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(1527-1593)

# Observation and Categories

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## Review: The Basic Strategy for Confirmation

If the hypothesis were not true, then the prediction
would not be true
The prediction is true
∴ The hypothesis is true

- This argument is valid, but is it sound?
  - We now have to be sure that the first premise is true
  - Problem—typically there will be alternative
    hypotheses (some slight variants of the one under
    consideration) that make the same prediction
    - In such a case, the first premise of this argument
      is false

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## Review: Full Form for Confirming a Hypothesis

If the hypothesis under investigation were not
approximately true and a plausible alternative
explanation were not true, then this prediction
would not be true
The prediction is true
∴ The hypothesis is approximately true or a
plausible alternative explanation is true

- To the degree (and only to that degree) that we can
  rule out alternatives that make the same prediction,
  we can infer that the hypothesis under investigation
  is at least approximately true.

## Review: The Basic Strategy for Falsifying a Hypothesis

❖ The basic idea that false predictions count against the truth of a hypothesis is captured in the following argument schema

If the hypothesis is true, then the prediction will be true
<u>The prediction is not true</u>
∴ The hypothesis is not true

❖ This argument form is *modus tollens*. It is valid.
  ❖ The question is whether the premises are true.

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## Clicker Question

What is an auxiliary assumption (hypothesis)?

  A  An alternative hypothesis to the one being tested
  B  An additional hypothesis required to derive the prediction from the hypothesis being tested
  C  A hypothesis that should be rejected if possible
  D  A hypothesis which has not yet been adequately confirmed and so requires more testing

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## Review: Full Argument for Falsifying a Hypothesis

If the hypothesis is true AND all auxiliary hypotheses needed to make the prediction are true AND if the experimental/observational setup is adequate, then the prediction will be true
<u>The prediction is not true</u>
∴ Either the hypothesis is false, an auxiliary hypothesis is false, or the experimental/observation setup is not adequate.

❖ To the degree (and only to the degree) that we are sure that no auxiliary hypothesis is false and that the experimental/observational setup is adequate, we can infer that the hypothesis is false.

## Review: Complications with Falsification

- Often when a hypothesis makes false predictions, scientists do not abandon the hypothesis (at least immediately)
  - This is especially true when a hypothesis has generated a lot of confirmatory evidence
- How can scientists resist the conclusion of a valid argument?
  - Because they reject the first premise
    - The prediction does not follow from the hypothesis alone, but from other assumptions (auxiliary assumptions or hypotheses) as well
    - They can reject these and still hold onto the primary hypothesis

## Evaluating Hypothesis: The Simple and the Subtle

- In principle the logical evaluation of a hypothesis given evidence is simple:
  - If a hypothesis predicts something not otherwise expected, we tend to think it is true
  - If a hypothesis makes a false prediction, that counts against its truth
- But most interesting hypotheses in science both make new, unexpected predictions that turn out to be true and make predictions that turn out to be false
  - There is no simple recipe for deciding whether to reject a hypothesis once it has made a false prediction or to hold onto it because of its record of true predictions

## Review: Fallibility

- The basic procedures for confirmation and falsification leave open additional possibilities
  - That additional predictions will be tested
  - That an alternative hypothesis which explains the same prediction is true
  - That an auxiliary hypothesis is false or that the experimental/ observational procedure was inadequate which explains a false prediction
- As a result, neither confirmation or falsification give absolutely definitive results
  - The conclusion about a given hypothesis must be regarded as fallible
- Although at a given time we might have high confidence in the results of science
  - Even the best established claims might later be rejected
  - What are initially thought to be highly implausible hypotheses might come to be accepted.

## Clicker Question

The primary reason hypotheses and theories are fallible is that:

A. It is always possible that additional evidence will require scientists to revise their conclusions

B. Scientists don't insist on sufficient evidence before deciding on the truth of their hypotheses

C. Hypotheses and theories are only guesses, and should be rejected in favor of facts

D. Scientists make logical mistakes and need to correct themselves

## Preview: Observation

- At the foundations of science are procedures for gaining evidence about the world
  - We learn about the world through our five senses and are reliant on them for our evidence
- Tests of predictions ultimately rely on observation
  - Observations with the unaided senses
  - Observations made with the use of instruments
- Before observations can be used for testing predictions, they must be brought under categories
- Two fundamental questions about observation
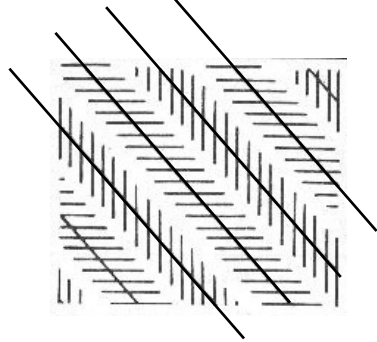  - How reliable are observations?
  - What does categorization involve?
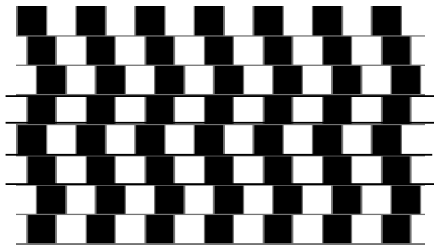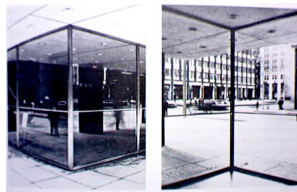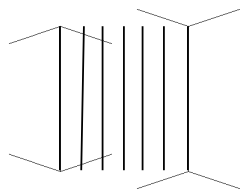
## Clicker Question

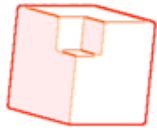Is this line straight?
A. Yes
B. No
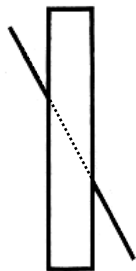
# Can these lines possibly be parallel?
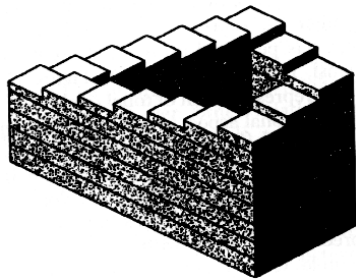


# How about these?



# Müller Lyer Illusion

## Seeing More than One Thing

## Seeing what isn't possible

## Clicker Question

Why is it that we sometimes see what isn't there, misperceive what is there, etc.?

A. We tend to be very careless when we see—if we were only more careful, we would not make mistakes

B. I never make mistakes in seeing—the world is wrong

C. Our visual system performs operations on sensory input, and these operations are fallible

D. We have learned that vision is unreliable and we need to find other sources of information

## What Changes?

## What Changes?

## Watch Carefully

* Count the times the players in white pass the ball

# Perception seems transparent

- But it relies on
  - The way in which the visual system is constructed
  - The effects of attention
  - What we have previously learned
  - What we expect to see
- It does not provide unmediated access to the world
- How can we determine what is really out there?

# Beyond mere registration-- identification

- Vision (hearing, smelling, etc.) requires more than mere registration of stimuli on our senses
  - It requires that we identify what we see—recognize an object as a tree, a street, or a car
- We typically only recognize those things with which we are already familiar
  - How, then, do we discover new things?
- We typically only recognize things in contexts where they are expected

# Recognizing

Familiar objects are often when seen from an unusual perspective

## The importance of context

C /-\ T
   A
   T

## Word Superiority Effect

READ

## Why proof reading is hard

We see what we espect to see and so mis errors

This is exspecially truu when we have writen the text and now what is suposed to be their.

To xllxstxatx, I cxn rxplxce xvexy txirx lextex of x sextexce xitx an x, anx yox stxll xan xanxge xo rxad xt wixh sxme xifxicxltx.

## Clicker Question

How many f's are there in the following sentence:

Federal fuses are the result of years of scientific study combined with the first-hand experience of fifty years.

A. 6

B. 7

C. 8

D. 9

## Count the f's

Federal fuses are the result of years of scientific study combined with the first-hand experience of fifty years.

## A problem not just for science

- ❖ What professions rely heavily on people's reports of what they have seen?
- ❖ In law, eyewitness testimony is often the most compelling with juries
  - ❖ And yet it is increasingly recognized as extremely problematic
  - ❖ After witnessing an event, one's memory of the event may be affected by what else one learns
    - ❖ Even by what questions one is asked

## Loftus on Eye-Witness Testimony

Showed subjects a video in which there was a car accident at a stop sign

Half the subjects later asked a question about a yield sign ("how fast was the blue car going when it went past the yield sign?")

Those who heard the misleading question were more likely to later remember the video as having a yield sign.

In other studies, people "recalled" a conspicuous barn in a bucolic scene that contained no buildings at all, broken glass and tape recorders that were not in the scenes they viewed, a white instead of a blue vehicle in a crime scene, and Minnie Mouse when they actually saw Mickey Mouse.

## I was certain, but I was wrong

By Jennifer Thompson

In 1984 I was a 22-year-old college student with a grade point average of 4.0, and I really wanted to do something with my life. One night someone broke into my apartment, put a knife to my throat and raped me.

During my ordeal, some of my determination took an urgent new direction. I studied every single detail on the rapist's face. I looked at his hairline; I looked for scars, for tattoos, for anything that would help me identify him. When and if I survived the attack, I was going to make sure that he was put in prison and he was going to rot.

When I went to the police department later that day, I worked on a composite sketch to the very best of my ability. I looked through hundreds of noses and eyes and eyebrows and hairlines and nostrils and lips. Several days later, looking at a series of police photos, I identified my attacker. I knew this was the man. I was completely confident. I was sure.

## I was certain, but I was wrong

I picked the same man in a lineup. Again, I was sure. I knew it. I had picked the right guy, and he was going to go to jail. If there was the possibility of a death sentence, I wanted him to die. I wanted to flip the switch.

When the case went to trial in 1986, I stood up on the stand, put my hand on the Bible and swore to tell the truth. Based on my testimony, Ronald Junior Cotton was sentenced to prison for life. It was the happiest day of my life because I could begin to put it all behind me.

In 1987, the case was retried because an appellate court had overturned Ronald Cotton's conviction. During a pretrial hearing, I learned that another man had supposedly claimed to be my attacker and was bragging about it in the same prison wing where Ronald Cotton was being held. This man, Bobby Poole, was brought into court, and I was asked, "Ms. Thompson, have you ever seen this man?"

# I was certain, but I was wrong

I answered: "I have never seen him in my life. I have no idea who he is."

Ronald Cotton was sentenced again to two life sentences. Ronald Cotton was never going to see light; he was never going to get out; he was never going to hurt another woman; he was never going to rape another woman.

In 1995, 11 years after I had first identified Ronald Cotton, I was asked to provide a blood sample so that DNA tests could be run on evidence from the rape. I agreed because I knew that Ronald Cotton had raped me and DNA was only going to confirm that. The test would allow me to move on once and for all.

I will never forget the day I learned about the DNA results. I was standing in my kitchen when the detective and the district attorney visited. They were good and decent people who were trying to do their jobs -- as I had done mine, as anyone would try to do the right thing. They told me: "Ronald Cotton didn't rape you. It was Bobby Poole."

# I was certain, but I was wrong

The man I was so sure I had never seen in my life was the man who was inches from my throat, who raped me, who hurt me, who took my spirit away, who robbed me of my soul. And the man I had identified so emphatically on so many occasions was absolutely innocent.

Ronald Cotton was released from prison after serving 11 years. Bobby Poole pleaded guilty to raping me.

Ronald Cotton and I are the same age, so I knew what he had missed during those 11 years. My life had gone on. I had gotten married. I had graduated from college. I worked. I was a parent. Ronald Cotton hadn't gotten to do any of that.

Mr. Cotton and I have now crossed the boundaries of both the terrible way we came together and our racial difference (he is black and I am white) and have become friends. Although he is now moving on with his own life, I live with constant anguish that my profound mistake cost him so dearly. I cannot begin to imagine what would have happened had my mistaken identification occurred in a capital case. . . .

# Jennifer Thompson and Ron Cotton



The man on the left, **Ron Cotton**, who spent 11 years in prison for the rape of Jennifer Thompson. The man on the right is the rapist Bobby Poole