
- Argued that bottom-up was the wrong way to understand vision, and largely rejected visual mechanisms and research to that end.

Problems:

1. Even if perception is direct in real world, it is indirect with computer graphics.
2. No clear physical affordances in graphical user interfaces (or does it?)
3. Gibson's rejection of visual mechanisms is problematic.

Discussion: What examples of Affordance Theory can you think of?

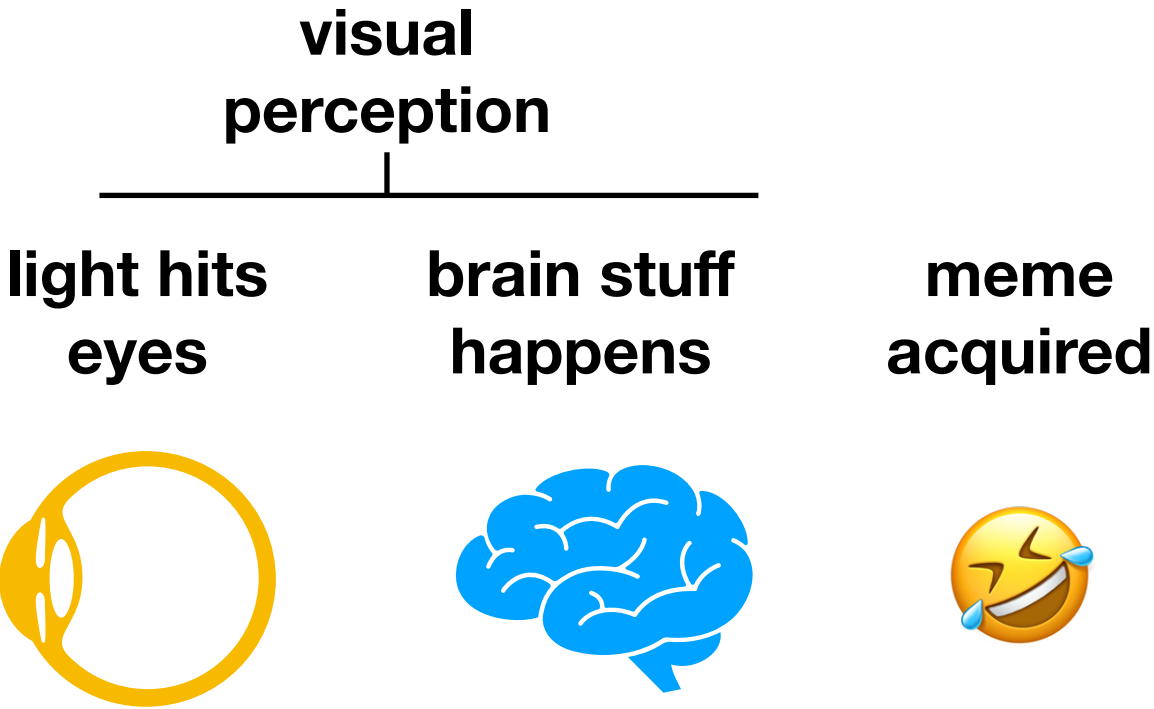
Fundamentals of Data Visualization

Discussion:

Why produce visualizations?

How does the perspective change between *designer* and *user*?

Model of Visual Perception



Model of Visual Perception

Stage 1: Parallel

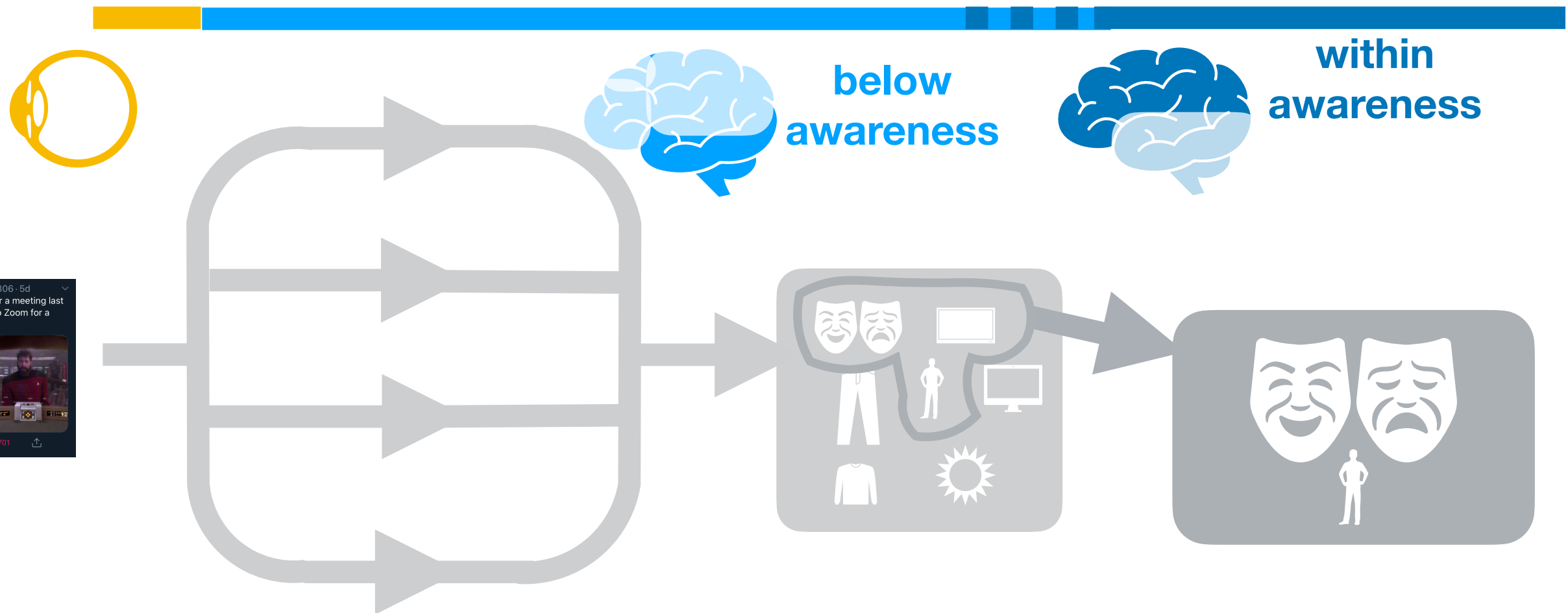
- First pass processing
- Parallel
- Transitory
- Rapid
- Extraction of features
- Bottom-up, data-driven
- Understand visual salience

Stage 2: Patterns

- Visual field is divided up, used for pattern finding
- Top-down attention
- Flexible
- Slower
- Serial
- Where/ what split

Stage 3: Visual Working Memory

- Small no. patterns (<4) passed to VWM
- Objects held in VWM by active attention
- Limited number of WM “slots” available



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Action Items for Next Time:

Homework:

1. Complete Data Carpentry R tutorial Section “Starting with Data” (<https://datacarpentry.org/R-ecology-lesson/02-starting-with-data.html>)
2. Choose a visualization and (a) list the properties of that visualization as sensory or arbitrary. (Do not turn this in! We will put it with part b next time.)
3. Post your Elo visualizations to the Discussion board and comment on two other visualizations (1 positive, 1 constructive critique).

Reading for next time:

1. Ware Chapter 2