

Perception and Memory

Critical Thinking

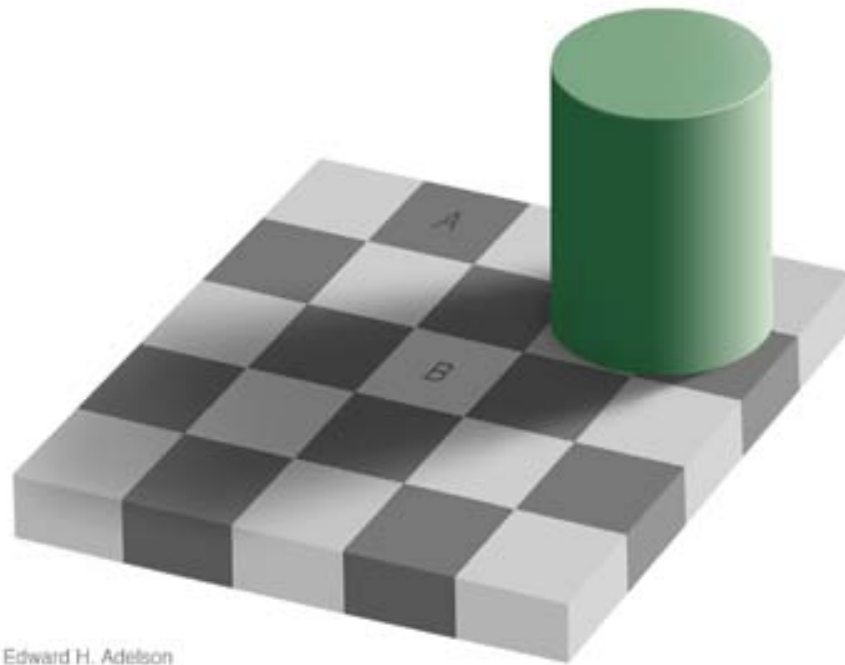
Sources of Belief

- Other people (parents, friends, media, teachers, experts, authority)
- Reasoning
- Observation (perception and memory)

Perception

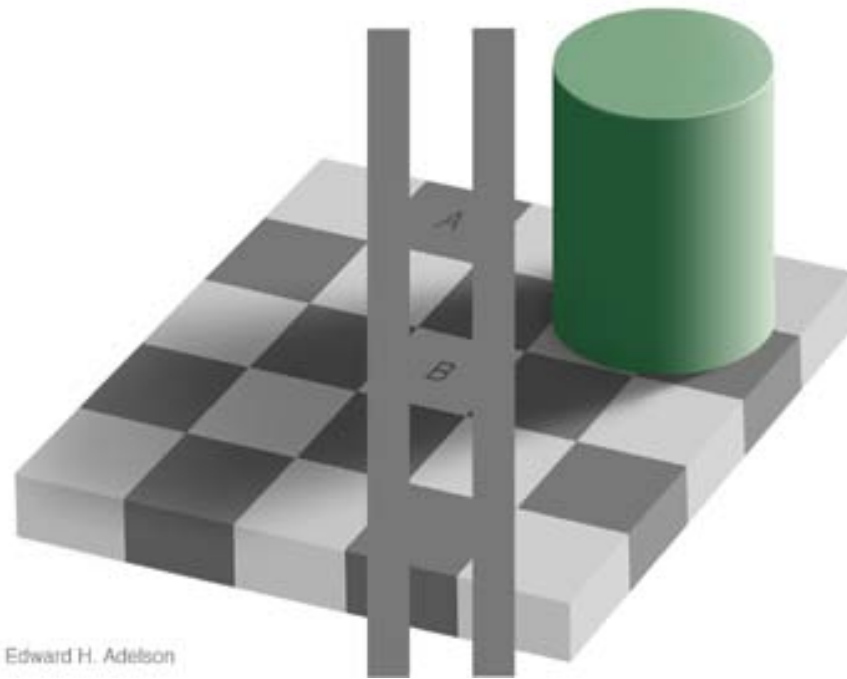
- How reliable is perception?
- First, here are a number of obvious factors that can effect the accuracy of our perception:
 - External factors: dark, noisy, busy, obstructions
 - Internal factors: distracted, drugged, tired, impaired

The Checker Board Shadow Illusion



Edward H. Adelson

The Checker Board Shadow Illusion



Edward H. Adelson

The Myth of 'Perfect' Perception

- Many (most) people regard perception as something that is, under normal circumstances, 'perfect'
- That is, as long as it's not dark, we're not drugged, we're not wearing funny-colored glasses, and we're not looking at a highly artificially constructed scene that provokes some specific visual illusion, we see things exactly *as they are*.
- So the idea is that we are looking at the world through a perfectly clean window, as if our eyes are a perfect camera, our ears perfect microphones, etc.
- False!

Perception *must* be Inferential!

Constructive Perception

- We can look at Perception as an Inversion Problem:
 - What is happening ‘out there’ causes there to be raw sensory data
 - My visual processing system (brain) thus needs to ‘reconstruct’ what it was that led to the raw sensory data: it needs to ‘invert’ this causal process
- However, this Inverse Problem is *underspecified*: the same set of raw sensory data can be generated by infinitely many different scenarios ‘out there’.
- Hence, I can only make an ‘inference to the best explanation’ *at all times*
- *All perception is a construction!*
- Our perceptual apparatus works kind of like a detective: given the ‘clues’ (raw sensory data), it tries to tell a plausible story.

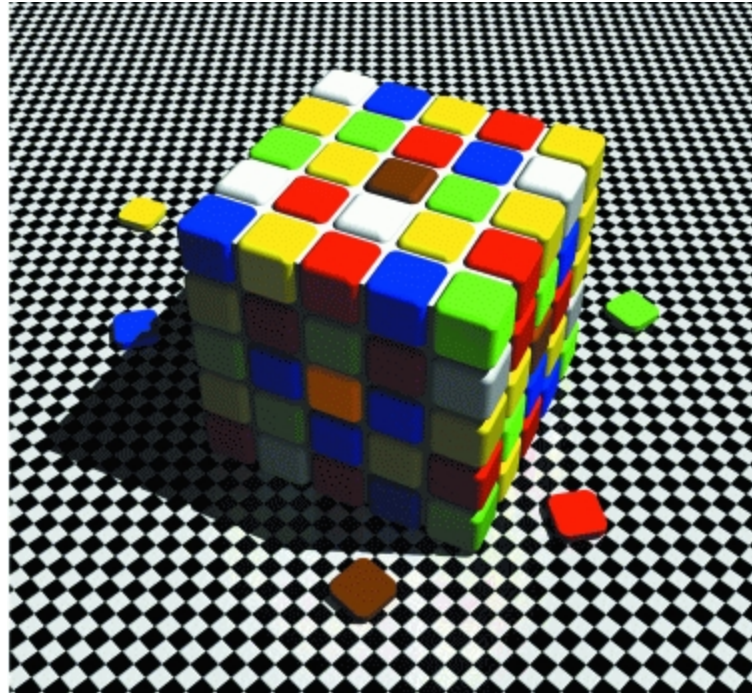
X

X

The Blind Spot

- There is a region in the back of the eye's retina where there are no light receptors. So, we don't see anything in this region.
- But, we don't notice this (close one eye right now: do you see a gap? No.).
- What is going on?
- The brain takes a best stab at what might be going on.
- In fact, it isn't so much 'filling in' (as that still suggest that the rest of the perception is 'perfect'), but the brain works with the raw data it is provided with, and constructs a perception from that.

Color Contrast

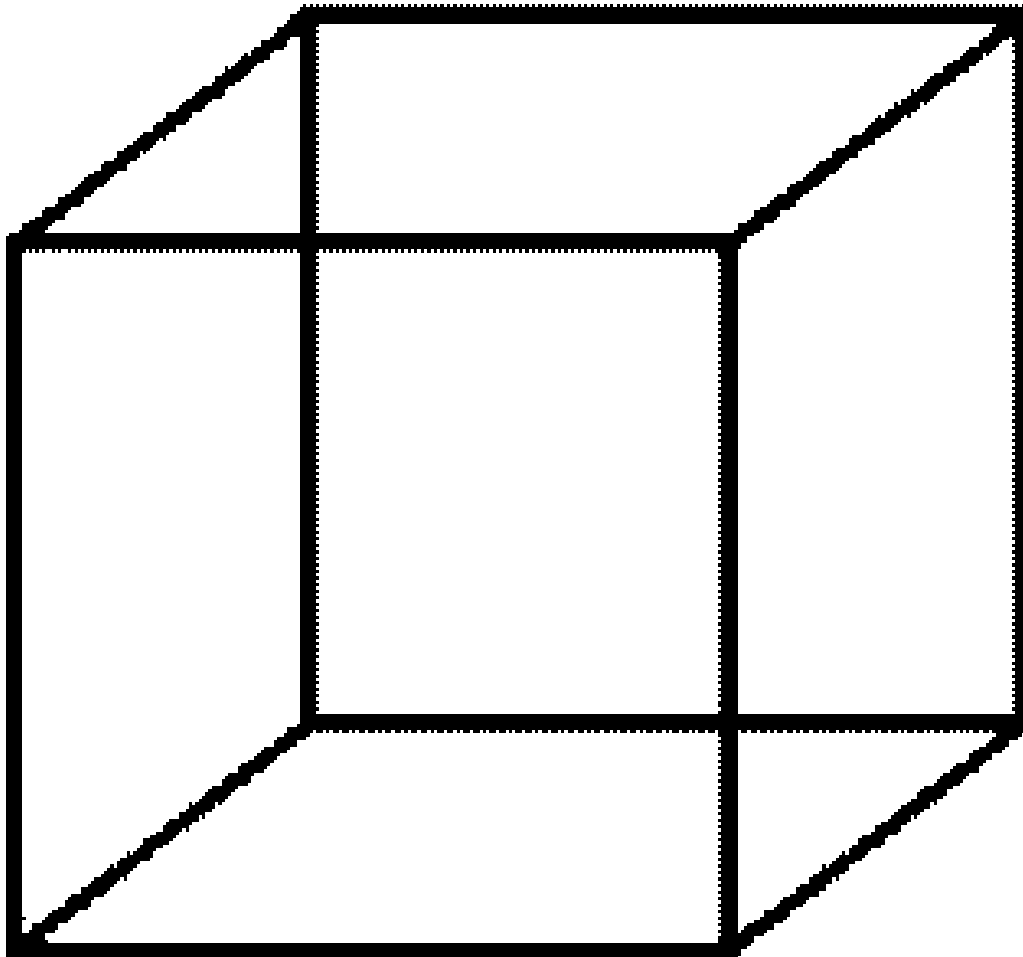


(compare color of the middle squares on top and in front of cube)

Background Knowledge

- Background knowledge/beliefs drive perception ('believing is seeing')
 - Color constancy: Cut-outs of trees and donkeys (made of same color material, but perceived as different color, in accordance to our beliefs)
 - Size constancy: even though approaching objects would seem to get bigger and bigger going by the mere raw 2D projection on retina, we never perceive them as growing in size, because we know (or at least based on background experience have strong reasons to believe) that they remain the same size.

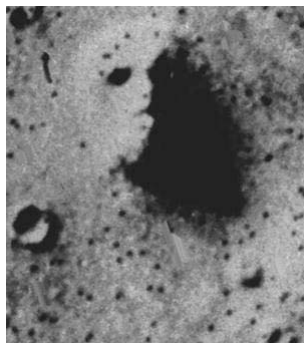
The Necker Cube



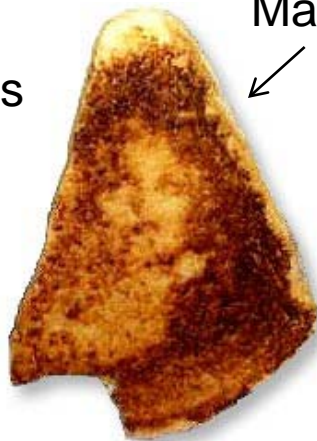
Expectations, Fears, and Wishes

- Corridor Experiment: subjects were told to walk through dark corridor and stop when they saw a flash of light ... almost invariable they stopped at some point or other ... but there never was actually a flash of light
- 'Monsters' under the bed, in the closet, etc.
- Blondlot Case: N-Rays

Devils, Angels, Aliens, Jesus, Mary, and ... Illinois!



Jesus



Mary



Clearwater, FL USA



Local
Jesus

Pattern 'Bias'

- It is important for our survival to recognize patterns in nature. Patterns allow us to make predictions and control our lives.
- Moreover, it is better to be safe than sorry: better to recognize a non-face as a face than not to recognize a face!
- Hence, our brains have 'pattern bias': when there may or may not be a pattern, it is likely to say that there is a pattern.

‘Pro-Active’ Perception

- Many people see perception as a kind of passive or reactive process: the perceptual processing areas of the brain just sit idly by until they get hit with sensory input.
- But this makes little sense:
 - “Hmm. I’m in a classroom now.”
 - (20 msec later) “Hmm. I’m in a classroom now.”
- It makes much more sense for perception to be much more ‘pro-active’, constantly *anticipating* sensory input.
- On this view, much of perception is simply *confirmation of what we already expected*.



[The Door Experiment](#)

Need-Based Perception

- In fact, what makes much more sense is that higher-level processes actively drive perception to a considerable extent, in that it ‘asks’ the visual system to look for certain things in the environment that the higher-level processes need.
- Such need-only based, purposeful, perception is something we can call ‘active’ perception: Much different from the kind of ‘passive’ perception idea one gets from a purely bottom-up model.

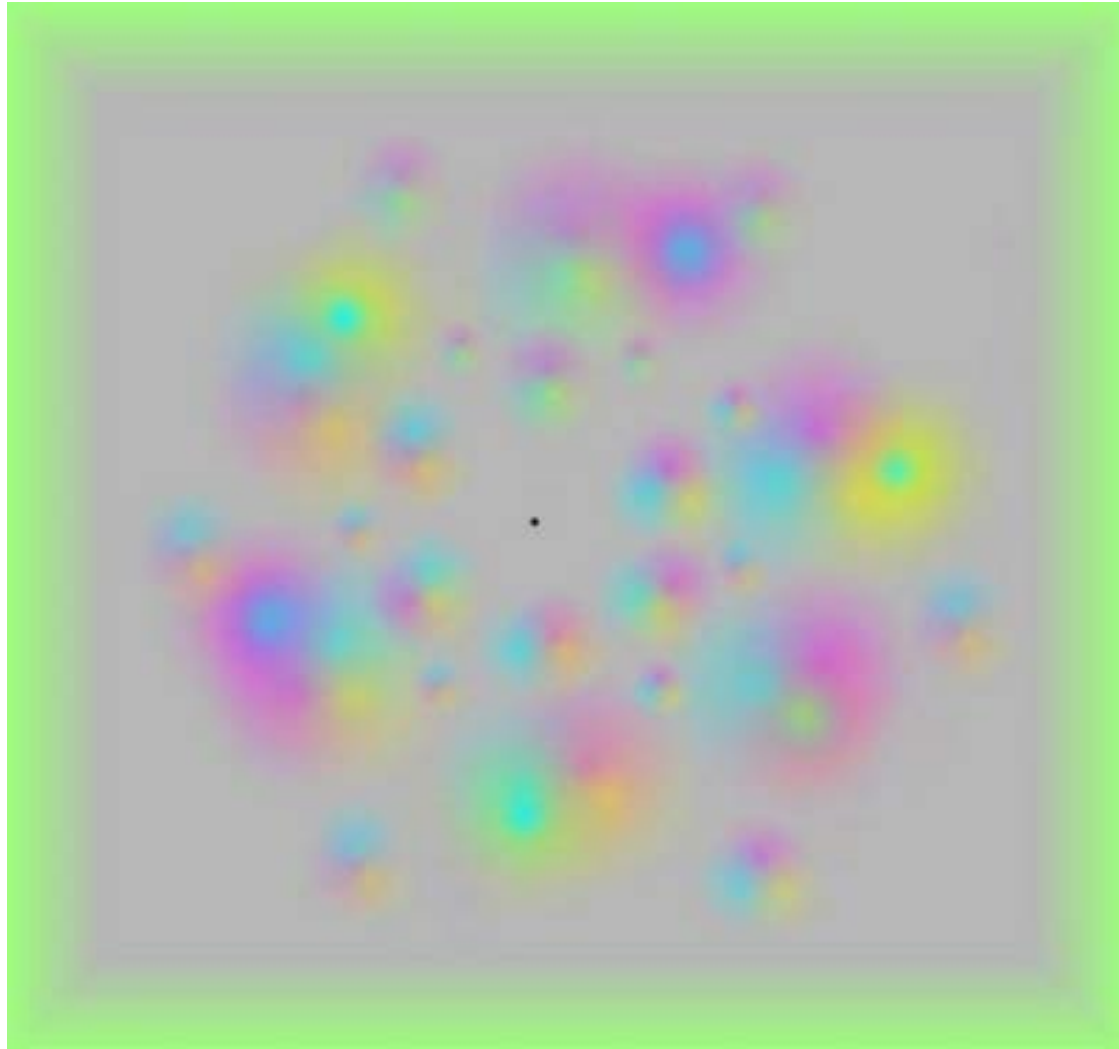
The Monkey Business Illusion

http://www.youtube.com/watch?v=IGQmdoK_ZfY

Selective Perception

- Another myth about perception: we see everything that is in our visual field.
- False!
- Our attention is only on a very small part of our visual field; we often don't see things that are right in front of our eyes!
- Again, this can be seen as an example of active perception: much of what we perceive is what the brain wants or needs, i.e. what we are looking for.

Focus on black dot in the middle



Sensory Adaptation

- As cognitive agents, we are most interested in changes in our environment.
- Our brain processes things in such a way that things that remain constant become less and less noticed.
- One way to do this: Subtract current (or predicted) stimulus from current stimulus, and pass on the difference to rest of brain.

Memory

- Memory ‘suffers’ from the same things as perception
 - Memory is selective: Little of what we are consciously aware of ever make it to long-term memory
 - Memory is leaky: Much of what was once in memory fades away
 - Memory is constructive: We re-create past experiences based on whatever traces were stored, filling in gaps based on general background knowledge
 - False memory: Sometimes, what we remember didn’t happen at all!

Selective and Leaky Memory

- A possible good reason for memory being selective and leaky is that only certain things may be deemed important to remember as far as the agent's functioning and survival goes
- We tend to remember things that 'stand out' more so than those that are not as 'salient'
 - We remember the psychic's 'hits', not the 'misses'
- Experiment:
 - Subjects had to watch video.
 - Half had arms in freezing ice water while watching
 - Half had not
 - The first group had better recollection of video
 - Possible explanation: events were deemed more important, as situation was one subjects would like to avoid in future.

False Memories

- Famous experiment by Loftus
 - Subjects saw video of car accident
 - A week later, subjects were brought back
 - One half was asked: “How fast was the car going when it bumped into the other car?”
 - Other half: “How fast was the car going when it crashed into the other car?”
 - Second half estimated (remembered) speed higher than first half. They also recalled seeing glass laying on the road after accident, even though there was none
- Courts are relying less on eyewitness testimony!

Memory is Constructive

- Rather than to look at memory and say that there is something ‘wrong’ with it, a more useful way to think about this is to see memory and recall as a process or reconstruction
 - Cues from the environment will trigger experiences from memory that agent will try and apply to current situation
 - Since no two situations are exactly alike, some amount of abstraction will have to take place in order for such a generalization to work
 - So, agents will try to ‘match’ their memory with current situation. Thus, constructive memory (and, constructive perception)
 - Would this explain déjà vu experiences?
- So, ‘imperfect’ memory allows for useful generalizations, that would be more difficult to achieve with ‘perfect’ memory