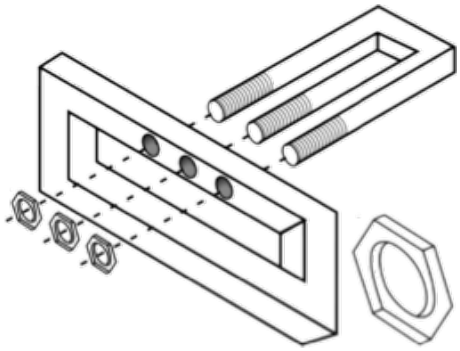
Cognitive Psychology

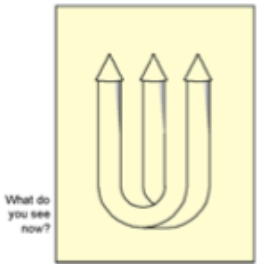
Lecture 3: Perception

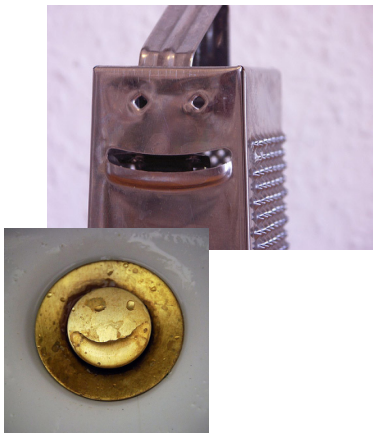
Outline for today: Perception

- Sensation vs. Perception
- Bottom-Up vs. Top-Down Processing
- Four approaches to understanding perception:
  - Helmholtz's unconscious inference
  - Gestalt laws of organization
  - Environmental regularities
  - Bayesian Inference

Perception is an *active, on-going, constructive* process

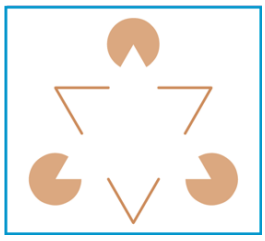






Sensation vs. Perception

- Sensation: effects of a stimulus on sensory organs
  - Vision: rays of light hitting our eyes
  - Hearing: pulsating air (soundwaves) hitting our ears
- Perception: elaboration & interpretation of the sensory stimulus
  - Not an exact copy of "the world"
  - The sensory information is translated into a meaningful representation



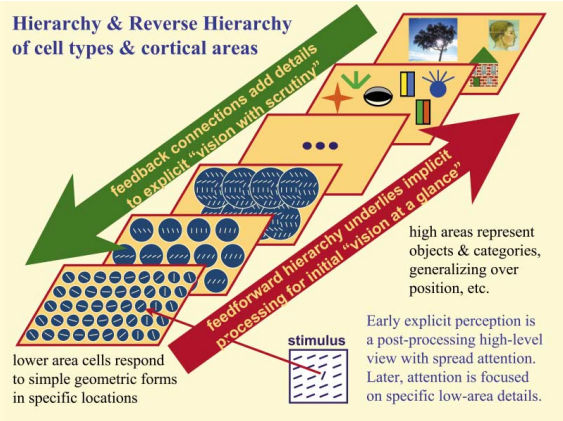
The Complexity of Perception

Bottom-up

- Perception may start with the senses
- Incoming raw data
- Energy registering on receptors

Top-down

- Perception may start with the brain
- Person's knowledge, experience, expectations



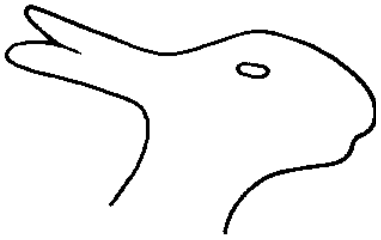
Bottom-up processing

- Data driven processing
- From receptors to recognition
- Direct perception

- Object recognition occurs after perception:
  - Template matching
  - Prototype theory
  - Feature-matching

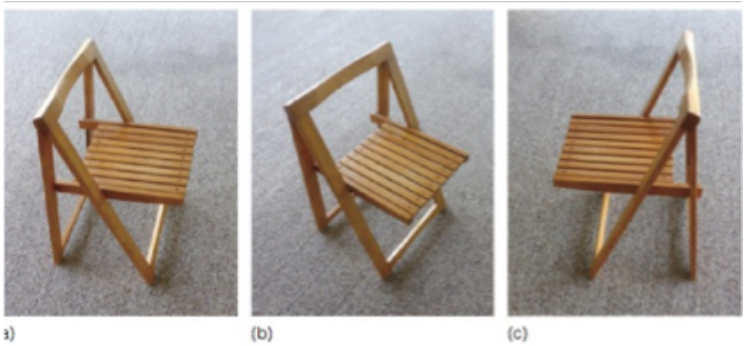
Why bottom-up isn't enough

- Ambiguous figures
  - Perception changes with knowledge & experience



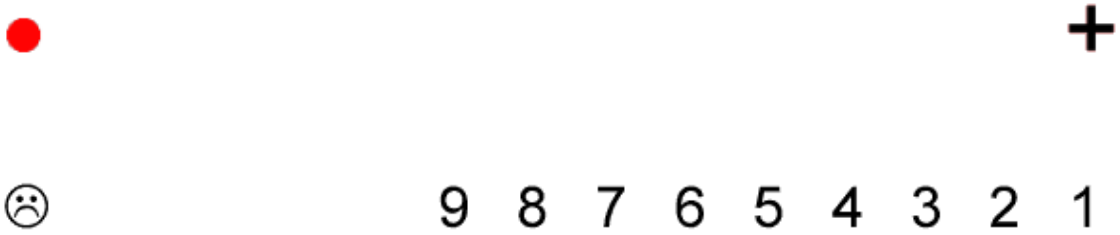
Why bottom-up isn't enough?

- How do you know this object isn't changing shape when you move around it?



Why bottom-up isn't enough

- In some cases, we need to literally fill in the gaps



Top-down processing

- Conceptually driven processing
- Influences from higher-level processes
- Indirect perception

A

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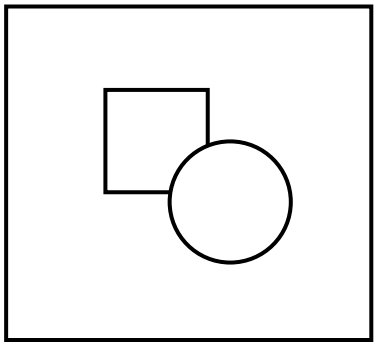
C

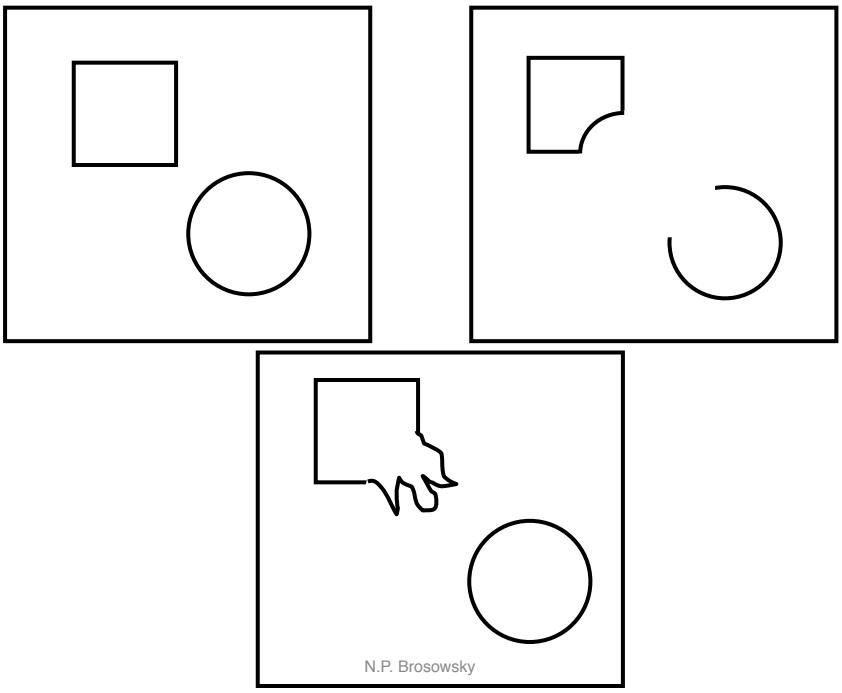
blob

- Sensory information is always ambiguous
- How do we translate ambiguous sensory information into a meaningful representation?
  - Helmholtz's unconscious inference
  - Gestalt laws of organization
  - Environmental regularities
  - Bayesian Inference

Helmholtz's Theory Of Unconscious Inference (~1860)

- Top-down theory
- Some perceptions are the result of *unconscious assumptions* about the environment
  - We use our knowledge to inform our perceptions
- We **infer** much of what we know about the world
- *Likelihood principle*: we perceive the world in the way that is "most likely" based on our past experiences



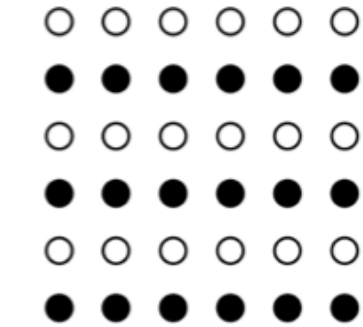


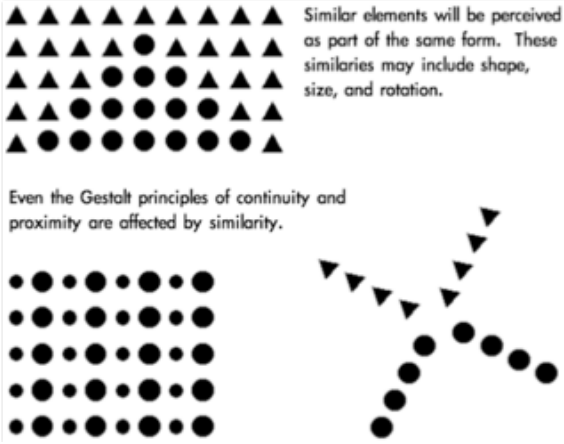
Gestalt Psychologists

- Concerned with *perceptual organization*
  - How are elements grouped to create objects
- People form global impressions of stimuli
- The impression (whole) is more than the sum of the sensations
- Stimuli have self-organizing (grouping) tendencies
  - Proposed *Laws of Perceptual Organization*
- Our perception of objects is driven mostly by these laws

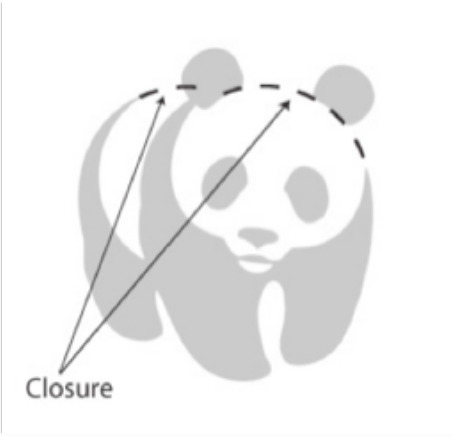
Law of proximity

Law of similarity

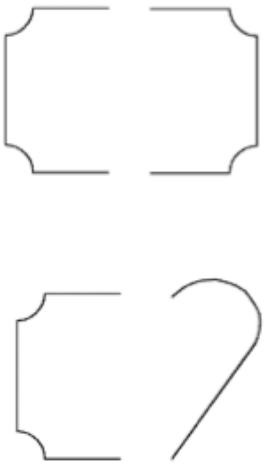




Law of closure



Law of symmetry



Law of common fate

Law of continuity

Helmholtz vs. Gestalts

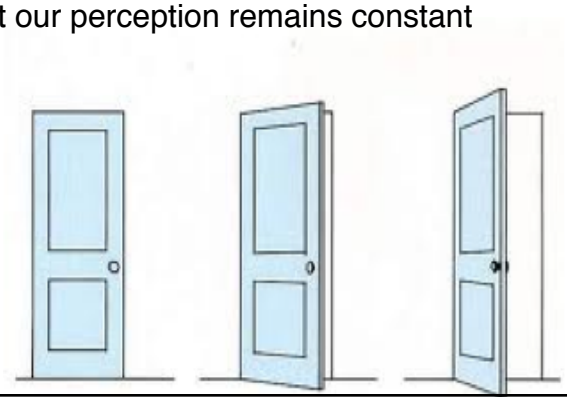
Differ in how much influence our experience has on perception

- Helmholtz
  - Our knowledge of the environment enables us to determine what is most likely to have created the pattern on the retina
- Gestalts
  - The influence of experience is minor compared to the ***intrinsic*** (built-in) laws of perceptual organization
- Modern Psychology: our experience with the environment is a central component of perception

Environmental Regularities: Perception, experience, and the environment

- Our perceptual system exploits regularities in our environment, and our experiences with them to create stable perceptual representations
  - The sensory information changes, but our perception remains constant

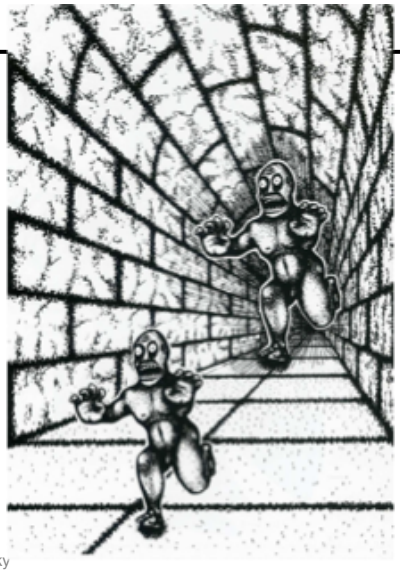
E.g., Shape Constancy
the tendency to interpret the shape of an object as always being the same, even when its shape changes on the retina

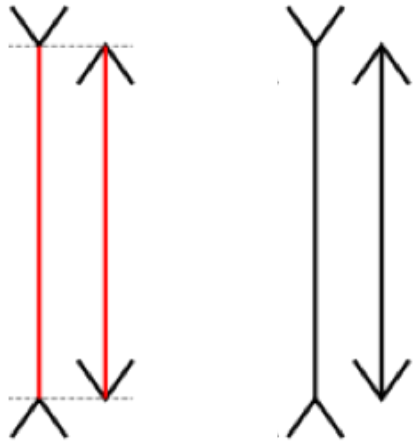


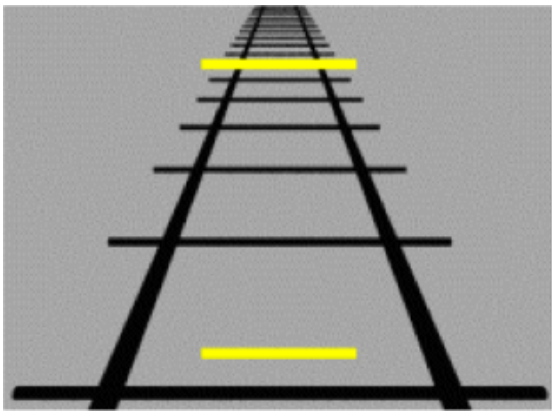
Perception, experience, and the environment

e.g., Size Constancy

- the tendency to interpret an object as always being the same actual size, regardless of its distance



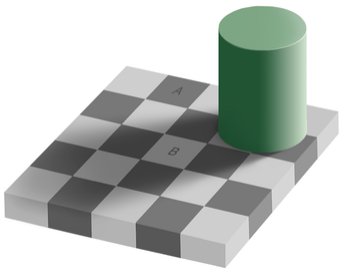




Perception, experience, and the environment

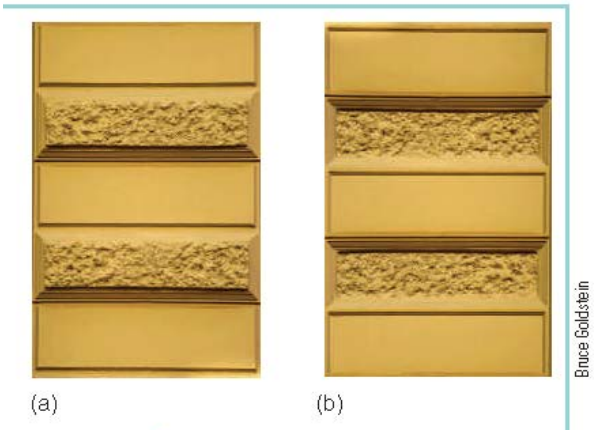
e.g., Color constancy

- The tendency to perceive the apparent color of an object as the same even when the light conditions change



Perception, experience, and the environment

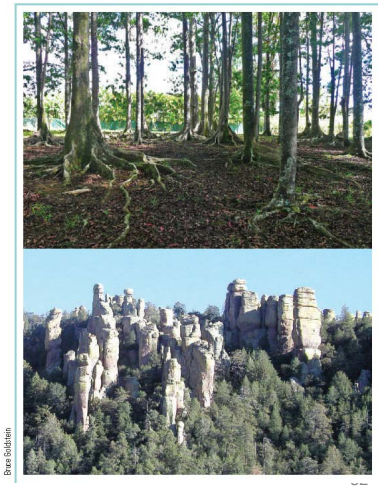
- **The light-from-above assumption**
- Light typically comes from above, therefore we interpret the left as protruding and right as indented..
- Even though they could be interpreted either way



Perception, experience, and the environment

Physiological evidence

- Some neurons respond best to things that occur regularly in the environment
- Neurons becomes tuned to respond best to what we commonly experience
  - Horizontals and verticals
    - "The oblique effect"
  - Experience-dependent plasticity



Perception, experience, and the environment

Physiological evidence

- Brain structure/function can change with experience
  - Experience-dependent plasticity

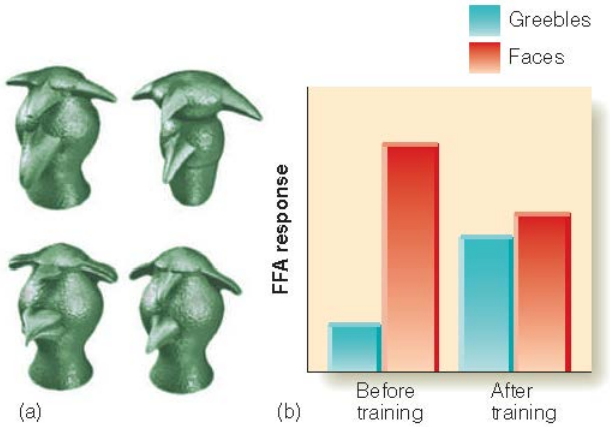
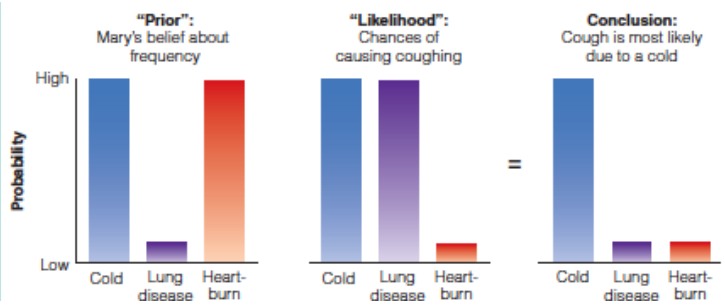
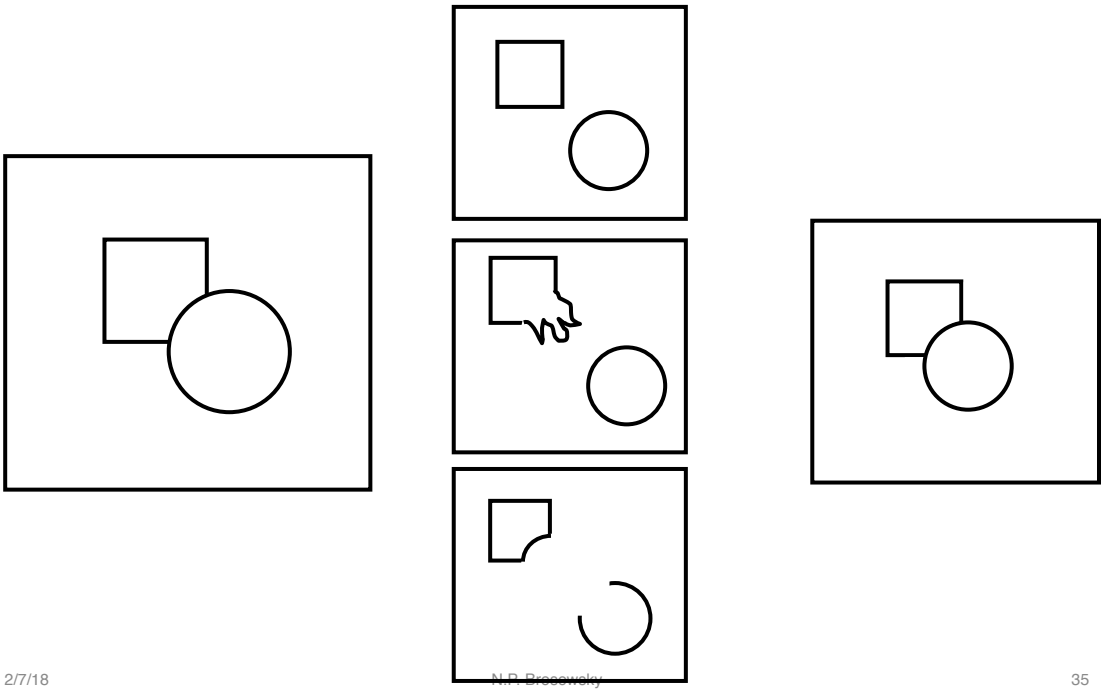


Figure 3.29 (a) Greeble stimuli used by Gauthier. Participants were trained to name each different Greeble. (b) Magnitude of brain responses to faces and Greebles

Bayesian Inference

- Prior beliefs -> evidence -> update beliefs -> perception





- Perception is an active, on-going, constructive cognitive process
  - Deal with variability in sensory input
  - Deal with ambiguous images
- Incorporates Top-Down & Bottom-Up Processing
- How does perception come about?
  - Innate components / perceptual heuristics
  - Inferences based on Statistical Regularities in the Environment & Environmental context
  - Experience / Learning
  - Experience-dependent plasticity